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EDITED BY

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THE TECHNOLOGIST.

VEGETABLE OILS AND FATS OF INDIA.

BY M. C. COOKE, F.S.S.

There is no country which supplies us with a greater variety of vegetable oils than India, and her resources are still unexhausted; for we could as readily be supplied with as many more, and those of an equal value to the varieties already established as articles of commerce. To Indian fibres and Indian oils there seems scarcely to be any limit; but the draw-back of careless preparation, so injurious in the former instance to the value of the commodity, can scarcely be pleaded in the latter. Had as much care been taken to make the commercial world acquainted with the oils and fats as with the fibres of India, there is little doubt that many of the kinds now unknown would ere this have become staples of commerce.

ADUL; ODUL; POOVENGAH; POOVANA OIL (*Sarcostigma Kleinii*).—This is a medicinal oil, said to be useful in the treatment of rheumatism. It was shown by the Tinnevelly and Travancore Committees at the Madras Exhibition of 1855, but does not appear to have excited much interest, or to be of any great importance. It has long been known and held in repute amongst the native medical practitioners of India, and it is largely used on the western coast.

BADAMIE; ALMOND (*Amygdalus communis*).—The almond is a native of the Himalayas, and is abundant in Cashmere. The oil is colourless or very slightly yellow, and is congealed with difficulty. It has a sweet taste, a light agreeable smell, and in all its properties and uses resembles olive oil. It is obtained for native use in India, but does not form an article of export. Both varieties of almond, bitter and sweet, are imported into the northern parts of India from Ghoorbund, and into the southern parts from the Persian Gulf.

BASSIA BUTTER, or PHOOLWA.—This is a beautiful, white, solid fat, the produce of the fruit of *Bassia butyracea*, and melts only at a temperature above 120° Fahr., in which it is superior to all other vegetable fats produced in India. The tree is a native of the Almora hills, where it is highly esteemed as a liniment in rheumatism, contraction of the limbs, &c., and when used by the natives of rank is frequently impregnated with some fragrant attar. The kernels are bruised and rubbed up to the consistency of cream, and subjected to moderate pressure in a cloth bag. The oil concretes immediately it is expressed. An important article on Bassia fats, by P. L. Simmonds, Esq., appeared in the TECHNOLOGIST, vol. i., p. 217, which will render unnecessary any very detailed account of them here.

MAHOWA, or EPIE (*Bassia latifolia*).—This fatty substance, obtained also from the kernels of the fruit, is an article of common consumption in India, and may often be met with under the names of Mowha or Yallah oil in the London market. It melts at about the same temperature as Eloopie oil, and would be equally valuable for candle-making. The tree is common in the Bengal Presidency, extending also all across Central India, even to the western coast.

ELOOPIE; ILPA; ILLEPIE YENNAI, Tam.; MOHAY-KA-TAEL, Hind. (*Bassia longifolia*).—This solid fat is obtained from the kernels of the fruit, and is generally of a dirty white colour, and not so firm as the Bassia butter of *B. butyracea*. It melts at a temperature above 70°. The tree is common everywhere in Southern India, and the fat or oil is employed largely by the natives. A competent authority (Mr G. F. Wilson) has pronounced it extremely valuable for the manufacture of candles. Though much used by the natives, who extract 30 per cent. of oil from the seeds, it is seldom sold. Candles and soap are made from it; but it is chiefly used as a substitute for butter in the native cookery, and for burning in their lamps.

The very great difference in colour, consistence, and flavour observable in different samples of this oil is entirely attributable to the mode of preparation, and to the pressure in some cases of a large quantity of mucilage and extraneous matter. In Tanjore it is obtainable at the rate of 2 rs. 8 as. per maund.

BELGAUM WALNUT; DESSEE AKROOT; HIDGELEE BADAM (*Aleurites triloba*).—Under the name of *Kukui* or *Kekui* oil, I recently drew attention to the medicinal properties of this oil in the 'London Medical Review.' It is also called *Lumbang* oil. The fruit from whence it is procured is very abundantly produced, not only in India, but in the islands of the Pacific and elsewhere; and the facility with which the oil is separable from the nut is also not an unimportant recommendation. It is, moreover, useful as a lamp oil.

Dr Riddell wrote in 1853 of this oil—"The nut in taste resembles the common walnut; but as they are considered unwholesome until kept a year, few like to eat them, even then. A friend gave me, some time ago, a small bottle of walnut oil he brought with him from the Upper Provinces: it has a fine scent like the fresh walnut, and I believe it to have been made from the nut generally eaten, as I remember often hearing, when up in Hindoostan, that the natives made oil from the nuts common in the Himalayas; and I attribute the oil retaining its peculiar odour to its being, in all probability, pressed, and not extracted by boiling.

The oil has been tried at Madras, and is considered to be of a superior quality to linseed. The nut when fresh is said to be of a purgative nature, but if kept for a year it loses that quality."

Dr Hunter, of Madras, states, "It will not do as a substitute for olive or almond oil except for a few purposes, as it is a drying oil, though it does not dry so quickly as linseed. We may perhaps require it in our School of Arts as a painting oil, for which it seems well suited, as it does not get stiff and cloggy like the linseed oil, nor does it turn brown, I believe, in drying."

Roxburgh says, in his 'Flora Indica,' that "the kernels taste very much like fresh walnut, and are reckoned wholesome: they yield by expression a large portion of very pure, palatable oil."

This oil has been experimented upon successfully in the West Indies as a drying oil, and appears to have answered every expectation.

BEN; SOHUNJUNA; MORUNGHY YENNAI, Tam.; MORUNGA NOONA, Tel.; SAHUJNA, Hind. (*Moringa pterygosperma*).—This oil is valuable, because it does not soon turn rancid; and it might be extensively procured, as the tree is common throughout India. But though the flowers, foliage, and fruit are eaten by the natives, and the rasped root employed as a substitute for horse-radish, the oil is seldom extracted, and does not form an article of export, except in very small quantities. It is occasionally employed by the natives as an unguent in gout and rheumatism.

BONDUC NUT; KUTKULEGA; KUTKARANGA CALICHIKAI (*Guilandina Bonduc*).—This oil is medicinal only; it is considered useful in palsy and other diseases.

BRYONY OIL; TOOMUTTIKAI YENNAI, Tam.; BODDAMA KAIA, Tel. (*Bryonia callosa*).—Bryony oil is burnt in lamps in India in parts where the plant abounds, but it is not extensively procurable. The bitter seeds are employed medicinally. The oil is only locally known, and is obtained by boiling the seeds in water.

CABBAGE-SEED OIL; GOOSIKEERAY YENNAY (*Brassica sp.*)—In the Madras Exhibition a sample of this oil was shown in the Madras Tariff Collection, but it received no notice in the Jury Reports.

CAPALA-SEED (*Rottlera tinctoria*).—The oil which is obtained plentifully from the kernels of this fruit after the removal of the celebrated *Kupli* or *Kamala* powder, promises to be of some importance medicinally as a cathartic oil, and deserves a more complete investigation. Hitherto the oil has only been employed in India for lamps, but we do not doubt its suitability for a higher office.

CARDAMOM-SEED OIL (*Elettaria cardamomum*).—A fixed oil obtained from cardamom seeds, insoluble in alcohol, æther, and the oils both fixed and volatile. It has some analogy to castor oil. This oil has only a medicinal application.

CASHEW NUT; MOONDREE COTTAY, Tam.; KAJEO, Hind. (*Anacardium occidentale*).—This light-yellow and sweet-tasted oil is affirmed to be equal, if not superior, as an edible oil to that of the olive or almond. The kernels have lately been met with in English commerce under the name of *Cassia* seeds; an evident corruption of *Cashew.* The tree is common in the East and West Indies. In Bengal it is found chiefly near the sea. The nuts are largely employed as a table-fruit.

CASHEW-APPLE OIL.—Is a powerful vesicatory, extracted from the pericarp of the same fruit. It very much resembles the oil obtained from the marking-nut (*Semecarpus anacardium*).

CASSIA SEED (*Cinnamomum Cassia*).—Under this name a sample of oil was shown at one of the Madras Exhibitions, but it appears to be unknown to the natives of India.

CASTOR OIL (*Ricinus communis*).—Two varieties of the castor-oil plant are produced all over India. One variety has small, and the other large seeds: the former yields the most valuable or medicinal oil; the latter, a dark oil, commonly burnt in lamps.

ARENDI-KA-TEL, Hind.; SITT-AMUNAKEI-YENNAI, Tamil.; CHITT AMINDIALOO-NOONA, Tel.; AMSINACOO of Travancore.—The mode of preparation of this medicinal oil in India is thus described:—The fresh seeds, after having been sifted and cleaned from dust, stones, and all extraneous matters, are slightly crushed between two rollers, freed by hand from husks and coloured grains, and enclosed in clean gunny. They then receive a slight pressure in an oblong mould, which gives a uniform shape and density to the packets of seed. The "bricks," as they are technically called, are then placed alternately with plates of sheet-iron in the ordinary screw or hydraulic press. The oil thus procured is received in clean tin pans, and water in the proportion of a pint to the gallon of oil being added, the whole is boiled until the water has evaporated; the mucilage will be found to have subsided and encrusted the bottom of the pan, whilst the albumen solidified by heat forms a white layer between the oil and the water. Great care must be taken in removing the pan from the fire the instant the whole of the water is evaporated, which may be known by the bubbles having ceased; for, if allowed to remain longer, the oil, which has hitherto been of the temperature of boiling water, or 212°, *suddenly* rises to that of oil, or nearly 600°, thereby heightening the colour, and communicating an empyreumatic taste and odour. The oil is then filtered through blanket, flannel, or American drill, and put into cases for exportation. It is usually of a light straw colour, sometimes with a greenish tinge. The cleaned seeds yield from 47 to 50 per cent. of oil, worth in England from 4d. to 6d. per lb. The result of experiment on the oil-producing properties of seed, sorted into three qualities, shows that 980 lb. of kernels and 488 lb. of raw oil were obtained from 1,400 lb. of seed.

1st sort,	632 lb. kernels.	324 lb. oil.
2nd „	184 „	87½ „
3rd „	164 „	76½ „
	980	488

The average cost of the oil in the Madras Presidency is nearly 4d.

per lb. It is chiefly employed as a mild purgative. Soap may be made of it, but the odour is disagreeable.

About 12,000 gallons of castor oil for medicinal purposes are exported annually from Madras alone. The whole imports into Great Britain from British India were, in

1854	8,672 cwt.	1857	39,296 cwt.
1855	11,910 „	1858	20,592 „
1856	29,411 „	1859	20,702 „

Castor oil extracted *hot* differs from the preceding only in the method of preparation. The seeds are boiled for two hours in water, dried for three days in the sun, freed from the shells, pounded, and then boiled in fresh water until the whole of the oil has risen to the surface: $3\frac{1}{8}$ lb. of seed should by this process yield 1 quart of oil. This is the kind generally employed in medicine by the native practitioners; it is straw-coloured, and free from unpleasant taste or smell.

JUNGLE LAMP OIL; VULLAK ENNAI, Tamil.; PED-AMIDUM, Tel.; CHIRAGH-KA-TEL, Hind.—This is the oil pressed from the larger variety of castor-oil seed, and is sometimes drawn cold, when a pale straw-coloured oil is obtained, resembling that from the small-seeded kind. It is generally extracted by heat, and forms the common "lamp oil" of the bazaars.

The seeds having been partially roasted over a charcoal fire, both to coagulate the albumen and to liquefy the oil, are then pounded, and boiled in water until the oil rises to the surface. The roasting process gives a deeper red colour, and an empyreumatic odour. The average export of the six years ending 1855 was about 28,000 gallons annually from the Madras Presidency; the average price, two rupees and six annas per maund.

CHEERONJEE, or TUMBI PULLUM (*Buchanania latifolia*, *Chirongia sapida*).—This oil is rarely extracted from the abundantly oleaginous seeds, which are eaten by the natives to make them fat. The oil is clear, sweet, and straw-coloured. The trees grow plentifully in Mysore and Cuddapah.

CHEMMARUM; KHANA, Hind.; TIKHTA-RAJ, Beng. (*Amoora rohituka*).—From the seeds, where the trees are plentiful, the natives extract an oil which is useful for many economic purposes. It is found in Travancore and Bengal.

CINNAMON SUET (*Cinnamomum zeylanicum*).—This fat is procured in Ceylon by boiling the fruit. An oily fluid floats on the surface, which, on cooling, subsides to the bottom of the vessel, and hardens into a substance like suet. The Cinghalese make it into candles, and also employ it for culinary purposes. It contains about 8 per cent. of a fluid resembling olive oil, the residue being of the nature of wax.

CIRCASSIAN BEAN (*Adenanthera pavonina*).—These hard red seeds are best known here by their employment for ornamental purposes; but, from the Madras Jury Report, it would appear that an oil has been obtained from them. We do not anticipate that it will be viewed in any other light than as a curiosity.

Cleome; Hoorhoorya (*Cleome viscosa*, Linn.; *Polanisia icosandra*, W. & A.)—The seeds of this plant, which are employed medicinally in India, and sold in the bazaars under the name of *chorie-ajooain*, yield an oil, when subjected to very powerful pressure, which is of a light olive-green colour, and very limpid. It might prove of service in cases where a very limpid oil would be an acquisition.

Cocoa-nut Oil; Taynga vennai, Tamul.; Tencaya noona, Tel.; Nariel-ka-tael, Hind.; Valeecha of Travancore (*Cocos nucifera*).—This oil is too well known to need any description. It is obtained in Continental India; and an equally extensive trade is carried on in this valuable fat with the Island of Ceylon, where it is known under the names of *Navasy* and *Tembely*. The enormous quantity of 900,000 gallons is annually exported from Madras. The largest proportion goes to Great Britain and France; the rest to Arabia, Mauritius, &c. The prices vary from 40*l.* to 50*l.* per ton, that called Cochin oil fetching the highest price. In Europe, candles, soap, &c.; in India, cookery, lamps, medicine, and anointing the person, are all uses for which this fat is available. At the commencement of 1861, Cochin oil was worth 55*l.* 10s., and Ceylon about 53*l.* per ton, in the home market. In 1860, the relative prices were 41*l.* and 42*l.* 10s.; and in 1859, 37*l.* 10s. and 40*l.* During the years annexed, the following were the total imports into Great Britain:—

1855	12,300 tons.	1858	9,889 tons.
1856	6,000 ,,	1859	9,237 ,,
1857	9,500 ,,	1860	9,715 ,,

Cocum or Kokum Butter (*Garcinia purpurea*).—This solid vegetable oil is of a whitish colour, and melts at a temperature of 95°, being very little below that of piney tallow. It now forms an article of export to Great Britain.

The oil is extracted from the seeds by boiling. They are first dried in the sun, and then pounded and boiled in water; the oil collects on the surface, and on cooling concretes into a solid cake. When purified from extraneous matter, the product is of a rather brittle quality, of a pale yellowish hue, inclining to greenish, and mild to the taste. The seeds yield about one-tenth of their weight of oil. The tree is found abundantly on the slopes of the mountains on the western side of India, from within 100 miles of Bombay to Cape Comorin.

Colocynth-seed Oil (*Cucumis colocynthis*).—The seeds of the officinal colocynth contain rather more than 4 per cent. of a bitter fixed oil, which has been extracted in India for medicinal purposes.

Coorookoopillay (*Inga dulcis*).—The seeds of this common hedge-plant of India yield, by expression, a light-coloured oil about the consistence of castor oil. Of its qualities and uses I am at present ignorant.

Cotton-seed Oil (*Gossypium herbaceum*).—This oil is well known, and consequently requires no description. It is manufactured rather extensively in India; and the samples we have seen were pale, limpid, and well refined. Cotton-seed oil is increasing in repute in this country, and seems to have established itself amongst trade imports.

Country Cress (*Arabis chinensis*).—From the seeds of this plant an oil has been extracted in India, as evidenced by the fact of its being shown at the Madras Exhibition of 1855.

Croton; Jamalghota; Jayapala; Neervalum, Tam.; Naypalum, Tel. (*Croton tiglium*).—The seeds yield a powerfully cathartic oil. It is prepared by grinding the seeds, placing the powder in bags, and pressing them between plates of iron. The oil is then allowed to stand fifteen days, and afterwards filtered. The residue of the expression is saturated with twice its weight of alcohol, heated on the sand-bath from 120° to 140° Fahr., and the mixture pressed again. The alcohol is distilled off, the oil allowed to settle, and filtered after a fortnight. One seer (2 lb.) of seed furnishes 11 fluid ounces of oil,—6 by the first process, 5 by the second. The oil is well known in this country for its medicinal properties.

Water-melon; Turbooz; Turmuz (*Cucurbita citrullus*).—The seeds of this cucurbitaceous plant are used as the source of a mild culinary oil in some parts of India.

Sasa; Cucumber-seed (*Cucumis sativus*).—The oil of cucumber-seed is a mild edible oil, which is obtained by expression for native use only.

Kheera Khira' (*Cucumis sp.*)—The fruit contains sugar, and the seeds yield a mild oil. It is cultivated in Bengal.

Pumpkin; Meetha Kuddoo; Kumara; Valerikoi yennai; Thosa noona (*Cucurbita pepo*).—Several edible oils are obtained in India from seeds of cucurbitaceous plants. This is a very clear, bland oil, suitable for culinary purposes.

Melon; Kurbooza; Pitcha pusjhum; Dharbooza (*Cucumis melo*).—The seeds of this species are employed for the expression of a mild oil, which, however, readily becomes rancid.

Ka'nkur (*Cucumis utilissimus*).—The fruit is yellow, the size of an ostrich's egg. The seeds are ground into meal; oil is expressed from them, which is very nourishing. It is much cultivated in the Guntoor Circars.

Squash; Saphari Kumra' (*Cucurbita maxima*).—The seeds yield an oil which is both suitable for oil and burning. It is cultivated in Bengal.

Bottle Gourd; Kadu (*Lagenaria vulgaris*).—The fruit is employed for bottles. The seeds yield a bland oil. The plant is common in the East and West Indies.

Luffa Oil; Torooi, Beng.; Jhingo, Beng.; Beer-kai, Tel. (*Luffa acutangula*, Roxb.)—This cucurbitaceous plant is much cultivated in India, where the natives employ it in their curries. A medicinal oil is obtained from the seeds, which has a reputation among the native practitioners.

Custard Apple (*Anona reticulata*).—These seeds yield a mild oil, which has been expressed experimentally, but there is little ground for imagining that it will ever become an article of commerce.

EETTIE OIL; SHWET-SAL, Beng.; VIROOGOODU-CHAWA (*Dalbergia latifolia*, Roxb.)—The oil obtained from the seeds of this tree is procured in but small quantities, and hence is only medicinally employed. It is used principally in cutaneous diseases.

Dalbergia arborea, Heyn.; *D. frondosa*, Roxb.—This valuable timber tree, which is found in most parts of India, but especially in Travancore, yields seeds from which an oil is procured, and used by the native practitioners in rheumatic affections.

EXILE OIL (*Thevetia neriifolia*).—The kernels of the seed of this shrub, which is very common in India, yield by expression a large percentage of a clear, bright yellow-coloured oil.

FENNEL FLOWER-SEED; KALA-JIRA; MUGRELA, Bengal.; SIAH DANEH, Pers.; NULLA GILLIKARRA, Tel.; KULONJEE, Hind. (*Nigella sativa*).—A dark and fragrant oil is extracted from the black aromatic seeds of this plant. The oil obtained in Egypt under the name of *mildew* oil from the same source is limpid and colourless, and with but little odour. A specimen from the latter locality was shown, with the seeds, at the Exhibition of 1851. The oil appears to be employed in India principally as a medicine. It is called *Jungle geerah oil* in Mysore.

FŒTID STERCULIA; COODIRI PUSJUN; JUNGLEE BADAM (*Sterculia fœtida*).—This semi-solid oil contains a great quantity of stearine. At present it does not appear to be obtainable in sufficient quantities to render it of commercial importance or interest. The trees from which the seeds are obtained are fully 30 feet high, and grow very straight. The seeds are produced in large pods, three, four, or five joined together, with a rough velvet coat outside, red on the side exposed to the sun. They are in shape and appearance very much like green peaches; and within these pods are found the seeds, about six in each. There is a little more labour required in extracting the kernel from the seed than in castor-oil making; in other respects the process is just the same.

The results of an experimental manufacture of oil from these seeds is stated as follows:

	Maund.	Seers.	Chs.
Original quantity of seed - -	1	2	0
Clean kernel - - - -	0	22	0
Husk and sweepings - - -	0	20	0
Produce of unboiled or raw oil - -	0	6	5
Produce of cake - - -	0	15	4
Loss in weight - - - -	0	0	7

Four seers of the above oil were boiled to extract the water, as in the manufacture of castor oil, and produced 3·2 seers of oil fit for the market.

GAMBOGE BUTTER; MUKKI-TIJLUM (*Garcinia pictoria*).—This solid fat is obtained from the fruit of the gamboge tree of India. It is known by the somewhat barbarous name of *Arasemiagoorghy.* It is obtainable in moderate quantities by pounding the seeds in a stone mortar, and boiling the mass until the butter or oil rises to the surface. Two and a half measures of seed should yield one seer and a half of butter. In the Nuggur division of Mysore, it is sold at the rate of 1 r. 4 as. per seer, and is chiefly used as a lamp oil by the better class of natives, and as a substitute for ghee by the poor. It does not possess the drastic qualities of the gamboge resin, but is considered an antiscorbutic ingredient in food. The tree grows abundantly in certain parts of the Mysore and Western Coast jungles.

Madool.—The Madool oil of Ceylon, obtained from the fruit of *Garcinia echinocarpa*, is probably of a similar character.

Garlic Oil; Poondoo vennai (*Allium sativum*).—This is only a medicinal oil. It is clear, colourless, limpid, and contains the full odour of the plant. It might be available in cookery for those who admire the flavour of garlic in their dishes, but this will evidently be the fullest extent of its application; hence it can scarce be considered of any importance commercially.

Gingelly, or Sesame; Nool ennai, Tam.; Mundie noonay, Tel.; Meetha Till-ka-teel, Hind.; Nulla Oil of Travancore (*Sesamum indicum*).—This oil is employed by the natives of India even more than cocoa-nut oil, and it is second to none other in commercial value. The seed, as well as the oil, is exported. In 1848, 250,000 cwt. of seed and 72,000 gallons of oil were shipped from Madras. It is chiefly used in India for cooking and anointing the person. In England it is made into soap, and consumed in table-lamps. Its value in 1855 in this country was 47*l.* 10s. per ton; and at the commencement of 1861, 41*l.* per ton.

The black-seeded variety (*Tillee*) affords a larger percentage of oil than the red-seeded kind. Sesamum seed has of late been exported largely to France, where it is said to be employed for mixing with olive oil.

Three varieties of sesame seed are cultivated in India,—the white-seeded (*Suffed-til*), the red or parti-coloured (*Kala-til*), and the black variety (*Tillee*): it is the latter which affords the greater proportion of the gingelly oil of commerce. At the commencement of 1861, white seed was worth, in the London market, 65s.; black and brown, 58s. and 60s. per quarter.

Great difference of colour is observable in Indian samples of sesame oil, which is due entirely to modes of preparation. The method sometimes adopted is that of throwing the fresh seeds, without any cleansing process, into the common mill, and expressing in the usual way. The oil thus becomes mixed with a large portion of the colouring matter of the epidermis of the seed, and is neither so pleasant to the eye nor so agreeable to the taste as that obtained by first repeatedly washing the seeds in cold water, or by boiling them for a short time, until the whole of the reddish-brown colouring matter is removed and the seeds have become perfectly white; they are then dried in the sun, and the oil expressed as usual. This process yields 40 to 44 per cent. of a very pale, straw-coloured, sweet-smelling oil, which is an excellent substitute for olive oil.

Kharasanee yelloo is a second sort of sesame oil, sometimes called "Rape," which is obtained from the red-seeded variety.

Black sesame is sown in March, and ripens in May. *Red* sesame is not sown till June.

GRAM; MOONEELA (*Dolichos biflorus*).—A pale yellow or almost colourless, viscid, clear oil, in Tanjore is stated to be obtained from this source. It is generally known as *Gram* or *Moneela gram oil.*

GROUND NUT; BHOE-MOONG; VAYRCUDDALA-YENNAI, Tam.; MANILLA NOONA, Tel.; KATJANG OIL (*Arachis hypogæa*).—This plant is extensively cultivated in various parts of India. The kernels yield about 44 per cent. of a clear pale yellow oil, which is largely used as food and for lamps. Two varieties of the ground nut, or *Katjang tanah*, are produced in Malacca,—the white and the brown. The plant is also much cultivated in Java, in the vicinity of the sugar plantations, and the oil-cake is used as a manure. The value of ground-nut kernels in London is about 16*l.* 10s. per ton, and of the oil 42*l.* to 43*l.* per ton. This oil is believed by the natives of Bengal to be aperient, but it appears really to produce only the same effects as olive oil. It burns with little smoke, a clear flame, and affords a very full bright light.

It is said to be employed for adulterating gingelly oil in North Arcot, where it costs from 1 r. 8 as. to 2 rs. 12 as. per maund. In 1848-49, 37,000 gallons of this oil were exported; and in the two following years, upwards of 1,000,000 gallons.

GUTTA-PERCHA SEED (*Isonandra gutta*).—I should presume it to be only an experimental sample of this oil which was exhibited at the Madras Exhibition of 1855, as I find no mention of it elsewhere; neither does it seem to be known at all to residents in India. It appears to present no feature of importance.

HEMP-SEED OIL; GANJA YENNAI, Tam. (*Cannabis sativa*).—The plant is largely cultivated in India, but the oil is not of general use. It is obtained by expression; although so generally burnt in lamps in Russia, it is almost universally unknown to the natives of Hindoostan.

HINGUN, or HINGOOTA (*Balanites ægyptiaca*).—This plant is very common about Delhi, and in the Doab as far as Allahabad, and especially on the banks of the Jumna. Roxburgh describes the pulp as exceedingly bitter, and having an offensive greasy smell. An oil has been obtained from it experimentally, and shown at the Madras Exhibitions.

IRIPA (*Ajnometra ramiflora*, Linn.)—This tree is found on the Malabar coast. Rheede states that the natives prepare an oil from the seeds which is used in scabies, leprosy, and other cutaneous diseases.

KARINGHOTA (*Samadera indica*, Gærtn.)—This tree grows abundantly in Travancore and Cochin, and is propagated easily from seeds. An oil is extracted from the kernels, which is extensively used in rheumatism on the western coast, and is obtainable in the bazaars.

KHALI-ZIRI, or KHATZUM; CAAT SERAGUM; BUKCHIE; WILD CUMIN (*Vernonia anthelmintica*).—This is a semi-fluid oil, obtained by expression from the seeds of a composite plant which is common in India.

PILOO-KURJAL; KIKUEL (*Salvadora persica*).—This oil has a somewhat aromatic odour, is of a bright green colour, and is solid at a temperature below 95°. A specimen of a solid fat of this character is exhibited in the East India Museum, under the name of *Kheknell* or *Kiknel*. This is doubtless the same product. It most resembles in appearance the vegetable tallow of Borneo, and if procurable in sufficient quantities, would meet with as ready a sale for the manufacture of candles.

LIMBOLEE; BURSUNGA, Bengal.; KARIVEPA, Telingee (*Bergera Kœnigii*).—An oil of a rich yellow colour is obtained at Bombay from the seeds of this plant. It is perfectly clear and transparent.

LINSEED; TISSEE TIL; MUSHINA, or AVEESEE NOONA, Tel.; ULSEE KA TAEL, Hind. (*Linum usitatissimum*).—Great quantities of this oil-seed are imported into Britain from India. During 1860 the imports from thence reached 565,700 quarters. The prices realised were very fluctuating, being at one time 51s., and at another 65s. per quarter.

The following quantities of linseed were exported from India to all parts in the years named:—

1850—1	30,665 tons.	Value £170,373
1851—2	57,258 „	317,964
1852—3	53,525 „	277,958
1853—4	40,779 „	277,853
1854—5	61,093 „	389,796
1855—6	99,458 „	644,704
1856—7	79,326 „	561,651
1857—8	79,712 „	636,709

MALKUNGEE; VALULVY, Tam.; BAVUNGIE, Tel.; MALKUNGUNEE, Hind. (*Celastrus paniculata*).—The oil yielded by the seeds of this species of *Celastrus* by expression is of a deep scarlet colour; it is only employed medicinally. A black empyreumatic oil is also obtained by the destructive distillation of the seeds. The tree is a native of the Circar mountains and Mysore. The seeds were sent here under the name of *Meilek* two or three years since, but, being unknown, were probably unsold.

An oil is exhibited in the collection of the East India House, of a pale yellow colour, said to be obtained by expression from the seeds of *Celastrus nutans;* but the *C. nutans* of Roxburgh is stated to be a synonym of *C. paniculatus*. The oils, however, are very dissimilar in appearance: this may result from difference in the mode of manufacture, such as decortication or heat.

MARGOSA; NEEM; VAYPUM UNNAY, Tam.; VAPA NOONA, Tel. (*Melia Azadirachta*).—This is a pale yellow semi-solid oil, obtained from the fruits of a common tree in India. It is known under the name of *Kohombe* in Ceylon. It is much employed by native practitioners, administered both internally and externally, and is sold in the bazaars, for burning, under the name of *bitter oil*. This is the *Taipoo* of Travancore.

In 1847-8, about 1,587 gallons were exported; in 1851-2, 1,917; and in 1852-53, 3,111 gallons. The chief market is Ceylon.

MARKING-NUT OIL; BHILLAHWAN; BHELA BHALATAKA; NELLA-JIEDE; ARUSHKARA (*Semecarpus anacardium*).—The acrid and vesicating oil which is contained between the laminæ of the pericarp is employed as a preventive against the attack of the white ant, and also by native practitioners as a remedy in rheumatic and leprous affections. The oil which is obtained from the kernel of the nut is of a different character, but it has only been obtained experimentally, and it would seem to resemble the mild oil of *Cashew-nut* kernels. The vesicating oil is produced chiefly in the South.

MAROTTY; MARAVUTTIE; NEERADIMOOTOO (*Hydnocarpus inebrians*, Vahl).—From the seeds of this tree, which is common in Travancore, an oil is obtained which is used as a sedative, and as a remedy in scabies and ulcers of the feet.

A semi-solid oil was shown at the Madras Exhibition of 1855 under both the above names, which was then supposed to be identical with the *Sooratee* and *Neeradimootoo* oils also exhibited, and doubtless derived from this source. The *Sooratee* oil has been referred to a species of *Jatropha;* but the peculiar odour is so identical with that of *Neeradimootoo*, notwithstanding the difference in colour and consistence, which may result from the preparation, that we do not hesitate in referring it also to this tree. Dr Hooker states, that the seeds of a species of *Hydnocarpus* called "Took" are pressed for oil at the base of the Himalayas, the fruits being employed for intoxicating fish.

MOORGANA TALLOW.—At present we are only acquainted with this vegetable tallow by name, but without any clue to its source, and that it was shown at the Madras Exhibitions, where it became an object of interest. It is perhaps the most solid oil with which we have yet become acquainted. The samples were received from Canara, a district to which we may look for some important additions to our imports from India.

BAKUL; MIMUSOPS (*Mimusops elengi*).—Although this oil is obtainable in considerable quantities, it is not much used in India, where it has some medicinal reputation. A sample was shown at the Madras Exhibition of 1855, and the Jury Report states that it is known in England. This is evidently a mistake, as we would venture to state that there is not an ounce in the country, even in a public or private collection, unless there should be a small specimen somewhere in the Kew Museum which has escaped our notice. There is no specimen in the East India Museum, and it has never been heard of in commerce.

MOODOOGA; PULAS; DHAK (*Butea frondosa*).—This oil, which I alluded to some time since on enumerating the products of this useful tree (vide TECHNOLOGIST, vol. i., p. 252), is only obtained in small quantities, and is consequently merely employed medicinally.

(To be continued.)

ALFA FIBRE FOR PAPER-MANUFACTURERS.

(Macrochloa tenacissima.—Esparto; Sparte; Spartum.)

BY JAMES WATT.

Several species of this grass grow wild on both shores of the Mediterranean for about five degrees of longitude, and are particularly abundant in some of the seaboard provinces of Algeria. They are found upon arid, rocky soils, having a basis of silica and iron. In Spain the herbaceous stalks of esparto have been used as a textile for centuries, for ropes, mats, sandals, baskets, &c.; also in the manufacture of a coarse paper. *Lygeum spartum*, *Stipa gigantea*, *S. barbata*, and other species, are also employed.

The attention of the French Government has for years past been directed to this plant as a substitute for rags; and in the London Exhibition of 1851, samples of alfa, as well as paper made from it, were shown in the Algerian section of French products. In consequence, however, of the difficulty of transport, and the imperfect methods then employed in its preparation, little progress was made; but the recent legislative enactments in England respecting paper, and the increasing prices of rags abroad, have caused the manufacturers here to pay more attention to this plant, and experience has proved not only its superiority to straw, but its perfect adaptability to making paper, either by itself, or when mixed with straw or rags.

The efforts which have been made to utilise more generally the herbaceous stalks of this grass have been attended with the most beneficial results, and for paper pulp it has been found exceedingly valuable, producing paper of great strength and tenacity. A large paper-mill has been established at Arba, near Algiers, and the 'Akhbar' daily paper, one of the oldest journals of Algeria, is now printed on paper of African origin, made of the fibres of alfa, diss (*Arundo festucoides*), and of the dwarf palm (*Chamœrops humilis*), all wild plants, met with in abundance.

The prosecution of an export trade in these fibres was long retarded by the stringent Customs regulations of France.

M. Michel Chevalier, some years ago, pointed out that the business-man of enterprise and capital in Algeria was placed in the same tantalising situation as Sancho Panza in the Island of Barataria: in the presence of a table covered with dainty viands, he was continually arrested by the command of the doctor, who prohibited his touching the various delicacies which tempted his appetite.

"The plains of Algeria," wrote M. Chevalier, "offer, without culture, a plant excellently adapted for making paper of the first quality: this is alfa, or esparto. The importation into France is permitted in the rough state—that is, with the stalks or stems tied up in bundles, like forage—which, from their excessive bulk, it is scarcely possible to transport profitably any great distance, or to ship; but when, by maceration, it is made into a pulp, and greatly diminished in weight and bulk, so as to be conveniently transportable, it is prohibited in France. The time is coming, however, when France will be open without duties to all Algerian productions."

Recent measures, taken by the Minister for Algeria, have greatly modified the Customs regulations for the French colonies. All its natural products, and a great many of its industrial and manufactured products, are now freely admitted.

The alfa in its wild state grows in a tuft or clump, of which only such stalks as have come to maturity, and are full of sap, ought to be gathered. If gathered too green, it produces a transparent fibre, with immense waste; if, on the other hand, too ripe, the constituent elements of silica and iron are with difficulty removed. The proper months for the harvest in Africa are, therefore, April to June. It must be gathered by hand, and left to dry for a week or ten days before being removed for packing. From the green to the dry state it loses 40 per cent. of its weight; but even in this latter form it is so cumbersome that when shipped in loose bundles it occupies from four to five tons space to one ton weight. When placed under a hydraulic machine, however, it can be packed into pressed bales, with iron hoops, and reduced to half the above volume, as far as space is concerned, each bale weighing about 2½ cwt., and 10 bales weighing about 1¼ tons. Reduced to this volume, the alfa fibre can be transported not only with greater facility, but this method of packing (resembling, in fact, bales of pressed hay) keeps the fibre clean, and renders it of easy stowage.

In the above manner considerable exports have lately taken place to France and Belgium, where its use is every day increasing; and it is now introduced upon the English market in the same form, with the conviction that the superior advantages of packing, as well as condition and quality, will not fail to attract the notice of paper-manufacturers. The method of treatment is now so well known that any detailed statement is unnecessary.

The chemical constituents of the plant are as follows:—

Yellow colouring matter	12·0	26·5
Red " "	6·0	
Gum and resin	7·0	
Salts, forming the ashes of the Alfa	1·5	
Paper fibres		73·5
		100·0

ON THE SUPPOSED INFLUENCE OF THE PAPAW (*CARICA PAPAYA*) ON MEAT.

Browne, in his Natural 'History of Jamaica,' tells us that the fruit of the papaw has a pleasant, sweetish taste, and is much liked by many people; that, when young, it is commonly used for sauce; and when boiled and mixed with lime-juice and sugar, is not unlike or much inferior to that made of apples, for which it is commonly substituted. In the opinion of Sloane, it is not a very pleasant fruit, even when helped with pepper and sugar; and the more ordinary use, he adds, of this fruit is before it is ripe, when as large as one's fist: it is cut into slices, soaked in water till the milky juice is out, and then boiled and eaten as turnips, or baked as apples.

The juice of the pulp is used as a cosmetic, to remove freckles on the skin caused by the sun; and the negroes in the French West India Colonies employ the leaves to wash their hair, instead of soap. The milky juice of the unripe fruit is a powerful and efficient vermifuge, and the powdered seeds answer the same purpose. But the most extraordinary property of the papaw tree is its alleged influence in rendering meat tender—an opinion that prevails commonly in the East and West Indies. Browne, in his 'Natural History of Jamaica,' mentions that "water impregnated with the milky juice of this tree is thought to make all sorts of meat washed in it very tender: but eight or ten minutes, it is said, will make it so soft that it will drop in pieces from the spit before it is well roasted, or turn soon to rags in boiling." Gentlemen who have been long resident in the West Indies speak of the employment of the juice for such a purpose as of quite general occurrence; and more, that old hogs and old poultry which are fed upon the leaves and fruit, however tough the meat they afford might otherwise be, are thus rendered perfectly tender, and good too, if eaten as soon as killed; but that the flesh very soon passes into a state of putridity. The juice causes a separation of the muscular fibres. Nay, the very vapour of the tree is stated to serve the purpose: hence many people suspend the joints of meat, fowls, &c., in the upper part of the tree, in order to prepare them for the table. Such is the effect upon hogs that feed upon the fruit, that the good housewives reject the flesh of such if it is destined for salting, well knowing that it is not sufficiently firm for the purpose of curing. In Ceylon, the opinion is that the effect is secured mainly by suspending the meat beneath the foliage of the tree during the night. In Barbados, a greater reliance is placed in wrapping the meat in its leaves for a few hours with a portion of the young fruit. Whether this power of hastening the decay of meat be attributed to the animal matter or fibrine contained in the juice of the papaw, I will not pretend to say; but the presence of such is a fact scarcely less wonderful than the property attributed to the tree.

Two specimens of the juice were brought from the Mauritius; in the one it had been evaporated to dryness, and was in the state of an extract; in the other, the juice was preserved by being mixed with an equal bulk of rum. Both were subjected to analysis by Vauquelin. The first was of a yellowish-white colour, and semi-transparent. Its taste was sweetish; it had no smell, and was pretty solid, but attracted moisture when kept in a damp place. The second was reddish-brown, and had the smell and taste of boiled beef. When the first specimen was macerated in cold water, the greatest part of it dissolved : the solution frothed with soap. The addition of nitric acid coagulated it, and rendered it white ; and when boiled, it threw down abundance of white flakes. When the juice of the papaw is treated with water, the greatest part dissolves ; but there remains a substance insoluble, which has a greasy appearance. It softens in the air, and becomes viscid, brown, and semi-transparent. When thrown on burning coals, it melted ; let drops of grease exude, it emitted the noise of meat roasting, and produced a smoke which had the odour of fat volatilised. It left behind no residue. The substance was fibrine. The resemblance between the juice of the papaw and animal meat is so close that one would be tempted to suspect some imposition, were not the evidence that it is really the juice of a tree quite unquestionable. This fibrine had been supposed previously to belong exclusively to the animal kingdom ; but it has since been found in other vegetables, especially in fungi.

The trials I have made of the property of the papaw afforded negative results, tending to prove that the effect on the meat was owing to other and incidental circumstances, rather than to any special power possessed by the plant. I shall mention one in illustration. Of two fowls killed at the same time, one was wrapped in the leaves of the papaw by my cook in the most approved manner, not neglecting the introduction of a piece of the young fruit ; the other was similarly treated, substituting the leaves and fruit of the squash (*Cucurbita Melopepo*, Linn.) Both roasted, were found equally tender. Other trials, using the leaves of other plants, gave like results. The juice of the leaf, to which by some the supposed effect on the meat is attributed, appeared, as well as I could judge, to possess very little activity. It is milky, almost insipid, or only in the slightest degree acrid, and only after many hours promotes fermentation, and that in a very slight degree, when added to a solution of sugar in water. The incidental circumstances alluded to—whether the suspending of the meat under the leaves of a succulent plant exhaling moisture, or the wrapping it in the same—may be sufficient to account for the softening effect on the meat at a temperature such as that of Ceylon or the West Indies, so favourable to rapid change—that change on which tenderness in meat depends—without reference to any occult virtue in the plant.

OAK TRUFFLES.

BY M. DE GASPARIN.

M. Rousseau, of Carpentras (Vaucluse), France, having obtained truffles by the culture of evergreen oaks, M. de Gasparin addressed the following Report upon the subject to the Jurors of the Paris Exposition of 1855:—

At the Exhibition I remarked a case shown by M. Rousseau, of Carpentras, in which were enclosed some beautiful specimens of preserved truffles, and accompanied by a *procès-verbal*, signed by the mayor and many of the principal people of the country, certifying that they had been obtained in a coppice of seedling oaks, planted expressly to obtain *oak truffles.* My colleagues of the Jury naturally addressed themselves to me, as a countryman of the exhibitor, to know what I thought of the matter. I had heard previous mention made of similar plantations in the Arrondissement of the Apt, and in the Department of the Lower Alps; but I had not paid any great attention to it.

It appeared fit to the Jury to give a recompense of some sort for the production, of which we have had no more circumstantial details, and it thought proper to accord to M. Rousseau a medal for the good preservation of the truffles exhibited. I proposed to visit the locality upon my return to the country; and having entered into conversation with the producer, through the introduction of M. Fabre, Director of the School Farm of Vaucluse, I paid a visit to the place on the 3rd of February, 1856, accompanied by M. Fabre, M. Aug. de Gasparin, my brother, and many amateur agriculturists who desired to assist in the examination which we had come to make. M. Rousseau is a truffle-merchant. Carpentras is one of the centres where this production flourishes on all sides; in the season it is not rare to purchase in the market 1,500 kilogrammes of truffles. M. Rousseau prepares them after the method of Appert, the quickest and the most perfect in Paris.

The lands of Carpentras possess a soil by no means fertile, as the following analysis will show:—

Stony element (calcareous and silicious) - - -	56·3
Earthy element - - - - - - - -	43·7
	100·0

The earthy particles contain—

Lime - - - - - - - - - -	4·1
Silex - - - - - - - - -	57·0
Clay - - - - - - - - - -	38·9
	100·0

The continual advance in price of truffles caused him to conceive the idea of utilising this earth by transforming it into a truffle-ground; and for that purpose he planted evergreen and common oaks, the acorns having been chosen from the oaks around which the production of truffles appeared the greatest. In the furrows made by the plough he planted the seeds, separated about four mètres apart, and nearly touching in the furrows.

In his new plantations he has given six mètres in width to his lines of oaks, and they are sown less thick. In the fourth year of the plantation, they found three truffles in the earth; but it is not more than six years since the commencement of the harvest. At present the oaks are nine years old, and one mètre in height.

During the year 1854, in the summer, there were obtained 15 kilogrammes of truffles; in 1855, the summer having been dry, the quantity obtained was rather less.

A sow is employed to search for the truffles. At the distance of twenty feet she scents the truffles, and makes rapidly for the foot of the oak, where she finds them, and digs into the earth with her snout. She would soon root up and eat her treasure, were she not turned aside by a light stroke of the stick on her nose, and given an acorn or a dry chesnut, which is her reward. In an hour we had gathered about 1 kilogramme of truffles in a poor part of the field sown with oak.

M. Rousseau marked with white paint the foot of the oaks where the truffles were found, so as to obtain from them acorns for the new sowing, and also not to sacrifice the trees when he cleared the woods.

I have often remarked that it is to the oaks marked in the preceding manner that the sow always applies herself: it does not, then, appear doubtful that they are individually more fit to produce this tubercule, and it is not without reason that they have been given the name of oak truffles. But, as all the oaks of this sowing produce the acorns of the oak truffles, we cannot regard this property as hereditary, and holding to one variety. It is purely individual.

The plantation of M. Rousseau contains evergreen and common oaks. One cannot, however, gather the truffles at the foot of the latter species, it so happening that it arrives later at the state of production, being less favourably situated: in fact, it receives a part of the shadow of a neighbouring house. M. Fabre has told me that, at Bordeaux, M. de Rouvrade had a plantation of oaks which covered a hill to the south and to the north, but had never found truffles on the northern part. The common oak, however, produces truffles, like the evergreen oak, for a great number of natural truffle-grounds at Vaucluse are planted with common oaks.

It is remarked that the truffles produced from these are larger but less regular than those of the evergreen oak, which are smaller, but nearly always spherical. The truffles are gathered at two periods of the year: in May only white truffles are to be found, which never blacken, and have no odour; they are dried, and sold for seasoning. The black truffles commence forming in June, enlarging towards the frosty season; then they become hard and take all their perfume. They are dug up a month before and a month after Christmas. There is not the slightest doubt but that truffle-plots can be formed at will in the centre of France by the seeds of oaks.

In the poor soils where they are produced, the oaks come up slowly, and the full harvest of truffles is late, owing to the development of roots augmenting probably the production in throwing out successively the oaks which do not furnish truffles, and in thus giving more space for the development of those which do. It is asserted that truffles are also produced about the vine; but those pointed out to me as having this property were surrounded by a belt of evergreen oaks.

It would appear, however, that the association of the vine is favourable to this production, because the truffle-plots near the vines are very productive; and it would seem to act in such a manner upon the roots of the oaks, as to render them more fit to receive their parasite.

The observation of this fact has, without doubt, decided M. Rousseau to plant a row of vines between the oaks.

Experience will decide the propriety of this operation, which will have the advantage of utilising his soil by a harvest of grapes. We see, however, to what results this agricultural speculation is limited. At the end of eight years were obtained 15 kilogrammes of truffles from two hectares of land, or 7½ kilogrammes per hectare, which, at the price even of 6 francs the kilogramme, gives a product of but 45 francs. We must deduct for labour, 10 francs, the days of the truffle harvest, and the rent of the soil, which would raise it to 25 francs per hectare (2 hec. 5 of rye for the master's share); and lastly, the interest of the charges of the plantation and of the maintenance before the production.

If the future does not render him larger profits, and the quantity of truffles does not considerably increase, M. Rousseau will have made some curious experiments, but not attended with any remunerative return. He can only look forward in the distance to any fall of wood.

We owe, nevertheless, our thanks to the author of this enterprise, which should be persevered in, and an exact account kept of future products. It will be desirable that those who have made similar experiments in other localities—and it is said that there are numbers in Périgord willing—should furnish an account of the results which have been obtained.

I may state, in conclusion, that M. Rousseau has shown us a meadow manured with parings of truffles, which has given prodigious results.

THE CORAL OF COMMERCE.

BY THE EDITOR.

As coral ornaments are again coming into fashion among the ladies, and coral is more likely to be sought for, a few words on this product of the fisheries may be deemed acceptable.

The ordinary varieties of coral met with are either bright red (the most common), rose-coloured, white, and sometimes the black kind, furnished by a different order. Coral is characterised by the dealers by various technical terms, according to the shades of colour.

The coral of commerce is the natural skeleton or organ of support of a species of Polypi (*Corallium rubrum*, Linn.), of which numerous individuals live connected together in a ramified form. Each of these creatures is provided with eight ciliated and radiated tentacula at the mouth, by which it seizes its prey, and organs by which it digests it. The separating skeleton of coral is secreted by a system of vessels which is common to the several individual polypes, and which conveys nutriment to them.

Almost all the species of Asteroid Polypes have an arborescent form; and so much does the flexible axis of many kinds resemble the stem of a plant, that even so late as the year 1825, the celebrated Blumenbach writes—"The stems appear to be really vegetables (the woody nature of which in the strong main stems cannot be mistaken), merely incrusted with corals."

Dr Carpenter thus speaks of coral:—"Of the stone-depositing coral animals, a large number are often associated in a compound structure. This consists of a stony tree-like stem and branches; but instead of the soft animal being contained in its interior, as in the Hydrozoa, it usually forms a kind of flesh that clothes the surface and connects together the different polypes; and new branches are formed, either by the subdivision of the polypes, or by gemmation from the connecting substance.

"The firm axis of the *Antipathes* presents, when dry, a smooth polished surface, which, joined to its dark colour, has caused it to receive the designation of black coral. In the *Corallium rubrum*, the solidification of the axis has proceeded still further; for it contains not only horny animal matter, but a large quantity of calcareous particles, so closely deposited in every part as to give great solidity to the stem, and to enable it to receive a very fine polish when cut into fragments. No vestige of polype cells can be detected upon the surface of the axis. These are confined to the flesh and its integument, which are both very soft; the latter does not contain enough calcareous matter to make it perceptible as a crust when dried upon the axis. The density of the red coral renders it very brittle; and did it not grow in a somewhat stunted form, it would be liable to injury from the violent motion of the water in which it grows."

Coral is fished up as an article of commerce for the manufacture of necklaces, bracelets, ear-rings, brooches, pins, buttons, charms, and other ornaments or articles of personal decoration. The delicate flesh-coloured variety, which is very rare, fetches extremely high prices, especially of late years. Professor Robert Hunt states that he has seen an invoice for this choice coral, in which the manufacturer was charged 75 piastres, or 15*l.* 11s. 7d. sterling, for the Neapolitan ounce: as the Neapolitan ounce is one-third less than the English ounce, we have 20*l.* 15s. 5d. as the price for that quantity; the value of gold being, at the present time, less than 4*l.* per ounce. The imports of ornamental coral into this country seldom exceed 4,000 or 5,000 lb. weight a year of all kinds, roughly computed at an average value of 3*l.* the pound.

Another kind of coral—the *Tubipora musica*, inhabiting the Indian Ocean—takes its name from the regular arrangement of its cylindrical tubes by each other's side; whence it is commonly termed "organ-pipe coral." These tubes are of a dark and rich crimson. Being much cheaper than the ordinary stony coral, it is frequently used as a representative of coral in cabinets of economic products.

Sea-fan corals (*Gorgonia*), brain-stone corals (*Meandrina cerebriformis*), brush corals, large and small tree corals, and other kinds, are imported as objects of natural history and curiosity.

The chief places from which coral is obtained are the Red Sea, the Persian Gulf, the Coast of Africa, and some parts of the Mediterranean Sea. The coral fishery in the Mediterranean used to be chiefly followed by the Trapanese of the Island of Sicily, who went for the purpose to Bona, off the Coast of Africa. The corals are polished and worked, &c. at Trapani, and sent to Catania, Naples, Leghorn, &c.

In the Strait of Messina there is a coral-ground of about six miles in length, whence 12 or 13 tons of ordinary coral used to be obtained. It is fished for in some of the bays of Corsica and Sardinia. Red coral is also found on the shores of Provence, and about the isles of Majorca and Minorca.

The coral fishery of La Calle (Constantine), Algeria, is now the principal source of this commercial article. In the years 1838 and 1839, the average shipment of coral from Naples was 12½ tons, valued at 23*l.* to 24*l.* the ton. There are some coral fisheries off the coast of Dalmatia. Coral-fishing was formerly carried on to some extent on the coasts of Rhodes, but has been abandoned for many years, in consequence, it is said, of the rapacity of the Turkish Government functionaries.

A valuable discovery of a bank yielding the coral of commerce was made a few years ago near Balepitye, in the southern province of Ceylon. Coral is said to be obtained off the coast of Japan and Sumatra.

The number of boats engaged in the coral fishery off the coast of Algeria varies considerably year by year. In 1832 it was only 62; in 1836 there were 245 employed. In 1837 the value of the coral obtained there was 46,540*l.* In 1851 the coral taken there by 150 boats was estimated to be worth 80,000*l.*, most of it being sold in Naples. In later years even a larger money value than this has been obtained. In 1853, 156 vessels prosecuted the coral fishery in the vicinity of Boné and Calle, and collected on an average 230 kilogrammes per boat: at the price of 60 francs per kilogramme, this gave a total value of 2,152,800 francs. Large banks have recently been discovered on the coasts of the province of Oran.

The coral fishery is a source of more profit than is perhaps generally known, and is attended with hardships, the bare thought of which might diminish some of that natural vanity with which the fair one contemplates the glowing ornaments that repose upon and contrast with her white bosom.

The following graphic account was published some years ago in the 'Athenæum:'—

"Torre is the principal port in the South of Italy for the vessels engaged in the coral fishery—about 200 vessels setting out from hence every year, about June. They have generally a tonnage of from 7 to 14 tons, and carry from 8 to 12 hands; so that about 2,000 men are engaged in this trade, and, in case of an emergency, would form a famous *corps de reserve.* They generally consist of the young and hardy and adventurous, or else the wretchedly poor; for it is only the bold spirit of youth, or the extreme misery of the married man, which would send them forth upon this service. For two or three months previous to the commencement of the season, many a wretched mariner leaves his starving family, and, as a last resource, sells himself to the proprietor of one or other of these barks, receiving a *caparra* (earnest money), with which he returns to his home. This, perhaps, is soon dissipated, and he again returns and receives an addition to his *caparra;* so that, when the time of final departure arrives, it not unfrequently happens that the whole of his scanty pay has been consumed, and the improvident or unhappy rogue has some months of hard labour in prospect, without the hope of another *grano* of compensation. Nor does the proprietor run any risk in making this pre-payment; for as the mariner can make no engagement without presenting his passport perfectly *en règle*, he is under the surveillance of a vigilant police. The agreement between the parties is made from the month of March to the Feast of San Michaele (29th September) for vessels destined for the Barbary coast, and from March to the Feast of the Madonna del Rosario (October 2) for those whose destination is nearer home. Each man receives from 20 to 40 ducats, according to his age or skill, for the whole voyage; whilst the captain receives from 150 to 400 ducats, reckoning 6 ducats to £1 sterling. These preliminaries being settled, let us imagine them now on full wing—some for the coast of Barbary, and others for that of Sardinia, or Leghorn, or Civita Vecchia, or the islands of Capri, San Pietro, or Ventotene, near which I have often seen them, hour after hour and day after day, dragging for the treasures of the vasty deep. On arriving at the port nearest to the spot where they mean to fish, the 'carte' are sent in to the consul, which they are compelled to take again on return. A piastre is paid by each vessel for the magic indorsement of his Excellenza, another to the druggist, and another to the medical man; whilst the captain, to strengthen his power, and to secure indemnity in case of some of those gentle excesses which bilious captains are sometimes apt to commit, has generally on board some private 'regalo' for his consul. The next morning, perhaps, they push out to sea, and commence operations—not to return that evening, or the next, or the next, but to remain at sea for a fortnight or a month at a time, working night and day without intermission. The more humane captains allow half their crews to repose from Ave Maria to midnight, and the other half from midnight to the break of day; others allow only two hours' repose at a time; whilst some, again, allow no regular time;—'so that,' said a poor mariner to me, 'we sleep as we can, either standing or as we haul in the nets.' Nor do they fare better than they sleep; for the whole time they have nothing—literally nothing—but biscuit and water, whilst the captain, as a privileged person, has his dish of dried beans or haricots boiled. Should they, however, have a run of good luck, and put into port once in fifteen days or so, they are indulged with a feast of maccaroni. These privations make it rather rough work, it must be confessed, for a mariner, especially when it is remembered that it lasts seven months; but if to this be added the brutality of the captains, whose tyranny and cruelty, as I have heard, exceed anything that has ever been recounted to me before, we have a combination of sufferings which go far to justify the description given to me of this service by one engaged in it, as being an 'Inferno terrestre.'

"Now let us view them at work. Every vessel carries about 12 contaj (a contaio being about 200 pounds) of hemp to make the nets, which are changed every week. They are about 7 or 10 palmi in width, and 100 or 120 palmi in length, — worked very loosely, and with large meshes. On being thrown into the sea, the vessel is put before the wind, or else propelled by oars, until these loosely-formed nets have fastened upon a rock. Then comes the tug of war. If they have great good fortune, they will take a piece of 2 or 3 rotoli at a haul (a rotoli being 33 ounces), though this is a rare occurrence. The white coral is very rare and very precious, comparatively a small quantity being sufficient to make a good voyage, especially if it be taken 'ingrosso,' when it will fetch as high as 100 ducati, or more, the rotolo. The red 'a minuto' is not very valuable; but if it is 'scelta' and 'ingrosso,' it can be sold for from 25 up to 60 ducati the rotolo. As a rule, however, the round-shaped coral is much more valuable than the tree or the spiral coral.

> 'Full fathoms five thy father lies;
> Of his bones are coral made'—

So sang Ariel, without, I suppose, intending to lay down any rule as to the depth at which coral may be found. Indeed, it is found at all depths, from 12 to 16 palmi up to 150, or even more. At last arrives the Feast of San Michaele, or of the Madonna del Rosario. As soon as the day dawns, the nets are slackened; no man will work more, even if treasures are in prospect. So, pushing into land, and taking up their 'carte,' away they set on their return—many as poor as when they departed; some with a few ducats in 'sacco,' and a new Phrygian cap, or dashing sash, or some article of finery for the 'innamorata'—all, however, being thoroughly tired out, and injured, perhaps, in constitution. The cargo being deposited in the 'magazzin' of the merchant, is sold out to the retail merchants, who flock in from Naples and elsewhere, and is soon transformed into numerous articles of ornament or superstition—crosses, amulets, necklaces, and bracelets. And now these mariners have a long repose, till the spring comes round and sends them out again on this odious service,—though there are very few who make two or three consecutive voyages of this nature. Many vessels are lost in the season, owing to their long-continued exposure to all kinds of weather, and to their lying amongst the coral reefs. However prosperous the voyage, life aboard the vessels '*è la vita d' uno cane.*' Yet the service may be regarded as one of the most important in the kingdom of the Two Sicilies, as well for the wealth it annually brings in, as also for the school it offers for training hardy, well-disciplined mariners."

ON ANACAHUITE WOOD.

BY BERTHOLD SEEMANN, PH.D.

During the last two years, public attention has been directed to a new Mexican drug, imported from Tampico, under the name of Anacahuite wood, and recommended as a remedy for consumption. Shavings of the wood are administered in the simple form of infusion, to be drunk in the morning fasting, and again in the evening at bed-time. Even when the disease has already made some progress, this infusion is considered highly beneficial; at least, that is its Mexican reputation. The experiments made at the Berlin Hospitals have hitherto had no satisfactory result, and many already begin to doubt the efficacy of the wood, at least in our northern latitudes. However, the demand for the drug is steadily increasing, and yet no botanist has been able to say what species of plant produces this new article to our import list. Perhaps some of your correspondents or readers may be able to aid us in clearing up the doubts surrounding this question; and that is one of the chief reasons why I trouble you with these lines. Dr Berg, who has given a very elaborate account of the wood (Bonplandia, vol. viii., p. 302) thought it might possibly be derived from some papilionaceous tree; but as he had no specimens of the leaves, flowers, or fruit, his opinion is founded solely upon the structure of the wood itself. Some time ago, I pointed out that the name of Anacahuite is not to be found in any Aztec vocabulary, even the most recent; nor is it mentioned in the work of Hernandez. There was, therefore, every reason for assuming the name to be a corruption. Hanbury (Pharm. Journ. for Feb. 1861) seems to have arrived at the same conclusion, and conjectured that the name of "Nanahuaquahuitl, seu Morbi Gallici arbor," to be found in Hernandez, might be a possible version of Anacahuite. "Cahuite" is simply a Spanish corruption of Quahuitl = tree, which always occurs in that form in modern Mexican names; but I am unable to say what "Ana" may be traced back to. Hernandez gives a brief description of this plant, and a rude woodcut; according to which, it is a large tree with alternate simple lanceolate or elliptical leaves, said to be slightly scented and bitter; and "*decorti jus matutino liberalius ebibitum, Gallico medetur morbo.*" Of course, nothing can be made out of this account in the present state of the case; but it may become intelligible when we shall have received specimens and more information from Mexico. Mr Alexander Smith, at Kew, a few days ago directed my attention to Emory's Report, ii., p. 135, where Dr Torrey, on enumerating *Cordia Boissieri*, Alp. De Cand. (found by Edwards and Gregg near Monterey, by Thurber at New Leon, by Schott on the Rio Grande, all places on the east coast of Mexico, a few degrees north of Tampico, whence we obtain the wood), says—"The Mexicans call this plant 'Nacahuita.' Dr Gregg says that the fruit is eaten by cattle and hogs, and that a decoction of the leaves is used for pains in the limbs." The two names (Anacahuite and Nacahuita) are sufficiently alike to justify further inquiry. At the same time, it is necessary to state that there is only a distant resemblance between the leaves of *Cordia Boissieri*, of which there are fine specimens in Sir W. J. Hooker's herbarium, and the rude woodcut furnished in the Roman edition of Hernandez's work, leaving it quite an open question whether the two be identical or distinct.

USEFUL PRODUCTS OF WESTERN AUSTRALIA.

BY H. DRUMMOND.

Of the blackboy (*Xanthorrhœa*) there are several varieties. The glaucous-leaved York blackboy is, however, the most important, and grows thirty feet in height, without a branch. It is considered by the settlers the best material for thatch, and the young slender leaves are found to be an agreeable vegetable, and also serve as fodder for horses, goats, sheep, and cattle. The natives are particularly fond of the blackboy, and frequently refuse any other nourishment, whilst its sound old flower-stalks furnish them with the means of obtaining a light by friction.

The native yam, of the class *Dioscorea*, is stated to be the finest esculent vegetable the colony produces. The fungi are also palatable to the aborigines: one species belonging to this order, the *Boletus*, is remarkable for possessing the properties of German tinder when well dried, and for emitting a radiant light in its natural state.

A climbing species of the *Thysanotus*, near the Moore River, is much used by the natives as food. The madge and the guardine are roots from which the natives extract nutritious food; the pigs are also fond of them: and besides these, there are other wild roots used as food by the natives. The *Erythræa Australis* is stated to be a good substitute for hops, and used as such; and one species of tobacco is indigenous to the colony. There is a native celery which forms a good substitute for that of Europe: two varieties of it are mentioned—the *conna*, of which the roots are eaten by the natives after being pulled; and the *kukire*, the root of which resembles the carrot in appearance, with the smell and colour of the parsnep. The wild carrot is also an excellent vegetable, and from its root rich wine has been extracted. Of the *Hedeoma latifolia*, Dr Lindley remarks, that its half-ripe fruits, if sent to Europe, would give several original and valuable scents to the perfumer.

The Vasse apple, of the size of a peach, is stated, when boiled with sugar, to be an agreeable sweetmeat. It is of a deep orange colour, and closely resembles the Kojonup peach, another delicious fruit. The tree which bears the latter grows to the height of twenty or thirty feet, with a trunk from nine inches to a foot in diameter, and a fine bushy top. Another fruit of the *Mesembryanthemum* genus is of a less pleasing flavour; but one of the same species, resembling the English gooseberry, is said to be delicious. A nondescript shrub, about five feet in height, bears a pleasant fruit, as large as a middle-sized plum, of a fine purple colour, covered with a rich bloom, and having a stone similar to the plum. The bark of the root of the "doatta," a small kind of *Eucalyptus*, is much relished by the natives, having a sweet and pleasant taste; as is also the trunk of the red gum; and its leaves washed in water form an agreeable beverage.

They also collect a description of manna from the leaves of the York gum-tree, which yield a considerable quantity of saccharine matter. The common green wattle of the genus *Acacia* is found plentiful on the alluvial plots of the Swan, and the bark is much used for tanning; the gum-wattle of the same order produces so great a quantity of gum as to demand the attention of exporters. Yet another shrub of this order is found in the Vasse District, and produces galls similar to those of the oak, which might also be collected for exportation. The gum of some of these species is used by the natives as food; and the seeds, when ground, give them a tolerable substitute for flour.

The natives of King George's Sound subsist chiefly upon roots. The plant most abundant, and which forms the principal article of food throughout the year, is called *mynd.* It resembles the common rush in the leaf, but has a bulbous root. The bulb is of a fine orange red colour inclining to lake, about the size of a small short onion. The leaves, although resembling the rush, are rounder and finer in texture; the flowering vessels grow up in a single stalk, three or four feet high, which is covered near the top with twenty or thirty flowers of a deep pinky-brown, almost approaching to black, unlike any plant known in Europe. The mynd, however, is mostly eaten by the women and children, or very old men,—the young men disdaining it if other food can possibly be procured. Their mode of cooking this bulb is curious, and chiefly performed by the women. It is first well roasted, and then pounded between two stones, together with some *earth* of a reddish colour, nearly free from sand, which even in this sandy district can be procured in almost every sheltered place. This earth is understood to be the production of the white ant, whose hillocks or nests are very common. One measured by Mr Gilbert, the naturalist, was nearly four feet high, and of considerable girth. The women never travel without a supply of this earth, as in the iron-stone country the *co-kut*, or ants' nests, cease to appear.

The extraordinary fact of their mixing the earth with the mynd root, arises from the extremely acrid properties of the latter; and it appears that, notwithstanding the counteraction of this earth, the natives suffer much from excoriated tongues, which appear perfectly *purple* when they are obliged to live upon this root for any length of time. It is a common practice of the natives to exhibit the tongue to the settlers when soliciting the charity of a little flour or rice. The women living principally upon this root, are evidently injured by it; they appear almost a distinct race from the males, having a miserably shrivelled appearance, and are seldom long-lived. This may arise from both causes—namely, the bad effects of the sharp particles of sand lacerating the stomach and intestines, and the acrid and deleterious qualities of the mynd. The children, however, suffer less, both from distending their stomachs with enormous quantities of water, and from the greater quantity of mucus which naturally lines the coatings of their stomachs and bowels.

The next important bulb is the tieubuck, chiefly found in sheltered places in spring: when roasted, it bears some resemblance to the potato, but is more mucilaginous, and has less flavour. There is rarely more than one bulb to each root, and this seldom exceeds a large marble in size. About the month of October it is procured in considerable quantity, and, like the mynd, thrives best in a light sandy soil. The natives procure it by means of a long pointed stick, which is the only instrument used by the women in obtaining every kind of food from the earth. When the tieubuck is in season, it is difficult for a European to distinguish its leaf from the surrounding grass; but when in full flower, its beauty and fragrance render it everywhere conspicuous; the scent resembles the Tonquin bean or May grass. Like the mynd, it also shoots up a single stem, about a foot high, covered near the top with an abundance of flowers. The men eat this root greedily, and send their women out to procure it, but rarely seek it themselves. When the plant is in full flower, the bulb is absorbed. A number of other roots are occasionally used as food in their season; the native names of some our informant has collected in the following list:—

1. Quenine, the Zamia palm. The nut is poisonous; but the rind, which is of a fine red colour, *after being buried for a month*, forms a chief

article of food in the autumn. To me it was disgusting, the taste being rancid, and resembling train oil.

2. Yoke, Yike, or Yooke. This is a very curious plant, and is found in the interior. 3. Nornup, or Noornop: some pronounce it Nornoop. This also is very curious, and occurs in the interior. 4. Warran. Is found far in the interior to the north-east of King George's Sound, but it is more common about Swan River. 5. Tieubuck. Is plentiful about King George's Sound. 6. Carr. 7. Werringan. 8, 9. Toondong and Quording: quording resembles mynd. 10. Kg-Noowill. 11. Mike. 12. Cole-bar. 13. Chettagong. 14. Knongan. 15, 16. Tyac-Kut, and Moolul. 17. Mynd; the most important.

In very dry parts of the country, many other kinds of roots are eaten by the natives; but, as far as can be ascertained, they are otherwise despised, unless under cases of extreme necessity.

SARSAPARILLA OF THE MUNDRUCUS.

The medical virtues of sarsaparilla have given rise from time to time to great controversy, and have produced many and various opinions. Why it has fallen in the estimation of scientific men of this country and the Continent, or why it never obtained so great a reputation as it has in America, may arise from two causes: first, that the root imported into this country and offered for sale is generally the product of the less valuable species,—and the species are without number; and, second, that the fresh juice or sap, and not the rhizome or bark—dried as it appears in commerce—probably is the active and medicinal principle.

It is our purpose to state here the nature of the sarsaparilla of a particular Indian tribe; and, in doing so, some light may be thrown upon sarsaparilla generally, and thus account for the contrary opinions maintained.

This plant is one of the chief articles of commerce dealt in by the Mundrucus. It is gathered by the women and children six months out of the year; the remaining six months being spent in hostilities against tribes of adjoining territories.* The time adopted by the Mundrucus for gathering the sarsaparilla is during the wet season (as then they do not go to war, but choose the fine hot weather for this purpose), as the roots are more easily dug or pulled from the damp earth, especially where the tendrils grow near the surface, and they will pull up without breaking.

* The territory of the Mundrucus, or Beheaders, is situate far up between the Tapajos and Madeira. On the Tapajos above the Caxœiras, or Cataracts, their villages are found. Here they live without any interference on the part of the whites; but are very much harassed and perplexed by neighbouring tribes, especially the Muras, who live at the mouths of the Madeira and Rio Negro.

If the mother root be not dug out with the tendrils—which seldom if ever happens, as the improvident collectors think not of to-morrow, the day's sufficiency being to them all they require—it will rapidly yield a new crop of shoots; thus it might become exceedingly abundant. After gathering as much root as they can carry home with them, they return with their product to the malocca, or receiving-house. In this its fresh state, it is very heavy, arising from the quantity of sap it contains, and from the mud that adheres to it.

At this the primary mart sarsaparilla obtains its price. A bundle is bartered for about four dollars' worth of various commodities, such as iron tools and articles of warfare; but they more often exchange the product of their labour for ornamental gewgaws, as beads, ribbons, coloured prints, &c.—articles greatly admired and coveted by most savage races. The cost at first hand may be estimated at sixpence a pound; for the Mundrucu is very careful about washing a material that has cost his wife and children so much difficulty in gathering, and he well knows that his sarsaparilla is of the best kind and much sought after in the medical market.

The radix sarsæ that enters into commerce is the product of a variety of species of plants, most of them of the genus *Smilax;* but great quantities of the genera *Carex* and *Herreria* are imported and sold for this root, the resemblance to each other being very close. The Smilax grows abundantly throughout the whole torrid zone in America, Asia, and Africa; and it is also collected outside the tropics many degrees—as is the case in Virginia and on the whole banks of the Mississippi, and also on the warm, humid peat-lands of Australia. The best sarsaparilla, however, is that which grows in tropical countries, in warm and moist situations, and where the land is light and mossy. These conditions are necessary to enrich the virtue of the sap, and render it a valuable medicinal agent.

As stated above, the number of kinds that furnish us with what is called sarsaparilla are of great variety, are brought from all parts of the world, and are equally varied in respect to excellence of quality. Many species seem worse than valueless, inasmuch as they injure the reputation of a good article; and, for this reason, manufacturers of the various preparations of sarsaparilla should use careful selection in the quality they purchase. As a matter of course, like all other articles, either of food, clothing, or medicine, the best kinds are the most valuable, because they are the scarcest; as, in this instance, the best sarsaparilla can only be obtained in situations both difficult of access—from the unhealthy climate,* and dangers of exploration—from the savagery of the natives on whose

* The climate of the Mundrucu, although one of the most unhealthy in all the Amazon region, on account of its great heat and humidity, is for that very reason one of the most fertile. Nearly all those tropical vegetable products which characterise the exports of Brazil can be produced in greatest luxuriousness on the Mundrucu soil; but it is only those that thrive naturally, and which are the easiest to collect, which merit his absent and careless attention.

territory it grows. Of its vast abundance there is no doubt, for on the banks of many of the South American rivers it exists, in forests especially, on the Rio Negro—the "black river;" the Indians believing that its colour is produced by the dense wilderness and black roots of the sarsaparilla. This, however, is fallacious, as there are many of the white-water rivers that run through regions abundantly supplied with sarsaparilla root; therefore the black water of the Rio Negro and other rivers arises from other causes, at present not understood.

The Mundrucu Sarsa is the *Smilax papyracea* of Poiret, and is known in commerce as red sarsaparilla. It is a climbing plant or under shrub, the stem of which is flattened and angular, with rows of prickles growing along the exposed edges. It shoots straight up without any support as high as twenty feet, or until it clings to the branches of the surrounding trees, when it shoots out in all directions, and spreads for a considerable distance. The main root shoots out many long tendrils of one thickness, covered with a brownish or dark grey bark. The shoots are fibrous, and about as thick as a quill, always crooked—a natural tendency—and longitudinally wrinkled, with here and there some smaller lateral fibres branching off from the sides. The leaves are of an oval acuminated shape, and marked with nerves longitudinally.

The medicinal properties of sarsaparilla exist in the bark or epidermis of the rhizomes; but the tendrils, both bark and rhizome, are collected together, without any choice or discrimination, and it remains thus adulterated until it reaches the druggist, who has to prepare from it his medicamentous extract, and he is frequently disappointed through a want of vigilant examination, which should be bestowed upon it by the wholesale buyer.

What we have already said of sarsaparilla admits of but little doubt that its virtue—as a depurative and restorative in disorders of the blood, and in all its other therapeutic uses, viz., in secretions, cachectic, scrofulous, and consumptive habits, debility, &c.—is to be found in its fresh, juicy state. Of this it is certain, that it is not so generally esteemed in countries where it does not grow, as it is where it is common and can be procured fresh. In the whole of Spanish America its properties are unquestioned, and experiment and experience have there led to an unlimited use of it. It is, indeed, most natural to suppose that in the careless process of exsiccation—which is done during its transit from wherever it is collected—its virtues suffer very materially, and the question is whether they are not entirely destroyed.

The portions of the root trusted for its sanitary principles by the British colleges of medicine is the epidermis. It is mucilaginous, and bitter to the taste, and possesses highly tonic properties. By our Transatlantic cousins it is known generally as a "purifier of the blood."*

The preparations of sarsaparilla of the London Pharmacopœia are

* The bark of the *Laurus Sassafras* is also used by the Americans for this purpose, but sarsaparilla is more frequently preferred.

extract, syrup, and decoction, which should be administered with due regularity, and discontinued by degrees. Taken warm, sarsaparilla is decidedly sudorific; but for this purpose it is unfrequently employed.

The appearance of the radix sarsæ of commerce is familiar to all. It is in round bundles of uniform size, and is exhibited in numbers of druggists' shop windows. After the root is collected, and when it is somewhat dried for the convenience of stowage and carriage—an item hated by the trader—it is necessary to have uniformity of parcels. The parcels or packages of sarsaparilla are formed by laying the roots side by side, and doubling in the ends of the longer ones. A bundle of the proper size for stowage contains an arroba of twenty-five pounds, but the weight varies with the wet or dry state of the root. Each bundle is tied round with a "sipo," or creeping plant.*—'Chemist and Druggist.'

Reviews.

A Manual of Botany, including the Structure, Functions, Classification, Properties, and Uses of Plants. By Robert Bentley, F.L.S., M.R.C.S.E., &c. Illustrated by nearly 1,200 Woodcuts. London: Churchill.

Before the reader has proceeded many pages in this work, he becomes cognisant, from internal evidence of the fact, that he is in communication with an author who is also a thoroughly practical teacher. Too many writers of elementary scientific works seem to forget that they are not addressing individuals of equal attainments to themselves, and whilst professing to initiate their readers into the mysteries of the subject they are treating of, make no effort to smooth the way by intelligible or systematic explanations. From this fault Professor Bentley is at least free: he never seems to forget that, besides the enunciation of facts, he is moreover striving to teach, and that to succeed he must avail himself of a long experience to systematise his teachings so as to make them attain that end. In his preface, he declares one of his prominent motives to be "to furnish the pupils attending his lectures with a class-book, in which the subjects treated of should be arranged, as far as possible, in the same order as is followed by him in the lectures themselves. It may be noticed that this order differs in several respects from that commonly followed, but long experience as a teacher has convinced him that it is the most desirable one to be followed by the student."

Half the book now before us is devoted to Organography, and the

* It is stated that this sipo is a root of the sarsaparilla, with the bark scraped off; in which statement we quite concur, as the root of sarsaparilla is very flexible and tough when this operation is performed.

remainder to Systematic Botany. We are disposed to regret that these two portions were not published in separate volumes, at about half the price of the whole; by which means, we think, its sphere of usefulness would have been enlarged, and each portion would have formed a manual of its distinctive branch, at a marvellously low price, within the means of the humblest student, who, perhaps, might not require both.

The economic portion of the work, which lies in our especial province, is necessarily very brief. At the close of each order, the principal products are enumerated, with a short account of their sources and purposes. This is all that could be expected within the limits of the work; and when we remember that we have a complete Organography and Vegetable Kingdom, with twelve hundred woodcuts, for twelve shillings, we only marvel that space was found for anything more than a mere enumeration of the vegetable sources of articles of commerce.

The Organography embodies the results of the most recent investigations; and the Systematic Botany contains diagnoses of all the natural orders, with their properties and useful members. Without attempting an opinion thereon, we may state that the sequence of orders is not that of Lindley, and the classification approximates more nearly to that of De Candolle. We doubt not, the book will meet with an extensive sale, and, we are certain, not a more extensive one than it deserves.

THE PRACTICE OF HAND-TURNING IN WOOD, IVORY, SHELL, ETC. BY FRANCIS CAMPIN. E. & F. N. Spon.

This is one of those useful and well-arranged handbooks which are so exceedingly important to many, and one which has long been required. It is admirably arranged and full in detail, well printed and illustrated, and is, moreover, cheap—all great inducements for ensuring an extensive sale among the large class of amateur turners and beginners. It not only deals with the ordinary substances used by the turner, but also gives instructions to the student for turning such works in metal as may be required in the practice of turning in wood, ivory, &c.

An enumeration of the subjects treated of in the several chapters is of itself sufficient to point out the great utility of the work to the uninitiated in mechanical manipulation:—On lathes; on turning-tools; on turning wood, &c.; on drilling, &c.; on screw-cutting; miscellaneous apparatus and processes; turning particular forms; on staining, polishing, &c.; on spinning metal; on materials; on ornamental turning.

The instructions are given with the hand of a master; and no one can refer to the work on any point without acquiring a large amount of practical and useful information. The last two chapters alone are worth the entire cost of the book, from the great amount of information contained therein.

THE TECHNOLOGIST.

THE PIASSABA* FIBRE OF COMMERCE, AND THE ECONOMIC PRODUCTS OF THE ATTALEA PALMS.

BY BERTHOLD SEEMANN, PH.D., M.A., F.L.S.

For some years past, the streets of London, Manchester, Leeds, Birmingham, and other large towns, have been, in places at least, kept peculiarly neat and clean, by brooms and brushes made of a new material—those of the machines as well as those employed by hand. Strange to say, although the Corporation of Liverpool receives a considerable amount for town-dues, they have not yet applied these useful brushes to their streets. Mr Witworth, of Manchester, was the first to introduce the street-sweeping machines now in use here and on the Continent. If the question be asked, "What is this material?" the reply often heard is, "Whalebone, I suppose." But no: it is not of animal, but of vegetable origin; in fact, it is one of the Piassabas (Piaçabas) of commerce, the coarse chocolate-coloured fibre of a species of palm (*Attalea funifera*, Mart.), which now sells at 17*l.* to 18*l.* per ton, and comes to us from Bahia, whence 270,071 bundles were shipped in 1856, and 278,417 in 1858. There is besides a second kind of Piassaba, which reaches us from Pará, and is much more valuable, now selling at the rate of 37*l.* to 38*l.* per ton. This latter was largely employed for making brushes used in the cloth factories, but those made of kittool fibre are now substituted; and when dyed black, it is mixed with bristles, and used in the manufacture of cheap clothes-brushes. It is also much used for horse-brushes. But the business doing in Pará fibre is at all times limited, not more than four or five per cent. of the whole Piassaba imported, which in some years reaches 150 tons. This finer kind is the produce of *Leopoldinia Piassaba*, Wallace, a palm only recently become known through the excellent description of Mr Spence. (Cont. 'Journ. Linn. Society,' iv., p. 58.) Mr Wallace had previously given a popular description of it, as well as a figure of the tree. But as Mr Wallace had lost the better part of his materials, which would have enabled him to publish a more scientific account and illustration, botanists were led to confound the Piassaba-yielding palm of Pará and Bahia, until set right by Archer (Hook., 'Journ. and Kew Misc.,' vol. vii., p. 213), and Spence in the Journal above quoted.

* Usually known in commerce as "Piassava."

The Piassaba of Pará, the finer of the two sorts, is produced by the *Leopoldinia Piassaba*, Wallace. It is termed by the Brazilians Piaçaba, and by the Venezuelans Chiquichiqui, having a very extensive distribution on the eastern side of South America, where it grows on partially-flooded lands. Wallace, speaking of the distribution of this palm in those parts with which he is more intimately acquainted, says—"It grows in swampy or partially-flooded lands, on the banks of black-water rivers. It is first found on the river Padaviri, a tributary of the Rio Negro, on its northern side, about four hundred miles above Barra, but the waters of which are not so black as those of the Rio Negro. The piassaba is found from near the mouth to more than one hundred miles up, where it ceases: on the banks of the Rio Negro itself not a tree is to be seen. The next river, the Darahá, also contains some. The next two, the Marahivá and Cababuri, are white-water rivers, and have no piassaba. On the south bank, though all the rivers have black water, there is no piassaba till we reach the Marié, not far below St Gabriel. Here it is extensively cut for about one hundred miles up; but there is still none immediately at the mouth, or on the banks of the Rio Negro. The next rivers, the Curicuriau, the great river Uapes, and the Isanna, though of black waters, have none; while further on, in the Xié, it again appears. On entering Venezuela, it is found on the banks of the Rio Negro, and is abundant all up to its sources; and in the Tomo and Atabapo, black-water tributaries of the Orinoco. This seems to be its northern limit, and I cannot hear of its again appearing in any part of the Amazon or Orinoco, or its tributaries. It is thus entirely restricted to a district about three hundred miles from north to south, and an equal distance from east to west. I am enabled so exactly to mark out its range from having resided more than two years among people whose principal occupation consisted in obtaining the fibres of this tree." (Wallace's 'Palm Trees,' p. 19.)

The trunk of this palm reaches twenty to thirty feet in height. The leaves are very large, and their leaflets rigid, but slightly drooping at the tips: they form an excellent thatch. The dilated base of the petioles separates, like that of *Arenga saccharifera*, into a long, coarse fringe, which is collected by the natives, and partly used for home consumption, partly exported to Europe, tied up in bundles of several feet in length, and sold in London under the name of piassaba (*piaçaba*).

Piassaba is now made up in bales, and pressed to reduce its bulk, making it more suitable for shipment as cargo, whereas hitherto it had been confined to serve as stowage for other produce. The expense of packing and pressing is about 10s. the ton. In Bahia, piassaba is sold at so many milreis (of about 2s. 3d.) the 100 bundles or double-bundles; in Pará, by the arroba of 32 lb.

This fibre is an extensive article of commerce in the country where it grows, and it seems to have been used from a very early period to form cables for the canoes navigating the Amazon. It is well adapted for this purpose, as it is light—the cables made of it not sinking in water—and very durable. It twists firmly into cordage, from the fibres being rough-edged; and as it is very abundant, and is procured manufactured by the Indians, ropes made of it are much cheaper than any other kind of cordage. The standard length which all the cables are made to is 60 fathoms. Before the independence of Brazil, the Portuguese Government had a factory at the mouth of the Padaviri, one of the tributaries of the Rio Negro, for the purpose of making these cables, for the use of the Pará arsenal, and as a Government monopoly.

The cordage manufactured of the fibre is extremely light, and floats upon water, and is more durable in the navigation of rivers than ropes of hemp. It is extensively used in the Brazilian navy, and large quantities are exported to Pará and many of the West Indian islands.

Until within the last ten years, the fibre was all manufactured into cordage on the spot; but it is now taken down, in long conical bundles, for exportation, from Pará to England. That from Bahia comes in bundles of 10 to 14 lb. each. It is cut by men, women, and children, from the upper part of the younger trees, so as to secure the freshest fibres; the taller trees, which have only the old and half-rotten portion within reach, being left untouched. The trees are much infested by venomous snakes, a species of *Craspedocephalus;* and the Indians, when at work, are not unfrequently bitten by them, sometimes with fatal consequences.

Mr Spence has published the following additional information, partly extending and correcting, partly confirming, what Wallace had previously written:—

"The ascertained distribution of the Piassaba palm is from the river Padaviri (a large tributary of the Rio Negro, entering on the left bank) on the south, to the cataracts of the Orinoco on the north; and from near the Japurá on the west, to the sources of the Pacimoni on the east. Its place of growth is in low sandy flats, where the water stands to a slight depth in rainy weather, but it avoids the swamps and the gapós in which the *Mauritias* and *Euterpes* delight. It is mostly found far away from the banks of the rivers, and I have seen but a single plant in such a locality—namely, just within the lower mouth of the Casiquiari on the right bank, on a barranca beyond the reach of floods. This was a noble specimen—perhaps over forty feet high. My friend Wallace had been wrongly informed of the partiality of the Piassaba for black waters, as it grows more abundantly than anywhere else in the forests of the Casiquiari, and especially from the mouth of Lake Vasiva upwards, where the waters of the river are much whiter than below; but as I have nowhere seen it on ground inundated by the rivers, it is plain that the colour of their waters cannot influence its existence. Near two Indian villages on this part of the Casiquiari, where I penetrated deep into the forest, I came on large groves of Piassaba. Nothing that I have seen in Amazonian forests dwell more strongly and pleasantly on my memory than my walk among these strange bearded columns, from whose apex sprang the green interlacing arches which shaded me overhead. The ground was dry—herbaceous vegetation there was none—and almost the only companions of the palm were scattered low trees of *Heterostemon simplicifolium*, Spence, with its large blue butterfly-like flowers, and another sort of tree of equally humble growth, clad with numerous fresh-coloured flowers, which Mr Bentham is disposed to consider a new genus of Flacourticeæ. To have escaped from the cloud of mosquitos on the bank of the river, no doubt enhanced the enjoyment. This was on the south side of the Casiquiari; but the Piassaba is equally abundant north of that river, and throughout the broad plain included by the Casiquiari, Orinoco, and Guainia: north of the Orinoco, on the Cunucunomu, Ventuári, and Sipápo, it is apparently much scarcer.

"Of the Piassaba collected on the Casiquiari and Guainia, about half is taken down to Pará, and the other half to Angostura, on the Orinoco. In the summer season, the Indian villages on those rivers present a very lively appearance from the boat-building and rope-making which occupy their inhabitants. An interesting circumstance respecting the latter branch of industry came to my knowledge at San Carlos del Rio Negro, where, constantly hearing an old Indian woman spoken of as 'La Inglesa,' I sought her out, and found that she had been the lawful wife of an Englishman, a soldier in the Royalist army, who, when the Republican party triumphed, retired towards the frontier of Brazil, and squatted down at San Carlos. I was assured by his widow, and by others of the inhabitants, that this man, whom they knew only by the name of Don Juan, first taught the people to make Piassaba rope by the aid of a wheel, and, in fact, established the first rope-walk in the Canton del Rio Negro. Whether this were true, or whether the Portuguese at an earlier date extended this branch of industry beyond the limits of their own territory, it is certain that, in so much as I have yet seen of the Peruvian and Quitenian Andes, rope of every kind, whether of agave, yucca, palm fibre, or of cotton, is made purely by hand.

"To Mr Wallace's interesting account of the mode of collecting the Piassaba fibre I have nothing to add, save that, as in the young plants, from which it is solely obtained, the beard is not always completely separated into fibres, but hangs down in riband-like strips, it is necessary, before cutting it off, to comb it out by means of a rude comb of two or three pointed sticks or long palm-prickles.

"Besides the use which is made of the beard of the Piassaba, the pulpy envelope of the sarcocarp in the ripe fruit is said to yield the most delicious of all palm drinks, bearing great resemblance to cream both in colour and taste. I have not had the good fortune to taste it, or even to see the ripe fruit, which comes into season at Midsummer."

Attalea, the genus to which the Bahia palm belongs, is composed of about twenty members, ten of which (*A. amygdalina*, H. & K.; *A. Butiros*, Lodd.; *A. Cohune*, Mart.; *A. excelsa*, *A. funifera*, Mart.; *A. Maripa*, Mart.; *A. speciosa*, Mart.; and *A. spectabilis*, Mart.) are cultivated in our gardens: they are all natives of the American Continent, where they range from the mouth of La Plata to the British colony of Honduras, but chiefly congregate in the neighbourhood of the Amazon and its tributaries; their favourite habitat is the forest. They are erect trees, generally of middle size, with thick, irregularly-ringed trunks, terminated by a crown of large pinnatisect leaves (between which the spathes appear), yellowish flowers, and ovate and elliptical fruits (drupes), of a brown or greenish-brown colour, each of which contains generally three, but sometimes four or five, edible seeds. Only a few supply Piassaba.

What we term "Piassaba" is the fibre surrounding the petiole of the tree, the price and uses of which have already been stated. It has been used here for about a quarter of a century, during which time prices have much fluctuated. Some of the early arrivals were, in fact, thrown into the Thames, when a Customs duty was imposed, and importers would not take it out of bond. At least, I fancy that the information collected by Mr Simmonds on this head refers to the Bahia sort as well as to that of Pará.

The first arrival of Pará Piassaba came to Liverpool in the form of a large bundle, that was made up in Pará as a "fender," to let down over the bulwarks, to prevent injury by collision or grazing against the sides of other vessels, the dock-gates or quay, &c. When the ship left Liverpool, the bundle of fibre was thrown upon the quay, and a working brushmaker took it and manufactured a few brushes from it. These were found to answer so well, that a firm afterwards imported a small quantity, which was eagerly bought up by some of the dealers; and a little time after this date (about seventeen years ago), the trade in this product began. A large number of sugar-vessels were loading in Bahia for Liverpool, and the captains requiring something to use as "dunnage," purchased through their agents in Bahia small quantities of piassaba tied up in bundles of about 10 lb. each; these bundles were packed between the sugar-boxes, which were about 10 to 12 cwt. each, and down by the sides of the vessel. It was at first almost unsaleable here, the nominal value being about 5*l*. per ton; but after a time the brush-manufacturers began to use the article more generally, and a good demand sprang up. Mr F. J. Eaton, of Liverpool, and Mr Robottom, of Birmingham, at once introduced it to all the brushmakers in the United Kingdom, and in a very short time received orders for the whole that was lying in Liverpool. Merchants, finding that the article was attracting attention, soon began to import small quantities, and each vessel brought from 5 to 20 tons; the price gradually increased, and as freights became lower large quantities were shipped, some vessels bringing as much as 100 tons. The article is now looked upon as a staple export, and is regularly quoted in the Bahia Prices-Current. One vessel just arrived in London has brought over 200 tons, and many vessels bring from 50 to 100 tons at a time. Of course, this is now brought on freight, and not, as formerly, for dunnage.

The nuts of the tree are also an article of commerce, long brought to England under the name of "coquillas" or coquilhos. Being excessively hard, beautifully mottled with dark and light brown, and capable of taking a very high polish, they are extensively used for turnery-work, especially in making the handles of bell-pulls, the knobs of walking-sticks and umbrellas, egg-cups, humming-tops, small boxes, and similar articles. The number of these exported from Bahia in 1851 and 1852 averaged 4,163 mille; and in 1853, '54, and '55, the annual exports were 2,200 mille.

Another *Attalea*, the commercial importance of which has only lately become apparent, is *Attalea Cohune* of Martius, the northernmost species of the genus. In the year 1854, Chief-Justice Temple, of British Honduras, in a communication to the Society of Arts, drew prominent attention to it, as likely to furnish a valuable article of trade.

"The cohune (written also cahoun) resembles in appearance the cocoa-nut palm; but it is not nearly so high as that tree, and the trunk is considerably thicker. The branches or leaves, instead of growing from the top, shoot up and radiate from the bottom. The order and regularity in which it grows is surprising. I have seen rows of it presenting the appearance of having been planted with the greatest care—long avenues which closely resembled the nave and aisles of a cathedral, the arched leaves meeting overhead, and producing an exact imitation of the vaulted roofs; and if the sun was declining, the horizontal rays, shining at intervals through one side of the avenue, created the splendid effulgence of the most richly-painted window. The tree bears nuts about the size of an egg, which grow in large bunches, and, from their size, form, and weight, remind one of those Dutch tiles on which were represented the Hebrew spies bending under the ponderous clusters of the Promised land. The kernel tastes somewhat like that of the cocoa-nut, but is far more oleaginous, and the oil extracted from it is infinitely superior. No other oil except that of the cohune and the cocoa-nut is burnt in this country; but a pint of the former will last double the time that the same quantity of the latter will. The cohune oil congeals at a temperature of 72°; the cocoa-nut, at 68°. There is no question whatever that if it were known to the public in general, it would completely surpersede the use of the cocoa-nut oil.

"Honduras consists principally of two kinds of land: the one is called a 'pine ridge;' the other, a 'cohune ridge.' The former is, generally speaking, sterile and sandy, and but here and there interspersed with patches of greater fertility, 'green spots' in the midst of a sandy wilderness, the resort of immense herds of deer and antelopes, the flesh of which bears not the least resemblance to the succulent, well-fed venison of England, but is dry, white, stringy, and an utter stranger to fat. This ridge—densely covered with pines, which are much more numerous than the red pines of North America—might yield any quantity of pitch, of an excellent quality, for commercial purposes. The cohune ridge differs materially from the pine ridge. The soil of the latter, as I have said, is sandy and unproductive; whereas that of the former is rich and loamy, and possesses every agricultural capability.

"There is no tropical plant which cannot be grown in great abundance upon these ridges. The cohune there abounds: for miles and miles you have nothing but forests of it; and yet, with all these trees, bearing nuts from which a most valuable oil can be extracted—an oil for which there would be a ready market in every town of Europe and America,—no one has yet been found to turn them to a profitable account. Over these vast fields of wealth, a few old negro women occasionally wander, picking up the nuts which have fallen accidentally to the ground, from which, in their rude and clumsy way, they manufacture as much oil, and no more, as will serve to satisfy their personal wants, and purchase for them a few luxuries—such as pickled pork and gin, pipes and tobacco.

"I should be glad if some enterprising individual would undertake to develop the riches of this country, and establish this new branch of trade. British Honduras contains numerous navigable rivers and creeks, and on the banks of all those rivers the cohune is found in abundance. The River Hondo, the New River, the Northern River, the Belize, the Sibun, Manatee River, Mullins' River, Sette River, Monkey River, Deep River, Golden Stream, Rio Grande, Moho River, and the River Sarstoan, are all navigable, and by these cohune oil could be conveyed from the place where it is manufactured to the sea."

Mr J. H. Faber, Crown Surveyor of Belize, a very intelligent gentleman who thoroughly knows the country, also speaks about this palm as follows:

"By the latest computation, the settlement of Honduras contains 37,500 square miles, of which, I do not hesitate to assert, two-fifths are composed of what is commonly called here cahoun ridges (corossales in Spanish). These corossales, or cahoun ridges, are mostly along the tracts of the rivers, and possess the richest virgin soil; some of them are only a quarter of a mile deep, while others extend to from twelve to twenty miles in depth. The cahoun trees grow at an average distance of five yards from one another, thereby forming arches of evergreens, which soften the rays of the tropical sun, and give a majestic air to those forests whose silence is only broken by the titter of bright-plumaged birds, or the solitary cries of some wild animal roaming in these wildernesses. The cahoun trees yield one crop every year; this crop consists of generally three, and sometimes four bunches of nuts, as close together as grapes; the nuts are of the size of a small turkey's egg, and on an average there are 800 nuts in one bunch. The people here extract oil from them in the following manner:—When the nuts are what they term full, they break between two stones the shell, which is very hard, then pound the kernel in a wooden mortar; the sediment is then put into a boiler with water, and boiled down until all the oil, or fat, floats; they skim the oil off, fry it in an iron pot, so as to disengage all the aqueous particles, and then bottle it. By this simple process the average yield is one quart bottle of oil from about one hundred nuts."

The General Manager of the British Sperm Candle Company, Fairfield Works, Bow, thus writes respecting the cahoun oil in the 'Journal of the Society of Arts:'—

"I have formed a very favourable opinion of the value of the cahoun nut oil (of which you were so kind as to send me a specimen) as regards its application to the manufacture of candles. I forward to you herewith a pair of candles which contain fifty per cent. of the oil; and having burnt another, I find that the light is white and steady. I consider the cahoun-nut oil superior to cocoa-nut oil for making composition candles; for the odour is more pleasant, and the compound is less oily. The best cocoa-nut oil is now selling in London at 2*l.* 11s. a cwt., and I think there would be no difficulty in selling the cahoun-nut oil at a higher rate in very large quantities."

Mr Temple also received the following testimony to the merits of this oil from Mr G. F. Wilson, F.R.S., the scientific Director of Price and Co.'s Candle Works, Belmont:—

"January 2, 1857.

"My Dear Sir,—We have now the pleasure to send you the results of a few experiments made to ascertain the exact commercial value of cahoun oil, which we find to be that of the highest quality of cocoa-nut oil, that which comes from the Malabar coast, and is selling at the present time at 51*l.* 10s. per ton. We send you specimens of the oil separated into its liquid and solid constituents, *coccinine* and *oleine*, and a little of the oil made into soap, which has all the very peculiar and characteristic properties of soap made from cocoa-nut oil. You may now rely upon cahoun oil being marketable in this country in *any quantity* at the price of the finest and purest cocoa-nut oil.

"Yours, &c., "G. F. Wilson.

"R. Temple, Esq."

All we know of the economical properties of the other species composing the genus *Attalea* is, that their leaves, like those of most palms, are used for thatch, and that their seeds are eaten by the natives of the countries in which they grow. The fruit of the *Attalea excelsa*, the urucuri of the Brazilians, is, according to Wallace, burnt, and the smoke employed to blacken newly-made india-rubber. The kernels of various other species of *Attalea*, when rubbed in water, form an emulsion, used by the inhabitants of Brazil both externally and internally.

VEGETABLE OILS AND FATS OF INDIA.

BY M. C. COOKE, F.S.S.

(Concluded from page 12.)

MUSTARD-SEED; KADAGHOO YENNAI, Tam.; AVALOO and SURSAVA NOONA, Tel.; RAYE KA TAEL, Hind. (*Sinapis sp.*)—Five or six species of *Sinapis* are cultivated throughout India for the sake of their oil, which is much esteemed in the country for cookery, for medicine, and for anointing the person; but it is not exported. The seeds, however, were shipped to the extent of 5,000 cwt. in 1848, and 16,000 in 1853. Mustard-seed yields about 20 per cent. of a brownish yellow fixed oil, with a faint smell and mild taste.

BUNGA SURSON (*Sinapis juncea*).—This species is cultivated for the sake of its oleaginous seeds at Tanjore, and in some other parts of the Peninsula Probably, some of the kinds which are here provisionally characterised as species, are in reality only varieties.

BLACK and WHITE MUSTARD (*Sinapis nigra, Sinapis alba*).—These two European species are also named as in cultivation in India. The seeds of *Sinapis alba* yield upon expression about 36 per cent. of a bright yellow, pleasant-tasted edible oil, having a strong smell and slight taste of mustard. The seeds of *Sinapis nigra* yield only 28 per cent. of a similar oil.

SHERSHA; SURSOO of the Punjab (*Sinapis toria*).—The species most cultivated in the neighbourhood of Meerut appears to be the above-named, which yields an oil similar to that of other species of *Sinapis*. It is also in cultivation in the Punjab.

SURSON; BURGA SURSOO of the Punjab (*Sinapis glauca*).—In the Chota Nagpore division, varieties of this species of *Sinapis* are cultivated, as well as in the districts of the Punjab.

PUNJAB RAPE (*Sinapis erysimoides*).—This is another of the species said to be cultivated in Northern India. If it is really a distinct species, it is of much more limited cultivation in the Indian territories than the majority of the others named.

RAEE, Beng.; BURLAI RAPE of the Punjab (*Sinapis ramosa*).—This is cultivated in the Punjab, and also in the Madras Presidency, as an oil-seed. It is one of the smallest of the seeds of *Sinapis*. *Sinapis rugosa* is another of the small-seeded species cultivated in India.

KALIE SURSON; TOREA of Punjab (*Sinapis dichotoma*).—This species, which is said to be the *Torea* of the Punjab, is cultivated there, as well as in other parts of India, as an oil-seed. This is doubtless a mere variety of *Sinapis glauca*. It is occasionally imported under the name of *Sursee*.

Our imports of mustard-seed of all kinds from India were, in

1855	4,835 cwt.	Value, £4,353
1856	38,870 „	54,418
1857	34,385 „	39,543
1858	50,396 „	76,925
1859	27,413 „	37,554

Myrobalan Oil; Kadukai; Haritaka; Umbedher; Hara (*Terminalia Chebula*).—The tree is found in the forests of Bengal, and is common in Mysore. The astringent fruit is employed in tanning and dyeing; the kernels yield in small quantities an oil which is occasionally extracted in India for medicinal purposes.

Beleric Myrobalan Oil; Tanikai; Bulla; Beheyra (*Terminalia Belerica*).—The tree is found in the mountainous parts of India, and is also common in Mysore. The fruit is astringent, but the kernels are eaten. They yield a small quantity of oil. I have been shown a semi-fluid and a rather limpid oil, both of which are referred to this source. It only appears to be of medicinal use in India.

Wild Almond; Budamie; Catappa, Malay; Nattoo Vadom; Ingudi, Sans. (*Terminalia catappa*).—This tree is probably a native of the Malayan Archipelago, but it is now extensively cultivated in India. The kernel of the fruit resembles an almond or filbert in taste and composition; hence it has been called the *wild almond* and *country almond.* It yields an excellent fixed oil, which is rather thicker and more amber-coloured than almond oil, for which it might be substituted.

Nagkesur; Naga Sumpunghee Oil (*Mesua ferrea*).—This promises to be a valuable oil, if it can be obtained in sufficient quantities. It is procurable at Canara at the rate of 4 rupees per maund, and the seed at 1 r. 8 as. per maund. It is used as a lamp-oil, and as a healing application to sores.

Noonee Gatcha, Tel.; Umul Koochi, Beng. (*Cæsalpinia digyna*, Rottl.)—According to Roxburgh, an oil is expressed from the seeds which is used for burning in lamps. The plant is found in Bhaugulpore and on the Coromandel coast.

Jadipootree; Jajikarra; Juephul; Nutmeg Butter (*Myristica moschata*).—This fat is prepared by beating up the nutmegs, enclosing the paste in a bag and exposing it to the vapour of water, and afterwards expressing the fat by means of heated plates. We do not know whether any deviation from this process takes place in India, where a little is manufactured. This fat, as met with in commerce, is said to be much adulterated, particularly with suet, spermaceti, marrow, wax, oil of Ben, coloured with alkanet, &c. Two kinds are at times met with,—one in earthen pots, of mace colour and agreeable smell: this is exported chiefly from the Moluccas to Holland. The second kind occurs in flat cakes, is far inferior, and is frequently adulterated with spermaceti.

Poondy-seed (*Myristica malabarica*).—The oil obtained by a similar process to that employed for expressing nutmeg butter from this wild species of *Myristica*, somewhat resembles in appearance an inferior sample of that substance. It was shown at the Madras Exhibition of 1855, but I am not aware that a sample has yet reached England. If successfully prosecuted, this may prove another source of adulteration for the nutmeg butter of commerce.

Nux-vomica Oil; Caringootry; Moovettie Cottay, Tam. (*Strychnos* *nux vomica*).—The oil known under this name is empyreumatic, and has only a medicinal application. It is prepared from the fresh nut in Travancore.

Wild Olive or Pootroojie Oil.—This is said to resemble olive oil, and to be obtained from an oleaceous tree growing plentifully in Canara and Mysore. We have never seen the oil or fruits from which it is obtained, but rather suspect that, instead of an oleaceous, it will be found to be the produce of an euphorbiaceous tree,—*Putranjiva Roxburghii*, Wall.,—which was at one time referred to another order. This tree is known in India under the name of *wild olive*, as well as *Olea dioica*, Roxb.

Napala; Caatamunaka; Junglie Erundie; Bhoga Cherinda, or Angular-leaved Physic Nut (*Jatropha curcas*).—This oil is employed not only medicinally, but also for lamps. It is, however, very local, both in its manufacture and use. It is a beautiful pale yellow oil, the *Katamanak* of Tanjore.

Bhoga Bhirinda, an inferior kind of oil from the same source, is known at Beerbhoom. The oil of this physic-nut has been of late years imported into Britain as a substitute for linseed oil; the colour is somewhat paler, it answers equally well, and can be obtained in parts of India where the plant abounds for almost the cost of manufacture. From the Cape de Verdes, quantities of the seed have been imported into Liverpool and expressed in this country. It seems to have met with considerable favour wherever it has been tried. The Chinese boil this oil with oxide of iron, and employ it for varnishing boxes.

Anthaulay; Addale, or Glaucous-leaved Physic Nut (*Jatropha glauca*).—The oil obtained from this physic-nut is locally employed in medicine. It will also answer the purpose of a lamp-oil, when obtained in sufficient quantity. In appearance and consistence it resembles castor-oil. It is procurable in South Arcot, where the plant grows on the waste lands.

Piney Tallow, or Hoopada Oil.—The vegetable butter of Canara is obtained from the fruit of an excellent timber-tree, the same which yields the piney varnish, or gum piney, known as *Vateria indica*. This butter is of solid consistence, beautifully white, and requires a higher temperature to melt it than animal tallows. It is produced all along the forests of the Malabar coast, and is easily accessible. It is prepared by cleaning the seeds, and then roasting and grinding them into a mass. Water is added, and the whole boiled until the oil rises to the surface, which is then removed, the contents of the vessel stirred, and allowed to stand until the following day, when more oil rises to the surface; this is collected, and the process repeated.

Pinnacottay; Hoenda; Oondee; Poonay, or Poon-seed Oil (*Calophyllum inophyllum*).—A thick, dark greenish-coloured oil, fluid at a temperature above 50°. It is manufactured and used at Bombay, Tinnevelly, and other parts of India, as a lamp-oil. The seeds from which it is obtained are very oleaginous, and yield about 60 per cent. of their weight of oil;

In Ceylon this oil is called *Domba*. *Keena* oil is obtained from another species of *Calophyllum*. The tree is known as the *Alexandrian laurel*, and is common in all parts of India. The oil is known in Canara under the name of *Houeh*, at Goa as *Oleum unda*, and in Cochin as *Perun Poonaka*. It has on one or two occasions made its appearance in the London market, but did not meet with a ready sale.

POOTUNJEE; CHEROO PINNAY, Tam. (*Calophyllum spurium*, Choisy).—This handsome tree grows very plentifully about Cunneepooram, north of Trevandrum. The fruit yields an oil called Pootunjee, which is employed for lamps. It is also used in leprosy and cutaneous affections.

POONGA; KURRUNJ, or KANAGU NUNE (*Pongamia glabra, Galedupa arborea, Dalbergia arborea*).—This oil is of a pale brownish colour, and is fluid at a temperature above 55°. It has a slight smell, which becomes more evident in the darker-coloured samples than in the pale sherry-coloured. It is expressed chiefly in Southern India, and is mostly employed in India for adulterating lamp-oil. It is known under the name of *Caringooty* in Travancore.

POPPY-SEED; KHUSKASH, Arab.; KOOKNAR, Pers.; CHOSA, Sans.; CASA-CASA NOONA, Tel. (*Papaver somniferum*).—The seeds yield by expression about 56 per cent. of a bland and very valuable oil, of a pale golden colour, fluid to within 10° of the freezing-point of water. It dries easily, is inodorous, of agreeable odour, and partially soluble in alcohol. The seed is worth about 61s. in the English market. The poppy is largely cultivated through Malwa and the opium districts, where this oil is more extensively used than any other, both for lamps and as food. By simple exposure to the rays of the sun in shallow vessels, the oil is rendered perfectly colourless.

PORTIA-NUT OIL; PARIS-KA-PUL; POURSUNGHAI, Tamul; SOOPARSHAVAKA, Sans. (*Thespesia populnea*).—This is a deep red-coloured and thickish oil, extracted from the seeds of the tree, which is abundant throughout the Madras Presidency. The oil is supposed to possess certain medicinal properties which render it useful in cutaneous disorders, for which the bright yellow juice of the tree is also employed.

BRUMADUNDOO; COOROOKOO; SHIAL KANTA of Bengal; PRICKLY POPPY; YELLOW THISTLE of Jamaica (*Argemone mexicana*).—The oil obtained from the seeds of this plant is pale yellow-coloured and clear, and is sometimes consumed in lamps by the natives. The plant now flourishes luxuriantly throughout India, though not originally a native. The oil is mild, resembling that of the poppy, and may be taken in one-ounce doses without producing purgative effects. In South America the oil is much used by painters, and for giving a shining appearance to wood. It has also been employed as a substitute for castor-oil, and is applied externally in headache by the native practitioners. It is cheap, and readily procurable in the bazaars of India.

RADISH; MOOLANGA YENNAY (*Raphanus sativus*).—This oil resembles the rape-seed oils, and is very limited in its production. The only locality we have yet seen named for it is Madras. It is of the colour and consistency of brown rape-seed oil.

RAMTIL; SIRGOOJAH, or VALISALOO; KALA TILL KA TAEL, Hind. (*Guizotia oleifera*).—This is a sweet-tasting edible oil, plentiful in Mysore, and is similarly employed to Sesame or Gingelly oil, but is not generally considered so good. The seeds yield about 34 per cent. of oil. In some parts of India its value is said to be about 10d. per gallon. Under the name of *Niger* seed, this fetches in the British markets about 50s. per quarter. It was first shipped to London experimentally in 1851.

VALUSA MUM (*Guizotia abyssinica*).—A sample of oil from Ganjam was exhibited in London in 1851, said to be afforded by the above-named variety of *Guizotia*, which may be identical with *G. oleifera*.

Under this name we have received a specimen of oil-seed which resembles that of *Guizotia*, but the difference in appearance is distinct. The seeds are longer, and reddish at the extremities. They are equally rich in oil.

RAPE (*Brassica rapa*).—Although we do not receive the oil, large quantities of seed are imported under the name of rape-seed from India, probably some of it the produce of species of *Sinapis*.

Bombay and Guzerat rape-seed is realising about 68s., and Ferozepore and Scinde 55s. to 61s. per quarter.

Our imports from India were, in

1855	139,916 qrs.	Value, £ 487,374
1856	251,890 "	" 736,778
1857	144,894 "	" 441,927
1858	157,780 "	" 420,466
1859	354,199 "	" 791,360

ROSEBAY, or VAPPAULEY (*Wrightia antidysenterica*).—The seeds of this tree are in great repute in India for their medicinal virtues, which the oil is supposed also to possess; hence it is employed only medicinally, and is obtained in but small quantities. It is thick and scarlet-coloured.

SAFFLOWER; KOOSUMBA; CHENDOOROOKOO YENNAI, Tam.; KURRUR, or COOSUM KA TAEL, Hind. (*Carthamus tinctorius*).—This is a light yellow clear oil, when properly refined or prepared; but when not so, it is thick and black, like cotton-seed grease. It is used in India for culinary and other purposes. The seeds are also exported under the name of *Curdee* or *Safflower* seeds. In Mysore and Bellary it costs about 2 rs. 8 as. per maund. This oil deserves more attention than it has hitherto received in this country; and if once fairly introduced, there is no doubt whatever of its becoming a staple import.

SANDAL-SEED; CHUNDANA PUSJHUM YENNAI (*Santalum album*).—The seeds of the sandal-wood tree afford a thick and viscid oil, which is burnt by the poorer classes of India in their lamps. The Mahomedans express a precious oil from the moist yellow part of the wood, which they value as a perfume. Large quantities of sandal-wood oil are annually exported from Madras: this is chiefly sent to Bombay, Bengal, and the Persian Gulf.

SAND-BOX TREE (*Hura crepitans*).—These seeds yield an oil, in common with the majority of euphorbiaceous plants; but it is very little extracted in India, probably only occasionally or experimentally. It is, however, an article of manufacture in the West Indies, to a limited extent. It probably partakes of the deleterious character of the tree.

SARAY PAROOPOO.—The solid fat of *Spondias mangifera*. It is obtainable at Madras, and was exhibited in 1855. The only sample I have seen resembled the yellow Bassia butter in appearance. It is not largely manufactured in India.

SAUL-TREE SEED (*Shorea robusta*).—This oil has only been obtained in small quantities. The tree is valuable, and affords a resin in use over the entire continent of India and Malayan Archipelago.

SILK-COTTON OIL; PANIA; ELAVUM, Tam.; POOR, Tel. (*Bombax pentandrum*, Linn.; *Eriodendron anfractuosum*, D. C).—A dark-brown clear oil is obtained by expression from the seeds of the silk-cotton tree. It is not much employed.

SOAP-NUT; POOVANDIE; POONGUM; RITAH; BINDAKE; ARISHTA; KOOCOODIE NOONA, Tel.; REETHAY, Hind. (*Sapindus emarginatus*).—This is a pale-yellow semi-solid oil, valued in medicine by the natives, but too costly to be otherwise employed.

SUNFLOWER OIL; SURJEA MUKTI (*Helianthus annuus*).—This oil is known in England, where it is employed chiefly in the manufacture of soap. It is also extracted in India.

TAMARIND-SEED (*Tamarindus indica*).—Capt. Davis of Booldana, in writing to the Agri-Horticultural Society of India, states that while trying as an experiment the extraction of oil from jungle-seeds, he happened to order a trial to be made of the seeds of the common Indian tamarind, and, to his great surprise, and that of all the natives, he obtained an oil of a fine amber colour, free of smell and sweet to the taste, which, in his opinion, would prove a substitute for the olive oil of commerce, so much in use in India for culinary purposes, and so frequently adulterated.

TOBACCO OIL (*Nicotiana tabacum*).—An oil extracted from tobacco-seed was exhibited from Tanjore at the Madras Exhibition of 1855, and a sample is also in the East India Museum.

TOOMA GINJALOO (*Acacia arabica*).—The pods of this tree, known as the *Babool* in many parts of India, have long been employed in tanning on account of their astringency, but the extraction of oil from the seeds is only of recent date. It must rather be classed among the experimental oils.

WILD MANGOSTEEN; TUMIKA, Tel.; GAUB, Hind.; PANICHEKAI, Tam. (*Embryopteris glutinifera*, Roxb.; *Diospyros glutinosa*, Kœn).—The unripe fruit is employed in tanning, and from the seeds a concrete fixed oil is obtained by boiling. The seeds are first dried in the sun, then pounded and boiled. The oil collects on the surface, and becomes concrete during cooling. It is of a yellowish colour, and is employed by the natives as a healing medicine. Probably it might be a useful oil for other purposes, if procurable in sufficient quantities.

There are many other oils and oil-seeds quoted in India, some only by their native names, others of very questionable utility, or only to be obtained in small quantities and at extravagant prices, which we have consequently omitted from this paper. If this effort at supplying a condensed list of the vegetable oils and fats of India is not considered as complete as it might have been, it presents, at least, for the first time in a collected form, the names and sources of all the more important of the oleaginous products of our Indian Empire.

ON TINKALZITE (BORATE OF LIME AND SODA), FROM PERU.

BY T. L. PHIPSON,

Phil. Nat. Doct. Bruxelles University;
Member of the Chemical Society of Paris, &c. &c.

The useful mineral of which I am about to speak was discovered only a few years ago in the deposits of nitrate of soda in Peru. It is now imported into Europe in considerable quantities as a substitute for borax. It was first examined in 1850 by M. Ulex, who found that it contained boracic acid, lime, and soda; but the analysis published by this author shows too small a quantity of water, and too much boracic acid. In 1859, M. Kletzinsky received some samples of this same mineral from the Western Coast of Africa, and the analysis he has made of them coincides pretty well with my analysis of some specimens from Peru.

Tinkalzite is found in the layers of nitrate of soda of Southern Peru, in the shape of globular masses, which the natives call *tiza*, and which vary in size from that of a nut to that of a potatoe. The outer crust of these tubercles is rather hard; but they are easily broken, and are then seen to be formed, in the interior, of a mass of crystalline needles, intersecting each other in all directions, and of a brilliant white satiny appearance. Often these globular masses contain reddish crystals of gypsum and other minerals; and they always contain a certain quantity of common salt, which gives to the mineral a brackish taste.

Water extracts from tinkalzite all its chloride of sodium and borax; acids easily dissolve the whole mineral, leaving only a small residue of very fine sand.

The density of tinkalzite I find to be 1·93 (according to M. Kletzinsky, =1·9212; and according to M. Ulex, the satin-like fibres =1·8).

The analysis of the mineral in question has given me the following result, by the side of which I have placed the analysis of M. Kletzinsky :—

	American Tinkalzite. Phipson.	*African Tinkalzite.* Kletzinsky.
Water	34·00	37·40
Soda	11·95	10·13
Lime	14·45	14·02
Boracic Acid	34·71	36·91
Chlorine	1·34	1·33
Sulphuric Acid	1·10	0·50
Silica	0·60	„
Sand	2·00	„
Phosphoric Acid	traces	„
Alumina	„	„
Magnesia	„	„
	100·00	100·00

The difference in the quantities of water, as shown in these two analyses, is owing to the gradual loss of water by soda-salts when exposed for some time to the air.

By neglecting the accidental elements, and calculating the water, soda, lime, and boracic acid, we arrive at the formula—

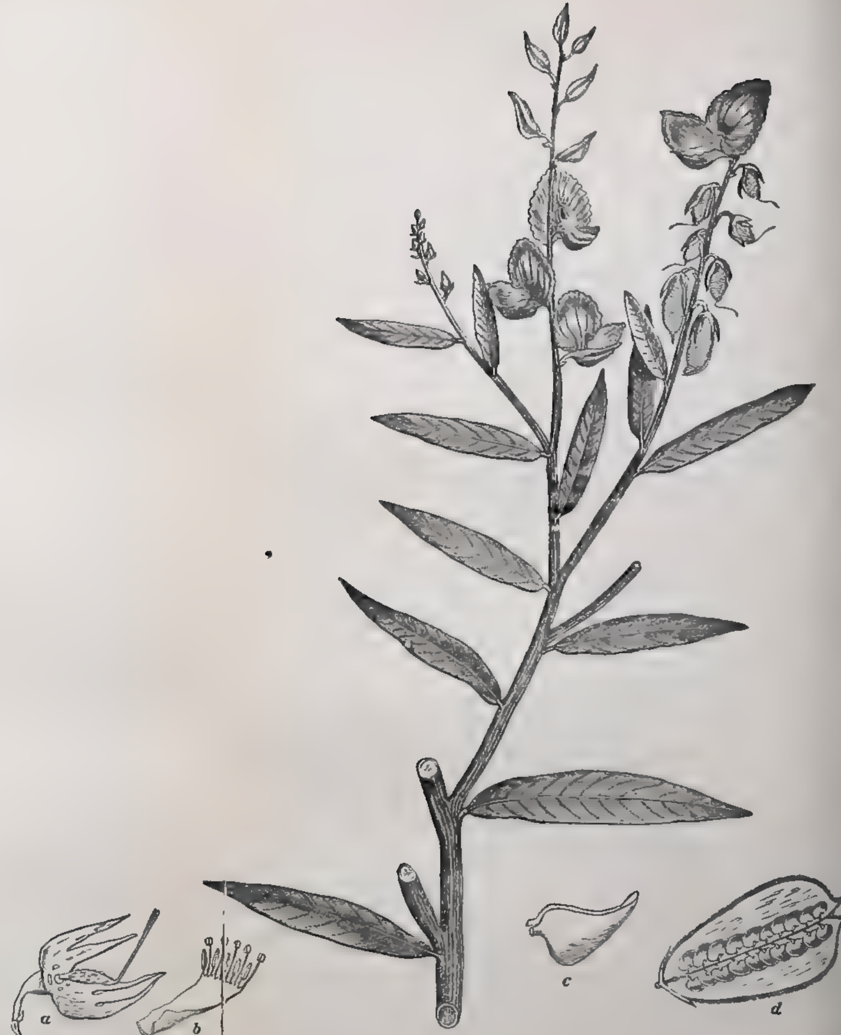
$$(\text{Na O, 2 Bo O}^3 + 10\ \text{HO}) + 2\ (\text{Ca O, Bo O}^3 + 2\ \text{HO}) + 2\ \text{HO}.$$

Borax. Borate of lime. Water.

The presence of the other substances given by analysis seems to indicate that this mineral has been formerly deposited by mineral springs; and the fact that the biborate of soda it contains has crystallised with 10 equivalents of water, shows that the temperature of these springs could not have been greater than + 55° (Centigrade). As it is imported from America for industrial purposes, tinkalzite contains about 60 per cent. of borax, 25 per cent. of borate of lime, and 2½ per cent. of chloride of sodium. It forms an excellent flux for metallurgical purposes, and has been employed with success in the porcelain manufactories of Sèvres by M. Salvetat. In fact, it appears capable of effectually replacing borax in all the applications of this rather expensive salt to industrial or manufacturing processes.

To extract boracic acid from tinkalzite, a given quantity of hydrochloric acid is diluted with water, and saturated while boiling with the pulverised mineral; the clear solution is decanted while hot, and, upon cooling, the liquid throws down the boracic acid in large quantities.

1.—JUTE (*Corchorus capsularis*).



2.—SUNN (*Crotalaria juncea*).

THE JUTE FIBRE OF COMMERCE.

BY ARTHUR ROBOTTOM.

There is no production of India that is so generally distributed over the world as jute, and a few remarks as to its culture and uses may not be uninteresting to the readers of the TECHNOLOGIST, especially as inquiry has been more directed to this staple since the great fire at Cotton's Wharf, where so much was consumed, the public generally having little idea what it is. No plant is more extensively cultivated throughout Bengal than jute; but it is only within the last twenty-five years that this product has formed such an extraordinary item in our imports from the East, or I may say from Calcutta, as the whole of this fibre is shipped from that port. In a paper like this, I must as far as possible dispense with minute details, as a large volume might be written upon this very important fibre.

The name jute is said to be derived from the Bengalee term *Choti*, which means false or deceptive—on account of the fibre having the appearance of beautiful silk when it is exposed to the sun for drying.

One plant which furnishes the jute of commerce is the *Corchorus capsularis* of botanists. This species is distinguished from all others by the capsules being globular, instead of cylindrical. An illustration is given of this plant, and of that which furnishes the Sunn hemp of commerce.

Another species cultivated in Bengal is *C. olitorius*. The fibres of its bark are also employed for making the coarse kind of cloth known as gunny (a corruption of *Goni*, the native name for the fibre on the Coromandel coast), as well as cordage for agricultural purposes, for boats, and even paper. This species is called in Bengalee, Blunjee pat; the other, Ghinatita pat. There is a wild variety called Bun pat. The fibre is long and fine, and might well be generally substituted for flax.

For the following account of the culture, I am chiefly indebted to an article on the Agriculture of Hindostan, in 'Simmonds's Colonial Magazine,' vol. ii., p. 284.

The ground is ploughed from the middle of February until the close of April, the operation extending to five or six double ploughings if the soil is aluminous, or only to three or four if silicious. Sowing is performed broadcast some time at the end of April or early in May, if sufficient rain has fallen to moisten the ground, which is generally flat. Two hoeings are necessary if the soil is light, but more if it is tenacious. As soon as the plants have flowered, in July or the beginning of August, being then from 4 to 13 feet high, they are cut. After the plants are cut down, their tops are clipped off, and 50 to 100 in number are bundled together, and tied round in lots; ten to fifteen of these lots are laid afterward in a shallow tank or reservoir, like rafts, over which a quantity of turf and clods of earth is placed to make it sink under the water. It is allowed to remain there for ten or twelve days, during which the cultivator daily visits it, in order to see that it is properly laid and the stems are not unduly rotted. When the bark is separated from the stalk and the fibres become soft, the weight upon the raft is removed and the stalks are unbundled. The dresser descends into the water knee-deep, and takes up five to eight sticks at a time; he breaks off about two feet of them at the bottom, which is called the "root of jute;" the bark, which is become soft like thread, is held in both hands, and the stalks are taken off. The fibres thus separated are dressed and exposed to the sun by hanging over bamboos; they are afterwards partially cleaned, and finally bundled or lotted in parcels of from one to two maunds weight for the market. One acre of land will produce about half a ton of jute; but after the jute crop is cleared off, the land will grow tobacco, rape or other oil seeds.

The lower parts of the bark nearest the root, which the hand has previously held, are so contaminated, that they are, as I have already stated, cut off as useless for jute fibre. These fragments, however, in themselves have their use: they are shipped from Calcutta to the United States for paper-makers, for preparing bags and such-like purposes, and even, it is said, distilled into whisky.

The great care requisite in watching the immersed jute until it almost putrefies is, to preserve the fine silky character so much valued in fibre intended for export. For local consumption in India such care is not taken in steeping, hence the article is stronger and more durable. The trade is very considerable. Besides the gunny-bags made from the fibrous part or bark, the stems of the plant themselves are used for charcoal, for gunpowder, fences, basket-work, fuel, &c.

To show the benefit that arises from extended intercourse with India, and the rapid progress that has been made since private enterprise has been allowed to enter the field, it may be stated that the price of jute has risen in Bengal from 12 to 14 annas (1s. 6d. to 1s. 9d.) per 100 lb. (the ruling quotation about twenty-five years ago) to 16 rupees (32s.) per 300 lb., the latest quotation in the 'Calcutta Prices-Current' of the Chamber of Commerce dated 1st July, 1861.

Mr P. L. Simmonds, in his new edition of 'Ure's Philosophy of Manufactures' (Bohn), which contains the best and most complete account of the import, trade, and manufacture of the great Textile Materials of Commerce, furnishes some most important and interesting statistical details respecting jute. The high price of flax of late years has led to the extensive use of jute in yarns hitherto purely flax or tow. The gradual increased imports of this fibre are shown by the following figures:—

	Cwt.		Cwt.
1853 - - -	275,578	1857 - - -	646,191
1854 - - -	481,733	1858 - - -	756,250
1855 - - -	539,297	1859 - - -	1,071,731
1856 - - -	731,093	1860 - - -	821,892
Average of 4 years	506,925	Average of 4 years	824,016

Some small portion of these imports consists of sunn (the fibre of *Crotalaria juncea*) and other hemp-like substances; but the chief quantity is jute. Nearly all imported is used in the kingdom, the reshipments not exceeding 12,000 or 15,000 cwt. yearly. Jute, which has long been extensively employed in the manufacture of coarse goods, such as cheap carpetings, bags, sacks, &c., is now employed in the manufacture of many fine fabrics in Dundee. It is mixed with the cotton warps of cheap broadcloths, and also with silk, and, from its lustre, can scarcely be detected. From 6,000,000 to 10,000,000 gunnies, or pieces of gunny-cloth, besides some thousand ready-made bags, are exported annually from India, chiefly to North America: 4,000 to 5,000 tons of fibre and rope made of sunn are also shipped yearly.

Although gunny-bags and gunnies are occasionally made from other fibres, still the proportion of these is so small that they may be disregarded.

Each gunny-bag weighs on an average 2 lb. The gunnies are usually in pieces of 30 yards, and weigh about 6 lb. In some years, nearly 270,000 tons of jute are exported from India, in the raw or manufactured state, or considerably more than the whole of the flax and hemp fibres consumed in this country. This brings out in a strong light the enormous jute production in India, since, in addition to what is exported, there is a large local consumption.

Jute is indigenous to the soil of India, and has been cultivated by the natives for their own manufactures for centuries. The extent of the demand is the only limit to the extent of the supply. The present export from India is but one-fourth part of the quantity cultivated for fibre. The whole supply is sent to this country through Calcutta. No vessel can load a full cargo of saltpetre, &c.: the cargoes are, therefore, usually completed with jute. There is not a town in the United Kingdom in which jute is not used, and for a great variety of purposes, such as clothes-lines, halters for horses, sail-lines, skipping-ropes, &c. &c.

Mr Henley, in a letter sent to the late Dr Forbes Royle, gives a most interesting account of the manufacture of this fibre in India; and from some of his remarks the reader will at once perceive how this article finds its way into nearly every house in England, in some form or other. After the jute has been dried and is ready for market, as described already, there is about one foot at the root which becomes brown and dark-coloured: this not being fit for export, is sold to the poorer inhabitants in Bengal, and gives employment to tens of thousands; and, to use the language of Mr Henley, we are led to believe that the manufacture of gunny-bags, or chutties, as they are called, employs all classes, and penetrates into every household. "Men, women, and children find occupation therein. Boatmen in their spare moments, husbandmen, palankeen-carriers, and domestic servants—everybody, in fact, being Hindoos (for Mussulmen spin cotton only), pass their leisure moments, distaff in hand, spinning gunny-twist. Its preparation, together with the weaving into lengths, forms the neverfailing resource of that most humble, patient, and despised of created beings —the Hindoo widow, saved by law from the burning pile, but condemned by opinion and custom for the remainder of her days literally to sackcloth and ashes, and the lowest domestic drudgery in the very household where once, perhaps, her will was law. This manufacture spares her from being a charge on her family; she can always earn her bread. Amongst these causes will be discerned the very low prices at which gunny manufactures are produced in Bengal, and which have attracted the demand of the whole commercial world. There is, perhaps, no other article so universally diffused over the globe as the Indian gunny-bag. All the finer and long-stapled jute is reserved for the export trade, in which it bears a comparatively high price. The short staple serves for the local manufactures; and it may be remarked, that a given weight of gunny-bags may be purchased at about the same price as a similar weight of raw material, leaving no apparent margin for spinning and weaving."

The gunny-bag or cloth is sent from Calcutta to Penang, Singapore, Batavia, and the whole of the Indian Archipelago, for packing pepper, coffee, sugar, &c.; to the west coast of South America, for nitrate of soda, borate of lime, regulus of silver, &c.; to the Brazils for coffee and cotton, and to the States for packing cotton only; in fact, it is superseding all other materials for this purpose. Thus it finds its way to Liverpool or London, and is sold to the wholesale dealer with the sugar, coffee, pepper, &c. When again disposed of to the retail grocers in the country, the bags are purchased from them by other people to make the bottoms of mats,—they buy jute to make the surface,—and these mats are sold all over the country. There are some people who make a good trade even by buying up the bags that have held the sugar, and selling them again to the ginger-beer or "pop" manufacturers, who first boil them to get out all the saccharine matter to sweeten this popular beverage, and then dispose of the bags to the matmakers.

I have been informed by a gentleman who has just returned from India, that the moment you step out of the palanquin, the bearers at once commence spinning "jute-root" into gunny, which is sold to make into bags. The demand for the gunny-bags has been so great, that a London company has established a large manufactory in Calcutta to make this bagging, and about 300,000*l.* has been already expended. With English ingenuity, steam power, and native labour, a most extensive and new business has sprung up. The writer has examined some of the bagging made by this company, and the quality is far superior to any of the same kind that is manufactured in England: there is no chance, however, at present of these bags coming into competition with those manufactured in Great Britain, as the demand is so great for local consumption and for export to other countries. Immense numbers are used in the Bombay and Madras Presidencies; and in Manchester large quantities of these gunny-bags are sold to the paper-makers, and for repacking.

Messrs G. and J. A. Noble state that while the quantity of jute imported into Dundee in 1838 was only 1,136 tons, it may now be estimated at 40,000 tons. With respect to the future supply of jute, we are able to state, on the authority of Dr J. Forbes Watson, that the growth of India is at least 300,000 tons, of which upwards of 100,000 tons are exported as gunny-bags, besides 40,000 tons in the raw state: it appears also that the better qualities are mostly retained for home use, and that the production admits of unlimited extension. We assume that, except in cases of natural monopoly, great demand is an essential condition of abundance and cheapness, and we therefore look upon the increasing wants of our manufacturers as the certain cause of a vast increase in the growth and importation of this useful commodity.

The following shows the comparative shipments of jute from Calcutta in the last three seasons (October to June inclusive) in bales:—

	1858-59.	1859-60.	1860-61.
To Great Britain - - -	356,479	235,138	283,775
France - - - - -	29,568	19,429	28,440
America - - - - -	15,768	13,694	20,441
Total - - - - - -	401,815	268,261	332,656

The present London wholesale prices (14th August, 1861) range from 12*l*. per ton for very ordinary, to 21*l*. for fine.

CAOUTCHOUC, OR INDIA RUBBER.

BY BENJAMIN NICKELLS.

II.*

Caoutchouc, in its chemical relationship to the hydrocarbon series, possesses many features of interest which claim the notice of men of science; yet little beyond "ultimate analysis," and examination of its physical characters, has been done towards furthering additional research.

Natural or native caoutchouc, as stated in a previous paper, exists in the form of a fluid emulsion obtained from numerous tropical plants. In examining this sap or juice, specimens of which are now common in this country, we find it to consist of a milky fluid, having the consistency of cream, and varying in colour from pure white, down to several shades of yellow. To preserve this fluid emulsion intact as collected from the plant, it should be sealed up in vessels carefully excluded from atmospheric influence; otherwise it speedily becomes covered with a pellicle of solid matter, which gradually increases in thickness until the whole of the caoutchouc has become separated.

The action of heat, as well as that of acids, causes rapid coagulation and

* See TECHNOLOGIST for July 1861 (vol. i., p. 382).

separation of the caoutchouc. The composition and density of the natural sap is by no means constant, possessing a variable amount of caoutchouc, which may be stated to average from 30 to 45 per cent.: the specific gravity also varies from 1·012 to 1·04125; and its composition may be represented by the following formula:—

Water containing free Acid - - - -	57·00
Caoutchouc - - - - - - -	33·10
Albumen - - - - - - -	1·00
Nitrogenised bodies soluble in water, variable -	6·10
Substances insoluble in water, variable - -	2·80
	100·00

Albumen, although existing in the sample from which this analysis has been made, is not at all times found in the juice, and the amount of caoutchouc is greatly influenced by the age of the plant from which it has been collected. After solidification and separation from the various substances associated with it, caoutchouc exists essentially as a pure carbide of hydrogen—

C.	87·20
H.	12·80
	100·00

and when freshly prepared and moulded into the various shapes and forms known in commerce, it is perfectly white and opaque. In this state it is surcharged with an acid moisture, and seldom presents a fresh cut surface or mass homogeneous, or free from minute air cavities or cells, almost imperceptible to the eye, and through which a gradual transudation of air and moisture readily takes place.

By age and exposure, caoutchouc loses this appearance, and becomes perfectly clear and transparent, resembling tortoiseshell both in colour and appearance. The moisture evaporates slowly, and this gradual loss causes the caoutchouc to shrink and contract. The air cells and cavities which were observable in its fresh state disappear, and it cannot again be made, under any condition, to take up an equal amount of water. Its specific gravity in this form also varies from 0·9190 to 0·9430; the produce of Java, Singapore, and Assam (*Ficus elastica*) being represented by the former, that of South America (*Siphonia elastica*) by the latter.

Caoutchouc in its solid state is a substance *sui generis*, possessing many specific properties, and approaching in its composition nearer to the essential oils than any similar substance. Microscopically examined, it presents neither definite form nor structure, resembling a mass or substance which may be likened to clear, transparent jelly. It is unaffected by water, alcohol, and most of the strong acids. Hydrochloric acid in the cold exerts no action upon it; neither does the same acid when aided by heat affect it to any sensible extent.

Concentrated sulphuric acid acts slightly upon the surface of caoutchouc, producing carbonisation and imparting a peculiar softness to the articles so treated ; aided by heat, it is rapidly decomposed with the disengagement of sulphurous acid, and complete destruction and carbonisation of the caoutchouc. Nitric acid of ordinary strength, contrary to general statements, exerts an action upon caoutchouc, and when aided by slight increase of temperature causes violent decomposition. Nitric oxide and nitrogen are evolved, while carbonic and oxalic acids are formed, the latter of which may be crystallised out of the solution. Chromic acid aided by heat also exerts a powerful action upon caoutchouc, reducing it to a soft and gelatinous substance. Concentrated solutions of the alkaline chlorides have been found to exert no action upon caoutchouc or any of its known compounds, even after immersion for several years. Metallic chlorides possess the property of acting in some peculiar manner upon its surface, imparting a softness and immunity from the otherwise rapid action of solvents and oils. Caustic alkalies exercise no action upon caoutchouc, even after long periods of immersion. Alkaline sulphides, under heat alone, produce an effect analogous to vulcanisation.

Caoutchouc is soluble in most of the fluid hydrocarbons ; coal-oil and its products, benzole and naphtha, ranking as the best : next in order we have bisulphide of carbon and perchloride of formyle (chloroform), and lastly, oil of turpentine. Oleaginous and fatty substances all more or less act upon caoutchouc, producing, in contradistinction to the first-named solvents, varnishes of a non-drying character.

Immersed in distilled water, caoutchouc undergoes no alteration beyond slightly increasing in weight, from 5 to 12 per cent. ; but after a few days' immersion, the parts most exposed to the water change their colour to a white or bleached hue : the stratum so affected is specifically heavier than the interior of the mass. This effect is caused by *a process of surface hydration, and not by the direct absorption of water; for under no condition, not even when aided by long immersion and extreme pressure, does water penetrate beyond a fractional distance into the substance of the caoutchouc.*

Immersed in water holding alkaline salts in solution, this hydration does not manifest itself in an equal degree, and has not been found to exceed more than 3 per cent.

It is quite a matter of question, whether this process is not due entirely to "endosmose," in place of the generally-received doctrine of absorption. Leopold Gmelin, in his 'Handbook of Chemistry,' vol. i., p. 28, (published by the Cavendish Society in 1848,) says, "Through any material *covered with caoutchouc*, endosmose proceeds from *alcohol to water*, first slowly, but afterwards quickly, when the caoutchouc has been acted upon by the alcohol : at the same time the alcohol becomes more and more dilute by the action of an opposite stream of water. A caoutchouc bottle filled with ether gradually empties itself in alcohol or water : if filled with alcohol, it distends in ether, but empties itself in water ; if filled with water, it distends when placed either in alcohol or ether. Hence, caoutchouc is more pervious to ether than to alcohol, *and lastly, water.*"

The most marked change in the alteration of caoutchouc is observed when it is suspended in the atmosphere and exposed freely to the direct action of the solar ray: it then undergoes a process of softening and direct oxidation, passing into a viscid mass, with the ultimate loss of elasticity and tenacity. In this state, analysis shows it to consist of—

C.	66·30
H.	11·25
O.	22·45
	100·00

and also to contain a soft resinous matter in variable quantities, averaging from 11 to 14 per cent., soluble in and extractable by alcohol. This change in its condition does not appear to be caused by any peculiar action of the solar ray, or actinism alone, the same effect taking place when it is similarily exposed to the red, blue, and yellow ray separately and at a temperature of 80° Fahr. Heat or increase of temperature, conjointly with light and atmospheric influence, *in the absence of all moisture*, appears to act as the chief exciting cause or agent in setting up this action; for it is observed that when moisture is present, the tendency to decomposition or oxidation is considerably diminished, *and when wholly immersed in water, so as to be perfectly excluded from atmospheric action, it is altogether checked, and never occurs.* Varnishes of an unoxidisable nature applied to the surface of caoutchouc also protect and preserve it intact, when thus exposed to the atmosphere.

We have observed that caoutchouc softens and becomes viscid when exposed to the sun; but this softening must not be confounded with a process of melting: the former result is due, as has already been stated, to direct oxidation with the formation of resin, while the latter requires an artificial temperature ranging from 240° to 250° Fahr., and in all cases varying with the description of material under trial. At this temperature, in common with most gums and resinous substances, caoutchouc begins to soften and melt, and upon the application of increased temperature, varying from 300° to 600° Fahr., it is totally decomposed; its constituent elements become broken up and re-arranged into new groups, having the form of oily fluids, differing considerably both in their density and boiling-points, and upon analysis affording nothing but carbon and hydrogen, differing in proportions only. Some of these oils boil at 90° Fahr., the lightest being highly limpid and colourless, with a specific gravity of 670; others have their boiling-points at 600° and 680° Fahr., and approach very closely to the composition of oil of turpentine, $C^{10} H^{8}$: little or nothing, however, is known concerning them.

Caoutchouc known as "masticated India rubber" is more prone to the direct action of the sun and oxidation than is the native or natural substance; but in this special feature much is due to the manipulation it has undergone. Excess of heat in this process causes considerable deterioration; incipient oxidation takes place with the formation of resinous matter, as shown by the following analysis :—

Before Mastication.	After Mastication.	Mastication under excessive heat.
C. 87·10	C. 87·73	C. 86·6
H. 12·90	H· 12·27	H. 11·3
		O. 2·1
100·00	100·00	100·0

"Caoutchouc is pervious to gases in the following order :—Ammoniacal gas, 1 minute; sulphide of hydrogen, $2\frac{1}{2}$ minutes; cyanogen, $3\frac{1}{2}$ minutes; carbonic acid, $5\frac{1}{2}$ minutes; protoxide of nitrogen, $6\frac{1}{2}$ minutes; arsenuretted hydrogen, $27\frac{1}{2}$ minutes; olefiant gas, 28 minutes; hydrogen, $37\frac{1}{2}$ minutes; oxygen, 1′·53″; carbonic oxide, 2′·40″. Caoutchouc appears from this to absorb gases with different degrees of facility: of carbonic acid it absorbs its own bulk, and swells up accordingly."—(Leopold Gmelin, 'Handbook of Chemistry,' vol. i., page 28; Cavendish Society, year 1848.)

In another article, we shall discuss the conversion of caoutchouc into a variety of products, new and old, which determine its importance in a technological sense.

NOTES ON KITTOOL FIBRE.

BY THE EDITOR.

Among the comparatively recent additions to our commercial imports is the kittool fibre, received exclusively at present from the Island of Ceylon, which has now become a recognised trade article.

Messrs Armitage, Brothers, and Co., of Colombo, were the first merchants who shipped the kittool fibre to this country, about the time of the Russian war, when so great an inquiry arose for all kinds of fibrous materials and substitutes for bristles; and it has since held its ground in public favour, in common with the Sisal hemp, or Mexican grass, as it was termed, obtained from the *Agave Sisalana*, introduced for brush-making about the same time. Messrs Darby, Butler, and Co., of Colombo, also now ship kittool largely. It comes home tied up in small bundles packed in gunny-bags, weighing about 28 lb. each. The fibre averages about 30 inches in length.

The lofty *Caryota* palm, which furnishes this fibre, is one of the largest and most charming of this beautiful tribe. It has a straight trunk, from 40 to 60 feet high.

In Ceylon the tree is called keetul, whence the corrupted name of kittool given to the imported fibre. On the continent of India it is known under the various names of Coonda-panna (Tam.); Erim-pana (Mal.); Teeroogoo (Tel.); Ramguoah, Bonkhejur, and Bura-flawar.

This palm is a native of the jungles of Malabar, Bengal, Assam, and various other parts of India, where it often grows with teak and wild mango trees. In Ceylon it is found in the south-western and Kandyan provinces. Humboldt has justly remarked, that the form of the leaf of *Caryota* is as singular among palms as that of the Gingko (*Salisburia adiantifolia*, Smith) is among *Coniferæ*. This singularity consists not only in the leaves being bipinnatisect, but also in their ultimate division, having the shape of the fin and tail of a fish; features so peculiar, that by means of it the genus *Caryota* may at once be distinguished from all other palms. The leaves are very large, measuring 18 or 20 feet in length, and from 10 to 12 across. They are attached to a strong skin as hard as a board, but full of fibres which are used as thread and made into cordage. Brushes, brooms, baskets, caps, and similar articles are manufactured of it. From the peculiar odour attaching to the kittool fibre on importation, it would seem to be steeped in cocoa-nut oil to darken it, and to make it more pliable and less brittle.

Within the last four years, large imports of the brown fibre in the natural state have been made; and it is steeped in rape-oil in this country to darken it and improve the quality. The strong brushes made with kittool are found well adapted for sweeping butchers' chopping-blocks, brewers' hogsheads, and such-like purposes.

Major Heber Drury, in his work on 'The Useful Plants of India,' states that "a fibre prepared from this palm is used for fishing-lines and bow-strings, which is the Indian gut of the English market. It is strong and durable, and will resist for a long time the action of water, but is liable to snap if suddenly bent or knotted."

In some 'Observations on the Vegetable Products of Ceylon,' by my friend Mr W. C. Ondaatje, surgeon, of Colombo, with a copy of which he has favoured me, he states that the black fibre from the leafstalks of the kittool is manufactured into rope, which is of great strength and durability, being used for tying wild elephants. The Rodyahs, or outcasts among the Kandyans, make this rope, generally with considerable skill, as it is both regular and compact. There is also a woolly material found in the petioles or base of the leaves, which is stated to be sometimes used for caulking ships. The leaves keep falling off as long as the tree continues to grow; but when it has attained its full growth, they adhere for many years to the stem, and so fresh ones are produced.

In Ceylon there are three varieties of kittool-gaha, the principal species of the palm (*Caryota urens*). The other two species of the genus, katu-kittool (*C. horrida*), and Do-talu (*C. mitis*), are also met with; but whether these furnish any of the kittool fibre of commerce, we have no definite information.

The kittool palm yields an uncommonly sweet sap of very pleasant taste and wholesome qualities. During the hot season, a single tree will often yield at the rate of fifty quarts of palm-wine in the twenty-four hours. From this juice, after boiling, a brown sugar called jaggery is prepared; and when particular care is used, it is scarcely inferior to white. The pith or farinaceous part of the trunk of old trees affords an article nearly as good as the ordinary sago of commerce, which is used in Assam as such. The natives make it into bread, and boil it into thick gruel. In Ceylon there is a distinct caste of natives, the Jaggeraroos, who take the name from all, male and female, being employed in the culture of the tree itself, or in the manufacture of the coarse sugar (jaggery) procured from it.

The split trunks of the kittool palm are used for rafters and window-bars, and are found very hard and durable. The seeds are used by Mahomedans as beads.

FOSSIL HYDRO-CARBONS, THE SOURCE OF LIGHT, HEAT, COLOUR, &c.

BY THOMAS D. ROCK.

In the entire range of Technological subjects, there is none more worthy of investigation than that I have selected for a few simple observations. Under whatever aspect I view my theme—whether it be the scientific history of the hydro-carbons, or their abundant and daily-increasing utility—I feel lost in wonder and admiration; and, impelled by a keen desire to make myself and others better acquainted with materials which play so important a part in the economy of daily life, I shall humbly strive to rescue from the dark and mysterious avenues of science such matters relating thereto, as shall be of special importance to readers of the TECHNOLOGIST.

Hydro-carbons are substances either solid, fluid, or gaseous, which consist altogether, or primarily, of the two familiar elements whence the name is derived, hydrogen and carbon. The latter body is ordinarily found in three special conditions,—viz., as amorphous, in certain coals which consist almost exclusively of pure carbon; as foliated or scaly, in graphite (*plumbago*), which contains as much as 95 per cent. of the same substance; and, in its most beautiful or crystalline form, as the diamond, which is considered to be pure carbon. Hydrogen is only known to man by its effects, and as the principal element of water. It does not exist in nature as a separate body, is with much difficulty disassociated from its intimate alliances, and even then, from its gaseous form, has no visible appearance.

From the earliest times man has appropriated the hydro-carbons for the production of artificial light and heat; although, possibly, without the knowledge that such combinations really constitute the only available source of these necessities of civilisation. The hydro-carbons which the ancients used were, however, entirely supplied by existing vegetation. The oil which they burnt in their lamps, and the wood with which they replenished their ovens, were all of recent formation; and such stores are still available in new and primitive countries. Colonists of Australia or

Canada may revel for a time in their supply of recent wood-fuel, or make gas from the grass-tree resins; but as population increases, and bears a greater relative proportion to the number of broad acres in those colonies, they, like ourselves, will come to the end of their visible resources, and have to fall back upon those hidden treasures which a Gracious Being has stored for the benefit of a too-often thankless offspring.

The principal fossil hydro-carbons are supplied by the mineralised or semi-mineralised remains of primeval vegetation. Trees and plants of former phases of this creation's existence, if not of former worlds, closely preserved and hermetically sealed, as it were, by surrounding matter, have retained their economic virtues; and, on being disentombed, readily yield up their latent properties to artificial heat, or are sometimes distilled in their secret resting-places by subterranean fires, and percolate in liquid streams of bitumen to the surface of the soil. These fossil hydro-carbons occur as coals, peat, and bitumen; and it is these substances exclusively which are to form the main topic of my paper.

We sometimes meet with opinions in opposition to the general impression that coals and bitumen are exclusively of vegetable origin. Animal remains in decomposition will undoubtedly produce certain substances analogous to those resulting from decayed vegetation; *i. e.*, certain combinations of the two elementary bodies, *hydrogen* and *carbon:* but such remains do not appear so abundant in any one spot as to constitute any sufficient source of these invaluable products. The power of locomotion possessed by animals, and the almost universally prevalent desire for solitude and seclusion in the times of sickness and extremity, would likewise militate against any large concentration of animal matter. Only an overwhelming deluge, sweeping millions of living carcasses into one common pit of destruction, could apparently supply matter for the elimination of bituminous substances, whether solid or fluid, in any noticeable quantities. I think, therefore, the opinions adverse to those commonly received may be dismissed as untenable.

It is in the vegetable laboratory that the hydro-carbons are elaborated. From the soil and from the atmosphere the raw materials are taken and combined in varying proportions by the invisible organs of plants; and of this fact we have much positive demonstration in the many saps and secretions of recent trees applied by man to the economic arts, which are nearly pure hydro-carbons.

EXAMPLES:

	Carbon.	Hydrogen.	Oxygen.
Gum Sarcocolla (Resin of) -	57·15	8·34	34·51
Rosin - - - - - -	75·94	13·34	10·71
Assafœtida - - - -	40·	26·	10·
India-rubber - - - -	87·20	12·80	
Gutta-percha - - - -	88·00	12·00	

The essential or spirituous oils are also, for the most part, combinations of these elements, and are chemically distinguished as the hydro-carbon oils. Sugars, starches, oils and gums, as well as the proximate principles of plants in general, are likewise mixtures of hydrogen and carbon, so universally prevalent in nature are these substances ; and it is not, consequently, surprising that fossil vegetation should be so largely composed of the same bodies.

An intimate relationship exists between the fossil and recent hydro-carbons : indeed, so far as those of vegetable origin are concerned, it is doubtful whether the former have undergone any very sensible modification by the mineralising process to which they have been subjected. If we distil wood, we obtain products almost precisely similar to those procured from coal,—as gas, tar, light and heavy oils, &c. : indeed, from this source, or from the saps of certain recent plants, even a supply of those hydro-carbons of modern discovery, and increasing interest, are forthcoming. Benzole can be obtained from gum benjamin, and other sources. Aniline is largely dispersed in indigo. Naphthaline also, which is the newest base of a beautiful blue colour, is equally found in wood as in coal naphtha.

It may then be argued, from the evident connection of the fossil and recent hydro-carbons, that the most obvious course would be to procure them, as it were, *first-hand;* but experience teaches us that although under favourable conditions, as to population and territory, we may derive light, heat, and colour from existing vegetation, yet that the hidden stores of hydro-carbon are far more generally available, and to England, at least, the only available source of supply. Coal is obviously cheaper than wood ; and the products of coal, whether natural or artificial, are necessarily less costly than any analogous substances obtained by man from recent plants.

The precise method by which wood is converted into coal is suggested by Thomson to be by a simple deoxidation of the former. "If," he writes, "we subtract from woody fibre $C_{36}\,H_{22}\,O_{22}$, 3 atoms H, 3 atoms H O, and "9 atoms $C\,O_2$, we get $C_{24}\,H_{13}\,O$—the formula for cannel or splint coal:" or, put into simple language, if certain quantities of hydrogen gas, carbonic acid, and pure water be abstracted or evolved from woody matter, the residuum is a certain sort of coal.

The relationship existing between the fossil and recent hydro-carbons is rendered still further apparent by the property of elasticity which both possess to a limited extent. Certain well-known saps from recent plants found in various parts of the globe are pure hydro-carbons, having great elasticity,—india-rubber, gutta-percha, &c. ; whilst, if we turn to the fossil world, we find a bituminous substance with the following composition—carbon 85·5, hydrogen 13·3, and likewise possessed of elasticity. This substance is elastic bitumen, or mineral caoutchouc, as it is advisedly called ; it will remove the marks of a graphite pencil precisely in the same manner as the vegetable caoutchouc, and, but for its great scarcity, it might possibly be utilised, and help to swell the supply of a material in many ways essential to the age in which we live.

I am not aware what effect would be produced by the dry distillation of the elastic gums of commerce, india-rubber, &c. ; but my impression is that sundry oils approximating more or less to those obtained from coals and bitumens would be the result, and possibly other hydro-carbons of equal utility to benzole, &c. : and if this surmise should prove correct, another link connecting the hydro-carbons of the past with those of the present would be established.

In how many ways, and for how long a period, have the recent hydro-carbons administered to the comforts and necessities of our race! "Wine that maketh glad the heart of man, and oil that gives to him a cheerful countenance," are compounded chiefly of these valuable ingredients; whilst the great bulk of our food, which is farinaceous, consists also primarily of the same elements. Odours the most enchanting, and flavours the most agreeable, owe their excellence to a combination of hydrogen and carbon, and it would require many pages to recount the numberless pleasures afforded to man's various senses by these products of recent vegetation; but I forbear, and return to my immediate subject, the fossil store, upon which man has not drawn largely until these latter times, although they now bid fair to rival the recent hydro-carbons in a variety of ways.

The ancients found an extensive use for the slime and bitumen which abound in Asia Minor and other distant countries. The very mortar that fixed the bricks in Babel's lordly tower consisted of this mineral pitch; and other minor applications of the rock-oils and solid bitumens were doubtless in vogue, although we have no historical account of such small matters.

Not many centuries have elapsed, however, since man first turned the fossil hydro-carbons to real practical account; whilst now, in addition to a vast variety of secondary blessings extracted from them, they supply us largely with heat, light, and colour—the latter a recent discovery of immense value, rendering the triple cord complete.

How beneficent a *design* the discovery of these invaluable deposits really develops, and how deep is the obligation of Britain to a Paternal Creator for such inexhaustible supplies of wealth and prosperity! England without her coal-mines would necessarily be limited both in population and power; and the continued and increasing well-being of this country is due, under the providence of God, to that fossil vegetation which appears to have been purposely stored to meet the exigencies of our island-home.

Light, heat, and colour, intimately associated as they are, and indissolubly bound together, we now extract from the unprepossessing and darkened vegetable remains of bygone worlds; and what interesting matter for reflection this curious fact really unfolds! Sir Isaac Newton's theory of colour involuntarily recurs to us. That great sage denied the existence of colour, except as a component part of pure light, and regarded the paints or pigments, which we commonly denominate colours, as simply substances possessed of certain modifications of form capable of separating particular colours, or shades of colour, from the rays of light. Assuming this theory to be correct, it is strange that of all the substances hitherto employed for the production of colour—those should prove the most efficacious, and the most durable, which are produced from the very same chemical combinations whence the light, which they in turn decompose, is derived.

The more practical part of my subject, as to the nature and application of the various fossil hydro-carbons, I propose to consider in a subsequent paper; but, before I close these preliminary observations, I wish to start a new theory into existence, which was suggested to my own mind by the fact that we are procuring light, heat, and colour from the fossil hydro-carbons.

It appears to be both possible, and even probable, that the light, heat, and colour which we receive from that great luminary which is the centre of our planetary system, originates also in hydro-carbon: and the scientific description of the glorious orb to which I referred rather confirms the idea. "It seems scarcely to admit a doubt," writes Dr Milner in his 'Gallery of Nature,' "that the sun is a solid body surrounded by two "envelopes, suspended in a transparent atmosphere; the upper one "luminous, forming the visible surface; the lower obscure, a layer of dense "clouds, highly reflective, throwing back the light of the upper regions. "In these strata temporary openings or rents are supposed to be made by "currents operating from below, analogous to the hurricanes and tornados "of our tropical districts. The altered appearance of the spots as they are "carried round by the solar rotation strikingly confirms the fact that they "are excavations. The variations are exactly those which depressions will "present in the course of rotation. Adopting this view, the nucleus of a "spot is the exposed dense body or solid substance of the sun; the "penumbra is the cloudy interior surrounding stratum; and the faculæ, "or bright ridges, are accumulations of the exterior luminous matter "heaped up by violent local agitation."

Such being a proper description of the sun, it provides every condition, or circumstance, necessary to the support of my theory. Moses informs us that "God made two great lights:" and why may not the light of the sun, which is the primary orb, be derived from large stores of coal or kindred substances deposited in its solid bulk; internal fire acting on the mass, and converting it gradually into a gas, which escaping through the large excavations or orifices called sun-spots, concentrates around the solar body in dense clouds like the dark interior portion of the flame of a candle, which is unburnt gas? The luminous or outer surface of the sun, like the outside portion of a candle's flame, may be the same dense gas undergoing the process of combustion; and the transparent atmosphere around, which in all probability consists of pure oxygen, would furnish the needful element for producing or sustaining combustion, since without oxygen the gas would not burn.

Upon this theory, the sun may be likened to an enormous lamp, suspended on its own axis, and replenished with a certain amount of inflammable gas, which is perhaps destined to last through a definite period, and then set for ever. I conjecture this, not because we have any hint in the Book of Revelation that the sun will cease to burn, but by reason of the statement therein given, that a time is approaching when the blessed will need no light of the sun nor of the moon, but the visible glory of Creative Power will shine with Divine effulgence on all around.

(To be continued.)

JAPAN LEATHER.

BY M. C. COOKE, F.S.S.

Having met with a material new to commerce offered for sale under the name of *Japanese Leather*, I at once ventured an opinion that it was not of animal, but of vegetable origin; not leather, but paper, or a paper-like substance saturated with some resinous fluid and rendered waterproof. The small specimen which I was able to obtain, scarcely more than an inch square, I digested for some hours in alcohol, which had the effect of extracting much of the extraneous matter employed in the preparation. The fabric then remaining was almost undistinguishable from the beaten liber of the paper mulberry (*Broussonetia papyrifera*) or the Tapè cloth of the South Sea Islands, except that it was still rather more compact, the fibrous tissue being held together by the remains of the preparation not removed by the alcohol. I afterwards boiled my miniature specimen in a strong alkaline solution, which had the effect of loosening the fibres, so that I could submit them to microscopical examination; the result being to strengthen my conviction that the base of this new material is a thin kind of bark cloth, similar to that manufactured in Tahiti and the surrounding islands; and it is exceedingly probable that it is obtained in Japan from the liber of the paper mulberry, the *morocco* pattern being given to the cloth by graining or in the beating, in the same manner that parallel ridges are formed on the Tapè cloth of the South Seas. There is even a possibility that this substance also is only a paper made of a very long fibrous stuff, such as the bark already alluded to, which is a common paper material in Japan. What are the adjuncts employed for saturating, colouring, and finishing the Japanese leather, had no consideration in my present examination, it being directed mainly to the basis itself. The result of this investigation will cause no surprise to those who remember the countless uses which the Japanese make of paper, of which this is but a variety, and the ingenuity with which they waterproof it so successfully that it is made into umbrellas and coats quite as impervious to wet as a macintosh, and very inexpensive. The Japanese leather is imported in sheets measuring about 19 by 13 inches, exceedingly like morocco leather on the face, and in various colours. Some sheets are embossed with more fanciful patterns. It is really a soft, tough, and apparently durable substance; although, from the novelty of its character, the price demanded, and the small size of the sheets, it has not at present met with a ready sale.

THE TECHNOLOGIST.

ON THE ESSENTIAL OIL OF PIMENTO FROM THE BERRY AND LEAVES.

BY DR L. Q. BOWERBANK.

The following communication was lately addressed to the Secretary of the Royal Society of Arts, Jamaica :—

"I forward a phial of essential oil extracted from the berry of the pimento. The process of extraction was this :—A handful of the spice as it is prepared for market was placed in a glass retort with half a pint of water, the neck of the retort luted to the receiver, and the flame of a spirit-lamp applied to the retort. The vapour arising, on being condensed, assumed the form of a milky liquid, which, on being suffered to remain quiet, separated into globules of oil, which sank to the bottom of the vessel, leaving the water transparent: that being decanted, left oil.

"Bryan Edwards, in his 'History of the West Indies,' thus notices the oil of pimento:—'It is remarkable that the leaves are equally fragrant with the fruit, and, I am informed, yield on distillation a delicate odoriferous oil which is commonly used in the medical dispensaries of Europe for oil of cloves.'

"There is nothing new in the fact of the pimento producing an essential oil; but at this period the attention of the public, which is now excited by the consideration of the minor productions of Jamaica, may be beneficially directed to this branch of profitable industry. A large quantity of leaves are annually wasted while the crops of pimento are being gathered. Were it generally known and appreciated that a valuable product might be cheaply and easily extracted from such portions of the tree as are now suffered to remain useless, much good might result. It would open to the industrious man in humble circumstances a daily source of profit; for a very small still of a few gallons, daily set in motion by his kitchen-fire, would yield a considerable return at the year's end. And where, in this Isle of Springs, can water and the leaves of pimento not be procured ?—where

———'Sabean odours from the spicy shore
Of Araby the blest'

abound.

"Further information from the Society on this subject, regarding the marketable value and demand of this oil, as well as the cheapest process for extracting it in considerable quantities, cannot fail of being useful to the public."

In reference to the above communication, we would make the following remarks :—

Pimento-berries bruised and distilled with water yield the pimento-oil of commerce. This oil is officinal in the Pharmacopœias of the London, Edinburgh, and Dublin Colleges.

Dr Royle states that, "it is obtained in the proportion of 1 to 4 per cent. by distilling bruised pimento with water. It resembles, and is sometimes sold for oil of cloves, or employed to adulterate it."

Dr Pereira, in his work on Materia Medica, observes — "Mr Whipple informs me that from 8 cwt. of pimento, he procured 41 lb. 6 oz. of oil (heavy and light): this is nearly 6 per cent. He also informs me that the light oil comes over first. The oil of pimento of the shops is a mixture of these two oils. By distillation with caustic potash, the *light oil* is separated ; the residue, mixed with sulphuric acid and submitted to distillation, gives out the *heavy oil.*

"*Light Oil of Pimento* (Pimento Hydro-carbon) has not to my knowledge been previously examined. Its properties appear to be similar to those of the light oil of cloves. It floats on water and on liquor potassæ, and is slightly reddened by nitric acid. Potassium sinks in, and is scarcely if at all acted on by it.

"*Heavy Oil of Pimento* (Pimentic Acid), very similar to caryophyllic acid or the heavy oil of cloves. It forms with the alkalies crystalline compounds (alkaline pimentates), which become blue or greenish on the addition of the tincture of chloride of iron, owing to the formation of a ferruginous pimentate. Nitric acid acts violently on, and reddens it."

The medical uses of the oil of pimento are very limited. It is sometimes employed to relieve toothache, to correct the operation of other medicines, as purgatives and tonics, and to prepare the officinal essence, spirit, and distilled water of the Pharmacopœias. The Edinburgh College directs the spirit of pimento to be prepared by distilling the bruised berries with spirit ; and the same College, together with the London, obtain their distilled pimento-water by distilling the berries with water.

The following is an analysis of the husks and kernels of pimento, as obtained by M. Bonastre in 1825 :—

	Husks.		Kernels.
Volatile Oil	10·0	....	5·0
Green Oil	8·4	....	2·5
Solid Fat Oil	0·9	....	1·2
Astringent Extract	11·4	....	39·8
Gummy Extract	3·0	....	7·2
Colouring Matter	4·8	....	——
Resinous Matter	1·2	....	——
Uncrystallised Sugar	3·0	....	8·0
Malic or Gallic Acid	0·6	....	1·6
Lignin	50·0	....	——
Saline Ashes	2·8	....	1·9
Loss	1·6	....	1·8
Red Matter insoluble in water	——	....	8·8
Pellicular Residue	——	....	10·0
Brown Floccule	——	....	3·2
	100·0		100·0

We were not aware that the oil had hitherto been prepared from the leaf of the pimento, but have little doubt that this can easily be effected; in fact, we find, on reference to Dr Pereira's work, that an analogous oil is obtained in Ceylon from the cinnamon leaf—" oil of cinnamon leaf." It is exported from Ceylon, and is sometimes called, on account of its odour, *clove-oil.* " I am informed by a gentleman," adds Dr Pereira, " on whose estate in Ceylon it is obtained, that it is procured by macerating the leaves in sea-water, and afterwards submitting both to distillation. It is a yellow liquid, heavier than water, and has an odour and taste analogous to those of oil of cloves."

We fear the consumption of pimento-oil is too limited to render it an object of manufacture on a large scale; but, as our correspondent justly observes, instead of wasting, as at present, the leaves and young shoots broken off in gathering the berry, it would be well that they should be turned to some good account. We know of no finer liqueur or dram than that prepared from the pimento-berry, and we have been informed that a dram no way inferior can be obtained by substituting the leaves for the berry. We would suggest that a trial should be made.

While on the subject of Pimento, it may be observed that the true bark of this tree at certain periods of the year appears to contain a very large quantity of tannin; and we find that it is a common practice to bury pimento-sticks in the red iron clay, by which means, through the tannin contained in them combining with the iron of the soil, they become stained of a deep black colour. When cutting down trees for the purpose of thinning or opening out a pimento-walk, it would be worth while to collect the bark, in order that its astringent or tanning properties may be tested.

For purposes of cookery, we have often observed twigs of dried pimento-leaves suspended in kitchens: these leaves retain their aroma for a long time. Would it not be worth while to make them an article of export as a substitute for the berry, more especially when the usual crop is short or fails?

Kingston, Jamaica.

SOME ACCOUNT OF THE TREHALA, A NEW INSECT PRODUCT.

BY H. MOQUIN-TANDON.

The *trehala*, or *tricula*, is a singular case which is well known in Constantinople and in some parts of the East. At the last Great Exhibition, some of these cases were sent from Turkey by M. Della Sudda as a particular species of Manna, without any other explanation appended to them than the word "trehala." This production is described in the Persian Pharmacopœia of Brother Auge, of Toulouse, under the name of *schakar tigal*, which means *sugar of nests*. It was at first supposed that the trehala was obtained from an onopordon. It was afterwards ascertained that it grows on the branches of a Syrian echinops (Decaisne). It is produced by an insect, and is found principally in the Desert between Aleppo and Bagdad (Bourlier).

The insect is neither a Cynips nor an Aphis, but a tetramerous Coleoptera, belonging to the family Rhyncophora; it belongs to the genus Larinus, and has been named by M. Chevrolat *Larinus subrugosus*. It is closely allied to the *Larinus onopordonis*, Germ. The *Larinus subrugosus* is of an oblong form, and of a black colour; it has a projecting snout, to the middle of which the antennæ are attached. The elytra cover the whole of the posterior part of the abdomen; they are oblong, and terminate each in a soft and slightly-recurved point. Their surface is marked by ten punctated lines, which commence at the anterior margin, and unite before reaching the opposite extremity.

The case is of an oval form, and attached in the direction of its length to a branch of the tree. Its greatest diameter measures from $\frac{6}{10}$ to $\frac{8}{10}$ of an inch in length; its external surface is very irregular, and of a light-grey colour. The under surface is flattened, and marked by a deep groove where it was attached to the branch. When separated, a large circular hole is found at one extremity, by which the insect escaped. The cavity of the trehala is large, and the perfect insect is often found in it just ready to escape. The internal surface is smooth, and of a whitish or reddish colour. Its tissue is not very thick;

it is irregular, hard, and has an amylaceous appearance. It cracks when bitten, has a sweet taste, and yields mucilage. In water, at the ordinary temperature, the trehala swells, but only partially dissolves, and changes into a mucilaginous mass. Iodine changes it to a blue colour, and in some cases to that of red wine. Analysis shows that it contains gum, a particular kind of starch which is much less soluble in water than that from the potato, and a new kind of crystallisable sugar, analogous to that from the sugar-cane, but much more solid: M. Berthelot has given this the name of *trehalose*. It is during the larval stage of its existence that the *Larinus subrugosus* constructs this curious kind of case. Does the trehala result solely from a wound inflicted by the insect? Is it an excrescence similar to the galls produced by the Cynipidæ, and to the cases of the Aphides? Or is it a nest which is made by the *Larinus?* M. Guibourt admits the second mode as the way in which it is formed. A circumstance which supports this opinion, is the fact that the trehala is not attached by a point or pedicle like the galls, but is fixed along its whole length by the groove which embraces the point of support. It appears that the larva of the *Larinus* collects a considerable quantity of saccharine and amylaceous matter, which it procures from the echinops, and that it constructs its dwelling by disgorging this matter and moulding it with its rostrum. M. Bourlier thinks that the formation of the sugar which is found in the case might be explained by the presence of albuminous matters in the saliva with which the insect binds together the starchy materials. Brother Auge and M. Guibourt think that the nest serves the *Larinus* for a habitation during the whole of its life: I am, however, inclined to believe, with M. Bourlier, that the insect emerges after it has assumed its perfect form. If it were otherwise, how could copulation take place, since each *case* contains only one individual? Moreover, most of the nests which I have examined were pierced at one end, and were empty. The trehalas are generally collected before the animal has escaped. In Turkey and Syria, a decoction is made of the nests of the *Larinus*, by breaking up about an ounce of them, placing the pieces in a pint and a half of boiling water, and stirring them for a quarter of an hour. This preparation is given to persons in affections of the respiratory organs, particularly those who are attacked with bronchitis. The trehala is also employed as food. The use of it is as universal in the East as that of salep and tapioca is in France.

A closely-allied insect, the *Larinus odontalgicus* of Dejean, out of which the genus *Rhinocellus* has been formed, has obtained a reputation as an odontalgic (Gerbi, Latreille). Some species of *Carabidæ*, *Chrysomelidæ*, and *Cochinellidæ* have been mentioned as possessing similar properties (Caradori, Hirsch).

WOODS OF THE INDO-BURMESE PROVINCES.

BY M. C. COOKE, F.S.S.

The somewhat vague title of this paper is intended to include under one general name the maritime provinces lying immediately to the east of the mouths of the Ganges; *i. e.*, Arracan, Prome, Tounghoo, Tharawaddee, Benzada, Bassein, Rangoon, Martaban, and the Tenasserim provinces. Each wood is noticed as briefly as possible, so as to restrict the list within a reasonable space. It is believed that the present will be found to be the most complete catalogue yet attempted of the woods of these provinces.

AIN, or AINTHA (*Dipterocarpus grandiflora*).—An immense tree, found at Tavoy and elsewhere.

AING (*Dipterocarpus alatus*).—Light-brown. Found in the Tounghoo and Prome districts; excellent for housebuilding, especially posts. It is the *Battee sal* of Bengal.

ANAN; ANNAN-THA (*Cyrtophyllum fragrans*).—Yellowish-white. In the Tenasserim provinces. One of the hardest and most compact woods known. The Burmese think it too good for any but sacred purposes. Neither heat nor moisture will warp or rot it; it is impervious to the attacks of ants, and the teredo will not touch it. Employed for piles, posts, housebuilding, &c.

BAIBYAH; BAHAI-BYA (*Conocarpus robustus*).—White. Plentiful in Pegu, Tounghoo, and Prome forests, with teak. Very large and strong timber. Useful for furniture, and might become available in shipbuilding.

BANBWAI; BANBOAY; BHAN-BHWAY; BAMBOOEE (*Careya arborea*).—Red. Very common in Burmah. Timber large. Chief material of which the carts of the country are made. Very useful wood.

BEE-EW.—Trees abundant near the sea all over the provinces. The wood is strong and hard. Employed in rice-mills wherever strength and durability are required.

BOKEMAIZA (*Kydia calycina*).—White wood, plentiful through the forests, especially in the Pegu and Tounghoo districts. Small saplings are used by the natives for banghy-sticks; it is large enough to afford timber of 3 or 4 feet girth.

BONE-BAYAZA (*Excecaria agallocha*).—White. Found in the Rangoon and Tounghoo districts, plentiful.

BONG-LONG-THA.—Found all over the provinces. Durable, yet light, with a straight grain. Much employed by the Burmese.

BOOK-THA.—Found on the sea-coast from Amherst to Mergui. Used by the Burmese for helves, but rots quickly.

BWAI-JIN; BIJION (*Bauhinia parviflora*).—White. Plentiful throughout the Tounghoo and Prome forests. Girth 3 to 4 feet. Applicable for house-work. It is heavy and compact.

BWAI-JIN (*Bauhinia brachycarpa*).—White. Found in the forests of Prome and Tounghoo. Not very large but useful timber for fancy-work.

BYEW (*Dillenia scabra*).—Light-brown. In the forests of Pegu plentiful. Large and good timber for housebuilding.

BYITZIN (*Antidesma paniculata*). — Red. In the Rangoon, Pegu, Tounghoo, and Tharawaddy forests. Small crooked timber, of close grain, for cabinet-work.

CAMBALA (*Sonneratia apetala*).—Red. Found throughout the Sunderbunds. A strong, hard wood, of coarse grain. Used for packing-cases.

CARRAWAYTHA, or SASSAFRAS (*Laurus sp.*). — Not very abundant. Used for interior work of junks, drawers, boxes, &c.; and has a smell which repels insects.

CHAI-BIN (*Semecarpus anacardium*).—White. Common in the Pegu and Tounghoo forests. Middle-sized. Useful for cabinet-work.

CHEE-NEB, or STINKING WOOD.—Found in Tavoy and Mergui. A long fibred tough wood when new, but rots readily. Used for boxes and cases.

CHIN-ZOOAY.—Found inland in mountainous districts, where it is abundant. The wood is the hardest and strongest known in these latitudes. Useful for planes, spoke-shaves, &c. It is seldom large.

DOUK-YAL (*Photinia serratifolia*).—Red. Found in the Rangoon district, in the direction of the teak-forests. Furniture-wood.

DAGOO-THA.—Abundant in Tavoy and Mergui. Used for boatbuilding, planks of houses, &c.; but is rather liable to be attacked by worms.

DOUKYAMAH (*Dalechampia pomifera*).—Red. Found on the Pymmah Choung, in the Pegu valley. Girth from 3 to 4 feet. Useful for cabinet-making.

DOUN-DALOUN (*Indigofera sp.*).—White. In the Rangoon and Tounghoo districts. Girth 3 to 4 feet. Scarce.

EING-GYEEN; ENG-GYENG (*Shorea robusta*).—Light-brown. Found in the forests north of Tounghoo, and at Amherst. It is the Sal, or Saul, of India. Used for posts.

ENG-BENG.—Woods of Tavoy. A strong wood, used for common carpentry.

GONGOO, or GANGAW.—Found near Mergui, and along the coast as far as Amherst. Hard, tough, durable wood, used by the Burmese for chairs and tables.

GWAI-DOUK (*Connarus speciosa*).—White. Plentiful in all the forests, growing with teak in the Tounghoo district and in Pegu. Large, heavy, strong timber. Worthy of a trial in shipbuilding.

GYEW.—Found in the jungle around Moulmein. Highly approved by the Burmese, by whom it is largely employed.

HSAI-THAN-BAYAH (*Geloxium bifarium*).—White. Found in the Rangoon district. Seldom more than 3 feet in girth. Only fit for house-posts.

HSEIK-KYEE (*Sapindus rubiginosa*).—White. Tree not very plentiful. Found in the Pegu district. Girth 3 to 4 feet. Tall and straight; useful for housebuilding.

HYEE-BIN (*Zizyphus jujuba*).—Dark-brown. Scarce in the Pegu and Tounghoo forests. Ornamental work.

IN-JIN-PEWOO.—White. Abundant. Light, perishable, and only fit for firewood.

JOE-BOE (*Walsura piscidia*).—White. Plentiful in the Pegu and Tounghoo forests, as well as the Tharawaddy forests. Timber large, heavy, and strong. Deserves a trial for shipbuilding.

JOUK-BIN (*Elæodendron integrifolia*).—White. Found through the forests of Tounghoo and Pegu, as well as at Rangoon. Plentiful, strong, fine timber, and deserving a trial for shipbuilding.

KABBAN-THA.—Found inland in Amherst and Tavoy. Makes beautiful furniture; and it is stated that when buried in ferruginous mud, it becomes of a very dark red. It also makes excellent planes, and is employed in constructing carts. A quantity was exported to Holland in 1857 as a furniture-wood.

KANAZŒ; KUNNAZOO (*Heritiera litoralis*).—Red. Common in the Rangoon districts and Tavoy. Strong timber, suitable for housework.

KANARJOE (*Pierardia sapida*).—Dark-brown. Plentiful in the Pegu and Tounghoo forests, as well as at Rangoon. For ornamental work.

KA-NYENG-PYAN; KUNNEAN-PHIN (*Dipterocarpus sp.*).—A heavy grey wood, used as timber. Found at Tavoy.

KA-MEEN-THA.—Abundant all along the sea-coast. Used for posts and planks of houses. Durable, but too easily split.

KA-THEET-THA.—Very abundant, light and perishable. Only fit for firewood.

KAUYEEN; KA-NYENG-KYAUNG-KHYAY; KANYEEN THA (*Dipterocarpus lævis*).—Light-brown. Found in nearly all the Burmese forests. Timber of great size and strength. Chiefly employed for rafters and in boatbuilding; is not attached by insects. An inferior wood.

KAYOOBIN (*Terminalia Chebula*).—Red. Plentiful in the Burmese teak-forests. Timber large, and useful for housebuilding.

KHA-BOUNG (*Strychnos nux vomica*).—White. Common in the forests of Burmah. Timber strong and close-grained, never very large. Employed for cabinet-work.

KHA-MOUNG-THA.—Very abundant. Light, and useless except for firewood.

KHAI-YAH.—This is a scarce but tolerably good wood.

KHAYAU-KAYOE (*Amoora (Aglaia) rohitoca*).—White. Found in the Tounghoo forests. Scarce. Useful for housebuilding.

KHWAY-THA-BYAI (*Eugenia pulchella*).—Red. Plentiful in the Pegu and Tounghoo districts. Close-grained, strong timber. Subject to the attacks of the white ants.

KOBIN (*Melicocca trijuga*).—Light-brown. Found on the banks of the Sitang, in the Kareen forests, above Tounghoo; also throughout the Pegu and Tounghoo forests in abundance, and with teak in Tharawaddy and Prome forests. Valuable timber. Employed by the natives for cart-wheels, oil-mills, and other purposes requiring strength and solidity.

KOUNG-MOO.—Found near Moulmein, Tavoy, and Mergui, on the coast. It is not a good wood, being soft and perishable.

KUSSOO.—Nearly white. Abundant near the sea. Maximum length 15 feet. Very tough, durable, and good for helves.

KYAI-GYEE (*Barringtonia speciosa*).—Red. Abounds in the Pegu districts. Hard and compact wood, used for building carts.

KYA-MOUK.—Stated to be a kind of oak. Found all over the provinces inland. An excellent tough wood, used for handspikes, casks, cavady-poles, &c.

KYAI-YEW.—Found along the banks of the rivers. Brittle, but sometimes employed for posts. Used principally for making charcoal.

KYAI-THA; KYWAY-THOAY; KYEE-THA; KYAY-MISHOUNG; ITCHWOOD (*Barringtonia acutangula*).—Red. Plentiful in the Tharawaddy district and Amherst. Wood is hard and of fine grain. Used in constructing carts, and for rafters.

KYANNAN; KEANNAN; KANNAN-THA (*Xylocarpus sp.*).—Red. Found near Mergui. Durable wood. Used for musket-stocks, spear-handles, &c.

KYANAN (*Syndesmus Tavoyana*).—Moulmein and Tavoy. Banks of rivers, in the province of Martaban, near the sea. Tough, light, and durable. Used for planes, spears, &c.

KYET-THAY.—Found on the sea-coast from Amherst to Mergui. Used for posts of houses, but is liable to split.

KYE-YO-THO.—Abundant at Mergui. Smooth-grained, close, tough, but not heavy wood. Durable, but small. Appears to be identical with Trincomallie wood.

KYE-ZAI (*Laurus sp.*).—Along the coasts from Amherst to Mergui. Very tough and durable; has been experimented upon, and found remarkable for strength and tenacity.

KYOONBOE (*Gmelina arborea*).—Yellow. Plentiful in the Pegu and Tounghoo forests. Large and remarkably strong, tough timber, for cabinet-work.

LAIBWAI (*Terminalia violata*).—White. Plentiful throughout the Pegu, Tounghoo, and Tharawaddy forests. Large and useful for housebuilding.

LET-PAN (*Eriolæna tilifolia*).—White. Grows plentifully throughout the Pegu and Tounghoo districts, attaining a height of 50 feet, with a girth of 7 or 8 feet sometimes, usually of about 6 feet. Strong, tough timber, useful for housebuilding.

MAI-KAY.—(*Murraya sp.*).—Abundant in Tavoy. Used for knife-handles and such purposes. It is a strong, tough wood, in grain like boxwood.

MAY-SHOUNG.—Found on the coast, from Amherst to Mergui. It is brittle, soft, and but of little value.

MAYALEE (*Cassia Sumatrana*).—Bombay black wood. Plentiful through the Hlaine, Pegu, and Tounghoo forests.

MAY-BYOUNG.—Found near the sea-side. Used for anchors of boats. An uncommonly heavy, hard, and durable wood.

Mai-tai-yo.—Found all over the provinces. Durable, light, and tough. Used for posts by the Burmese.

Maneeoga.—Said to be used by the Burmese for rice-pounders. Found all over Tenasserim and Martaban provinces.

Meenaban ; Tavoy Lance-wood.—Said to be the produce of an Apocynaceous tree. Used for bows, spears, chisel-handles, &c. Is tough, hard, elastic, and durable, capable of a beautiful polish, and makes excellent furniture. Will not bear exposure to the direct rays of the sun.

Mezzalee.—Scattered, but not very abundant, all over the provinces. The wood has a handsome streaked grain like Palmyra wood. Employed by the Burmese for rulers and walking-sticks.

Mhanbin (*Morinda excerta*).—Yellow. Only found cultivated in Pegu. Small timber for cabinet-work.

Mong-dayat-pew.—White. Found near the sea, and at the mouths of rivers. Not a good wood, being very perishable.

Mong-dayat-nee.—Red. Found from Amherst to Mergui, but not abundant. A tough wood, with a good grain. Used for boats.

Moketammatha ; Martaban Wood.—Found in Martaban and the adjacent jungles. Uncommonly heavy, and used for tool-handles.

Murrh-neen.—Abundant, and in appearance resembles deal, but is of no durability.

Myat (*Grewia Asiatica*).—White. Not so common as *Grewia floribunda*.

Myat-ya ; Mya-ya (*Grewia floribunda*).—White. Common tree at Tavoy, Amherst, and from Rangoon to Tounghoo. Good, serviceable timber for housebuilding.

Myouk sho ; Monkey-tree (*Dalbergia sp.*).—Found in Tavoy and Mergui, abundant inland. Resembles lancewood.

Najee (*Pterospermum acerifolium*).—Dark-brown. Large forest-tree, not plentiful in Burmah. Resembles the last.

Najee (*Pterospermum subacerifolium*).—Dark-brown. Plentiful in the teak-forests of the Burmese Empire. Large and extremely valuable timber. Doubtless applicable for shipbuilding.

Na-pew-gee, or Let-thouk-gee.—Found all over the provinces. Useful, but not very durable.

Na-yooay.—A scarce wood, with a curled grain, much like English oak in appearance, but deficient in tenacity. Used by the Burmese for oars.

Neentha.—Very abundant along the coast. A very heavy wood, but liable to split. Used for rafters of houses.

Nga-bai ; Chuckrassee (*Swietenia chikrassee*).—Red. Found with teak in the Pegu forests, and at Chittagong. Not plentiful. Equal to mahogany.

Ngy-soung tha.—Abundant. Of no durability or strength. Only fit for firewood.

Ouk-chinya ; Tai (*Dyospyros melanoxylon*).—Ebony. Found throughout the Burmese forests. Seldom of greater girth than 3 or 4 feet. Plentiful.

OUK-GUAY.—Found all over the provinces. Wood perishable, and grain short.

PANGAH (*Terminalia Belerica*).—White. Found through the Pegu, Tounghoo, and Tharawaddy forests. Large ; useful for housebuilding.

PAN-THE-YA ; PAN-THIT-YA (*Vateria lanceolata*). — Very abundant in Tavoy and Mergui. Excellent for tool-handles. The wood is largely used by the Burmese.

PADOUK ; PODAUCK ; PEDDOWK (*Pterocarpus dalbergioides*). — Red. In the neighbourhood of Prome. Rare in the forests. Useful for cabinet-work. A kind of rosewood. It resembles Andaman wood.

PADOUK ; PUDDOW ; TENASSERIM MAHOGANY (*Pterocarpus Wallichii*). —Red. Woods of Tenasserim and Tavoy. For cabinet-work. It is used also for gun-carriages and other ordnance purposes. Both kinds of PADOUK *may* be derived from the same species of *Pterocarpus*, which some suggest, but it is scarcely probable. There are evidently two varieties of wood obtained in these regions, differing much in quality, and both called *Padouk* or *Peddowk*.

PA-KA-THAN.—Found inland all over the provinces. Tough and good. Used by the Burmese for paddles.

PENG-LAY OUN ; PENLAY-PIJOUNG (*Xylocarpus granatum*). — Red. Very abundant all along the sea-shore from Amherst to Mergui. A good, fine-grained, strong wood, for spokes, helves, &c.

PET-THAN.—Abundant in Tavoy. Hard and durable ; used by the Burmese for wedges.

PEW-BOCK.—Found along the sea-coast. Strong, tough, and durable.

PHANGAH.—Found in the jungles near Moulmein. Used for poles of carts, and in housebuilding.

PHET-WOON (*Grewia Hookerii*).—White. Abounds with teak in the forests of Pegu and Tounghoo. Tall and remarkably straight ; girth from 3 to 4 feet. Useful for housebuilding.

PHET-WOON (*Grewia spectabilis*).—White. Plentiful in the forests of Pegu. Attains a girth of 3 to 4 feet ; tall and very straight.

PINATHA (*Artocarpus sp.*).—Yellow. A kind of jack-wood, found all over the provinces, and capable of affording a yellow dye, for which purpose it is employed by the Phoongees. Used for musical instruments by the Burmese.

PIN-KADOE ; PYANGADEAN ; PYENG-KHADO (*Inga xylocarpa*).—Black iron wood. Found in all the Burmese teak-forests and Araccan provinces. Girth from 6 to 9 feet. Very hard and durable wood.

PINLAY-JALLAT.—Found by the sea-side. Light but very strong wood, much used for rockets.

POUK-PIN (*Butea frondosa*).—Dark-brown. Plentiful in Burmah. Timber crooked, and fit only for cabinet-work.

PYMMAH ; PYEN-MA ; RED PEEMA (*Lagerstrœmia macrocarpa*).—Red.

Found throughout Burmah and Tenasserim. Common and valuable timber, equally useful with teak.

PYMMAH, or PEEMA PEW.—White. Found all over the Tenasserim and Martaban provinces. Tough, but does not last so long as the Red Peema; rots when shut up. Not recommended.

SEET; SEET-SEEN; THAEET THA (*Acacia elata*).—Red. Plentiful in the Pegu, Toungboo, and Prome districts. Timber straight, long, and large. Employed for cabinet-work.

SEET; TSEET (*Acacia stipulata*).—Red. The forests from Rangoon to Tounghoo. A large, heavy timber, used for furniture.

SEET (*Acacia Serissa*).—Red. Plentiful in the Tounghoo district. Large and useful furniture-wood.

SHABIN (*Acacia Catechu*).—Red. Great quantities in the Prome and Tharawaddy forests, and above Tounghoo. Large, and useful for furniture.

SOONDRA (*Heritiera minor*).—Red. Common in the Rangoon district, along the creeks and sunderbunds, and in Tenasserim. Strong and useful for housebuilding. Major Campbell found that out of 27 woods he examined, this was the strongest.

SOW-YEW; CHISEL-HANDLE TREE (*Dalbergia sp.*).—Yellowish-white. Not very abundant. Used by the Burmese in preference to any other for chisel-handles and helves of axes.

SOWAY-DO.—Very abundant. Crooked, but employed for gun-stocks.

TA KOOK THA; TAY-MINE.—Found all over the provinces. Durable, and useful for turnery, but small in size.

TALIENNOE (*Chaulmoogra odorata*).—White. A few trees about Rangoon, and on the banks of streams in the Tounghoo forests. Scarce. Useful for cabinet-work.

TAMAYOKE (*Rondeletia tinctoria*).—Dark-brown. Small timber, found in Pegu. Fine-grained, and useful for ornamental work.

TA-SOUNG-LET-WAH (*Juglans tricocca*).—White. Found on the banks of streams in the Pegu district. Scarce. Hard, strong timber.

TANYEN (*Inga bijemina*).—Black iron wood. In all the teak-forests of Burmah. Girth about 6 feet. Plentiful.

TAWSA-THAYET (*Mangifera attenuata*).—Dark-brown. Scarce. Found in the Pegu and Tounghoo forests.

TAWTHEDINBIN (*Ricinus diococca*).—Red. Scarce. Found only on the banks of streams in the Pegu and Tounghoo districts. Very tall, large timber. Useful for furniture.

TAYET KHYEE.—An abundant wood, pretty in grain, but of no durability.

TAY-THA.—Scarce in Amherst, but abundant in Tavoy. Subject to dry-rot.

TAY-YO-THA (*Grewia sp.*).—Found on the sea-coast abundantly. Used for oars and masts of boats. Not considered very durable.

TEAK (*Tectona grandis*).—Abundant, of which there are several varieties, differing as to quality. Much exported.

THABAIJEEN (*Eugenia myrtifolia*).—Red. Plentiful in the Pegu and Tounghoo districts. Strong and close-grained. Adapted for house-building.

THA-BAI-KYA.—A kind of oak, found in the inland forests. It is straight-grained, tough, and useful for building purposes generally.

THA-BATE-KEE.—Near the coast. Short-fibred, brittle, soft, and not durable.

THABYAI-THA-PHAN (*Eugenia vulgaris*).—Red. Occurs in the Pegu and Tounghoo districts. Strong, but subject to attacks of the white ant.

THABYEW-THA-BYAI (*Eugenia ternifolia*).—Red. Occurs in the Pegu and Tounghoo districts. Strong and close-grained.

THABYEW-THA-BYAI; THABYION (*Eugenia jambolana*).—Red. Occurs at Tenasserim, Pegu, and Tounghoo. Timber strong and close-grained.

THABYEW; THABYOO (*Dillenia speciosa*).—Light-brown. Tenasserim and Pegu forests. Not plentiful. Large and useful house-timber, durable, tough, and light.

THABYAIYWET-KYA (*Casuarina pentandra*).—White. Scarce. Found in the Pegu district. Timber strong and close-grained. Useful for cabinet-work.

THAH-BYAI-NEE.—All over the Tenasserim and Martaban provinces. Inferior and brittle wood.

THAH-BYAI-BEW.—Abundant, but not durable.

THAH-BYAI-GNET-GHEE.—Found inland all over the provinces. A tolerably good and tough wood.

THALAI (*Ulmus alternifolius*).—Red. Found about trees and villages in the Prome district. Very large and useful elms, applicable for house-purposes.

THALAI (*Ulmus integrifolius*).—Red. Found in the Prome district. Large and useful. Resembles ordinary elm timber. Fit for house-building.

THAMAJAMWAI-ZOKE (*Pterospermum aceroides*).—Dark-brown. Grows with teak in the forests of Burmah. Plentiful. Timber valuable. Strong as teak or oak. Girth 10 or 12 feet, and very lofty. Never been tried for shipbuilding.

THA-NAT-KHEE.—Found all over the provinces. Durable, light wood, with a straight grain. Much employed.

THA-NAT-THAYT-PEW-THA.—Very abundant. Useless, except for fire-wood.

THANGAU; TENGAUN; THENGAN; THINGAN-KYAUP (*Hopea odorata*).—Light-brown. Scarce in Pegu; a few trees near Rangoon; found in the forests of Martaban and Tenasserim. An immense tree. Strong but coarse-grained wood. Used for making canoes.

THAU-THAT.—Found inland up the Gyne and Attarau rivers. Difficult to procure. Very durable, and used for bows and spear-handles.

THA-PYKE-THA.—Found along the banks of rivers. A wood of no durability.

THAR-RABEE ; THURAPPEE (*Calophyllum longifolium*).—Red. Found near the Burmese towns, and in the woods of Martaban. A large tree. Wood used for masts and spars.

THAYET-KYA.—Not very abundant. Durable and light.

THAY-TO-THA.—Abundant in the Tenasserim and Martaban provinces. Useless, and only employed for temporary buildings.

THA-YINGEE.—Found all over the provinces ; but useless, except for firewood.

THAY-KYA-BA.—Abundant, inland, all over the provinces. Used for house-posts.

THAY-THA.—Found inland. A tolerably good, tough wood.

THEE-HO-THAY-ET (*Anacardium occidentale*).—Dark. Scarce. Only found near the large towns in Burmah.

THEE-KHYA-THA.—Very abundant in the Tenasserim and Martaban provinces. Crooked-grained and perishable.

THEE-LA-BAY.—Not very abundant. Found in Tavoy and Mergui. Brittle, but sometimes employed for posts.

THEET-SEE (*Melanorrhœa usitata*).—Dark red. The *lignum vitæ* of Pegu. Plentiful in the Tounghoo and Prome forests. Extremely close-grained, and dense. So heavy, that it is employed for anchors. Suitable for sheaves and block-pulleys. Girth 6 feet.

THEIT-TO (*Sandoricum Indicum*).—White. Timber large and plentiful in the Rangoon and Tounghoo districts. Cultivated by the Burmese for its fruit. Found near all large villages, but scarce in the forests. Useful in housebuilding.

THEM-MAI-THA.—Abundant all over the provinces. Useless, except for firewood.

THEMBAU-KAMAKAH (*Azidarachta Indica*).—Light brown. Plentiful, in the Prome district. Large, soft timber, only fit for flooring. It is the Neem or Margosa of India.

THET-KHYA (*Castanea Indica*).—Red. Plentiful in the Rangoon, Pegu, and Tounghoo districts. Timber large and useful for furniture.

THITWAJEE (*Ormosia dasycarpa*).—Red. Here and there in the forests north of Tounghoo. Timber much resembles mahogany.

THIT-KADO (*Cedrela toona*).—Red. Found on the banks of streams in the Tounghoo district. Scarce. Wood suitable for cabinet purposes.

THIT-PHYEW ; THAYT-PEW-THA (*Sibia glomerata?*).—White. Plentiful in Prome, Pegu, and Tounghoo. Compact and close-grained. Girth 7 or 8 feet. Applicable for furniture, and perhaps for shipbuilding.

TIM-BOOK-THA.—Found in Tavoy and Mergui districts. A good, tough, light wood ; small, and rather scarce.

TO-DOORYAN.—Scarce. Soft, light, and useless.

TOUNG-BYE-NAY.—Along the banks of rivers. Short-grained and brittle.

TOUNG-BY-NE ; TOUNG-BIEN ; MOUNTAIN JACK (*Artocarpus echinatus*).—Not abundant. Light and porous. Used for common carpentry.

TOUN-THAI-TAI (*Garcinia cowa*).—Yellow. Scarce. Found dispersed in the Pegu forests and elsewhere. Useful for cabinet-work.

TOUK-KYAU (*Pentaptera glabra*).—Dark-brown. Plentiful in the Burmese teak-forests. Very large and useful timber. Equal to teak or oak, and applicable for similar purposes.

TOUK-KYAU (*Pentaptera arjuan*).—Dark-brown. Found in the teak-forests of Burmah. Valuable strong timber. Girth 7 to 9 feet, and lofty. Worthy of a trial for shipbuilding.

TYE-YOO-THA, or LAM-THAH.—Found in Tavoy and Mergui. Brittle, and readily splits and warps.

TUNYEEN-DHA.—Found in moderate quantities near Tavoy and Mergui. Used in the construction of the large boats plying between Moulmein and Tounghoo. It has a peculiar and fragrant odour, and is tough and durable.

YAIYOE (*Morinda bracteata*).—Yellow. Only found cultivated. Timber small, and applicable for cabinet-work.

YEEN-GA.—White. Found in Moulmein, but not very abundant. Used for helves, &c., and is a pretty furniture-wood.

YEMMANEE.—Abundant. Found inland near the banks of the Gyne and Attaran rivers, and at the back of the mountains near Moulmein. Very durable. Used by the King of Ava for his carved furniture. It is slightly scented, free from cracks, and without any tendency to rot.

YINBYA (*Ancestrolobus malis*).—Dark-brown. Plentiful in the Pegu and Tounghoo forests. Tall. Girth 3 feet. Ornamental work.

YINDIKE; INDITTE; YENDAIK (*Dalbergia sp.*).—Black. Plentiful in the Tharawaddy and Hlaine districts, and the lower parts of Tounghoo and Tenasserim. There are four species. The timber of all is very heavy, and seldom exceeds 3 to 4 feet girth.

YOUNG-THA.—Along the sea-coast, near Tavoy and Mergui. A heavy, durable wood, used for posts and planks of houses.

YWAIGYEE (*Adenanthera pavonina*).—Red. Not very plentifully, in the Rangoon, Pegu, and Tounghoo districts. For cabinet-making.

ZINBYEWN; ZENGBYWOM; ZIMBOOM (*Dillenia augusta*).—Light-brown. Plentiful in the forests of Pegu and Tavoy. Large and good timber for housebuilding.

ZOUNGALI; TOUNGALAY; ZEENGALAY (*Ancestrolobus carnea*).—Dark-brown. Plentiful in the Pegu and Tounghoo forests. Timber very tall. Girth not more than 3 feet. Ornamental work.

ZOUNGYA (*Averrhoa Carambola*).—Dark-brown. Only found near towns in Pegu, &c. Fit for ornamental work.

——————— (*Hibiscus macrophylla*).—White wood. Plentiful in the forests of Pegu and Tounghoo districts. Tall, slender timber, of 3 or 4 feet girth. Would do for boards and house-posts.

——————— (*Pygium acuminata*).—Red. Scarce, but found on the banks of streams in the Tounghoo district. Girth 5 or 6 feet. Employed for cabinet-work.

——— (*Canarium geniculatum*).—White. Scarce in the Pegu valley. Large and valuable timber.

——— (*Millingtonia simplicifolia*).—White. Found in the forests of the Pegu valley. Not very plentiful. Valuable as a timber, from its weight and strength.

——— (*Aglaia spectabilis*).—Red .Found along the banks of the rivers in the Pegu and Tounghoo districts. Large, and affords a light, serviceable timber, stronger than American pine, and easily wrought.

ON THE SALUBRITY OF MARINE ATMOSPHERES.

BY THE HON. RICHARD HILL.

"The sight and sound of the ocean are as refreshing to the exhausted spirit as the breeze that blows from it is to the exhausted body." The air from it is redolent of health. It has an odour of its own, a peculiarly refreshing scent from the presence of iodine. M. Chatin, in the valuable papers on the iodine in mineral, but more especially in vegetable bodies, in the *Comptes Rendus* of the Academy of Sciences, has shown that rapid volatilisation, when heat acts on water, gives out abundantly to the atmosphere the iodine the water contains. He estimates that the 4,000 *litres* of air which traverse the lungs of a man in twelve hours, hold the same quantity as one *litre* of drinkable water moderately iodised. The iodine breathed from the air is fixed in respiration ; and if the atmosphere of ill-ventilated rooms and crowded places is deprived of it, then the fresh air, and above all, the fresh sea-air, where a volatile combination of it is given out constantly, possesses it in profuse abundance. Fermented liquors and wines contain iodine, but milk is richer in iodine than wine. Independently of its varying in milk with the soil on which the cow or the goat feeds, the proportion of iodine in that animal secretion is in the inverse ratio of the quantity yielded. Eggs contain much iodine : a fowl's egg, weighing 50 grains, contains more iodine than a quart of cow's milk.

Iodine exists in *aquatic*, but not in terrestrial plants ; at least, it cannot be detected in them. Plants living in *running* waters, or in large collections of water capable of being agitated by the winds, contain more iodine than those in stagnant water. Plants partially immersed in water yield it in a certain degree ; but the same plants, when grown dry, do not develop it ; and the confervæ, nympheæ, and ranunculuses, which are all equally rich in iodine in running waters, are all equally poor producers of it in ponds and marshes. The terrestrial cruciferæ, such as the cabbage and horse-radish, contain no iodine ; while the water-cress possesses it, in common with the sagittaria and ranunculus.

Sea-weeds may be classified for the quantity of iodine they yield according to their depth of growth, from the surface to what Professor Forbes called the Laminarian region, where the fuci are most abundant, that is, to about four or five fathoms. The iodine increases in measure as the sea-weed increases in growth. From the young weed it is nearly entirely wanting; but when the plant is thrown off in drift, it has then reached its maximum quantity. The more complete algæ comprehend species that form subaqueous forests of considerable extent in the open ocean, and they there partake of the measureless character of the element that produces them. Some grow as long and narrow leaves, having a vesicle filled with air at the end of each foliation to buoy up the leaves. Navigators describe some as being from 500 to 1,500 feet in length, with stems not thicker than the finger, and branches as slender as packthread. The *Zostera*, which is one of the fluviales, and not a sea-weed or fucus, spreads like a grassy plain all through the shoal water of many coasts, and as a subaqueous plant must abound in iodine.

Spanish Town, Jamaica.

THE TELEGRAPH SOIREE AT THE FREE-TRADE HALL, MANCHESTER.

CONTRIBUTED BY C. F. VARLEY.

Not the least interesting event in connection with the visit of the British Association to Manchester was the telegraph *soirée*, which took place in the large room of the Free-trade Hall, on the evening of the 7th September That vast hall, which, it may be said, has been "everything by turns, and nothing long," was on that day fitted up as a huge telegraph office, instruments of every description being exhibited, from the first invented to the most recent production,—in fact, such a collection as would enable the visitor to see the gradual improvement which had taken place in the art of telegraphy from 1837 down to the present period. As might have been anticipated, the room was entirely filled by members and associates of the British Association. Amongst those present, there was a large number of fashionably-attired ladies, without whose presence even the most learned assembly is nothing more than a mob; there were many of our merchant princes, who have amassed large fortunes by the honourable pursuit of commerce; and there were others mixing in the busy throng whose lives have been devoted to diving deep into the arcana of nature, and whose names have attained a high position in the scientific world. Gazing round that room—seeing that we were surrounded by instruments, the results of the ingenuity of man, which could transmit a signal round the globe, if a wire were laid, eight times in a second; and reflecting upon the great amount of genius then present in the aggregate,—who could be blamed for entertaining the thought for a moment that the circle might yet be squared, perpetual motion discovered, and the philosopher's stone be a thing that might be had for the asking? Looking at what human genius has achieved—and such exhibitions as that we are noticing will force the reflection on the most obtuse mind—surely we must all sympathise with that poet who wrote the couplet—

"Two things only I tremble while I scan,—
The stars of heaven and the mind of man."

The instruments which were worked were arranged in the central compartment of the room, and the Electric and International Telegraph Company had wires suspended from the Free-trade Hall to their Manchester office, where they were connected with lines extending over the whole of Europe.

At eight o'clock the President made his appearance on the platform, accompanied by Major-General Sabine, Sir D. Brewster, Lord Wrottesley, Rev. Dr Robinson, Professor Stevelly, Professor Miller, Sir E. Armitage, Mr James Heywood, F.R.S., &c. &c.

The PRESIDENT introduced Mr Grove, Q.C., who had been announced to deliver a brief address to the meeting.

Mr GROVE said that some three or four days ago he was requested by the authorities of the British Association to give a short impromptu address on the electric telegraph, and to slightly indicate to them what they were about to see. The various instruments then present were at that time in a small room, and he believed that all he would have to do would be to get on a chair and deliver a brief address in that room. To his surprise, after he had given his assent, and when he had gone too far to recede, he found that he was expected to address the whole body of the British Association in that hall assembled. (Laughter.) He would endeavour to sketch the history of the rise and progress of the electric telegraph; but if he were to go into details of each invention, it would take him thirty-six days to accomplish his task. Without referring to the numerous individuals who had contributed to the first notion of an electric telegraph, he would take as his starting-point the experiments of Bishop Watson and the Committee of the Royal Society, which might be taken as that which first gave to the public mind the idea of an electric telegraph. At that time, it was not known how far the electric spark could be transmitted; and he described the experiments made at Shooter's Hill to ascertain this fact, and said that round the hill there were several miles of wire stretched out to operate upon. After referring to the most important discovery by Œrsted in 1819, which materially hastened the application of electricity to purposes of telegraphy; that a magnetic needle delicately suspended in proximity to a conductor, through which an electric current was passing, had a tendency to place itself at right angles to such conductor; and that the moment the battery power was applied to the galvanometer, the magnetic needle was deflected to the right, and on reversing the current an opposite effect was produced; and to Herschel's discovery in 1821 of the connection between electricity and magnetism, and to experiments which had been made subsequently at the suggestion of

Laplace and others,—he said that it was in 1836 that the practical application of these various discoveries broke on the world. In the patent of Messrs Cook and Wheatstone, which was brought out about that time, they proposed, instead of having the unmanageable number of twenty-four magnets and wires, to have ten magnets and five wires, and one of the original dials connected with that patent was then standing close to him. This arrangement simplified the matter very much, and instruments of that kind were worked along the London and North-Western line, and they were found to work efficiently.

The number of wires used by Messrs Cook and Wheatstone was soon reduced to one or two, and he believed that there was a difference of opinion at present as to whether one or two wires were the best to use. At present, so far as regarded the needle telegraphs, instead of working with letters they used signals, and by ringing the changes on three or four deflections of the needle they got a sufficient power to communicate any message. The next invention was the dial telegraph. In order to be able to communicate within a reasonable time by the needle telegraph, it was necessary that the person working it should learn the language, and this was a work of time. It was therefore found desirable that unskilled persons should be able to communicate by telegraph, and the invention of the dial instrument enabled them to do this. The letters of the alphabet were placed round the dial; the person working had merely to point the finger to a certain letter, and on the dial at the place to which he was working to, the same letter would be indicated with certainty. By means of the dial telegraph, any merchant who wished could communicate from his counting-house to his country-house, or *vice versâ*, as easily as the most experienced telegraph clerk. Here Mr Grove had a message put into his hands, and he said the following had just been received from the Prince Consort at Balmoral :

"Has the meeting of the British Association in Manchester been successful ?"

The following answer was immediately telegraphed back :

"His Royal Highness will be pleased to hear that the meeting is a great success. Upwards of 3,000 members ; and everything going off well."

Both the message and the answer were hailed by the vast audience with cheers. Mr Grove then described the printing telegraph, which transmitted communications by dots and lines embossed or printed in ink on paper tape. The telegraph already communicated with the Caucasus and the Sea of Azoff, and by the system of automic relays they could signal to an indefinite distance. With reference to the rate at which electricity travelled, Professor Wheatstone had made some calculations to show that it travelled at upwards of 200,000 miles per second, which was quicker than the velocity of light. It would go round the earth eight times in a second, which was quite quick enough for all practical purposes. (Laughter.) That evening they were in communication with Liverpool, Bristol, Dublin, Glasgow, Aberdeen, Balmoral, Paris, Brussels, St Petersburg, &c. ; and he hoped, before he sat down, to ascertain for the meeting the time of day and the state of the weather in St Petersburg. They were in a position then to receive a message from Paris sent to-morrow (Sunday), and received there that day (Saturday). (Laughter.) Paris was situated to the east of London; and if a message were sent from that city as the clock struck twelve, it would be sent to-morrow and received here to-day.

From the platform to the opposite end of the gallery there was a wire stretched, and Mr Grove concluded by firing off six fusees by electric sparks discharged from a battery on the platform.

The question which Mr Grove had just mentioned having been transmitted to St Petersburg, the following answer was now announced :—

"The time at St Petersburg is fifty-two minutes past ten ; the weather is beautiful, the sky clear, and the thermometer 12½ deg. Reaumur.

Mr Grove suggested that a question should go to St Petersburg asking what the temperature was by Fahrenheit. The question was transmitted, and the reply quickly returned, "I have given the degrees in Reaumur ; you give them in Fahrenheit." (Laughter.)

The PRESIDENT said that Dr Robinson had just made the calculation, and found that 12½ Reaumur would be equivalent to 69½ Fahrenheit.

The Electric and International Telegraph Company's large collection of apparatus, &c., included two single-needle instruments, one in connection with Derby, the second with Birmingham ; a double-needle instrument in connection with Liverpool; a Bain's printing instrument, in connection with Bristol, Cardiff, and Falmouth. A Morse's embossing instrument communicated with Dublin ; a second with Glasgow, Edinburgh, Aberdeen, and Balmoral ; a third with London, the Hague, Amsterdam, Hamburg, Berlin, St Petersburg, Moscow, Odessa, and Nicolæv.

At 8.32 the message from the Prince Consort to the President of the Association was received, and at 8.45 the reply was returned to Balmoral.

As the Electric and International Telegraph Company offered to the persons present gratuitous correspondence with any friends at those towns with which they were in communication, we need hardly say that many ladies and gentlemen availed themselves of the opportunity to address inquiries and congratulations to their distant relatives and friends, of which we offer a few examples :

MESSAGE.

"9.20 p.m.—Miss ——, Free-trade Hall, Manchester, to Miss ——, —— street, Aberdeen.—I cannot answer your letter this week, but will write early next week. How are you ? Answer per bearer."

REPLY.

"9.50 p.m.—Joseph ——, —— street, Aberdeen, to Miss ——, Free-trade Hall, Manchester.—Mag is at tea with the P——s. All well. She can't answer herself. She will write soon."

MESSAGE.

9.27 p.m.—Henry ——, Manchester, to John ——, —— street, Edinburgh.—Will be glad to know how father and the family are. Reply per bearer."

REPLY.

"9.55 p.m.—John ——, Edinburgh, to Henry ——, Manchester.—Father and family are well and hearty. Expect to see you soon."

The time occupied in transmission and delivery of these and many messages to other places manifests not only the advantages derivable from this method of communication, but also the means which the Electric and International Telegraph Company have to ensure despatch in transmission and promptness in delivery; for it is but fair to state that no intimation was previously given to the several offices spoken to that such messages would be sent them. But when we come to speak of the communications this company made with Continental towns, the preceding instances appear a simple and easy matter. They had in attendance Mr Fischer, of their "foreign office," whose proficiency as a linguist very much facilitated the transmission of messages, by addressing the respective Continental clerks in their own languages.

At 8.0 p.m., messages were exchanged with Amsterdam; at 8.10 p.m., with Hamburgh; and at 8.20 p.m., with Berlin. At 8.51 p.m., a message regarding the weather was sent to St Petersburg, and at 8.52 the answer was returned. At 8.55, the second question about the temperature was sent to St Petersburg, and at 8.57 the reply was received.

At 9.5 p.m., St Petersburg joined up the St Petersburg and Moscow lines, when Manchester put the following question to Moscow:

MESSAGE.

"9.6 p.m.—Please say what weather you have, and also your time."

REPLY.

"9.7 p.m.—It is raining. It is thirty-six minutes past eleven."

At 9.17 p.m., Moscow joined up the Moscow and Odessa lines, when the following correspondence ensued:

MESSAGE.

"9.18 p.m.—Manchester asks—'What is your weather and time?'"

REPLY.

"9.20 p.m.—Weather cool, but very clear. Windy. Six minutes past eleven."

MESSAGE.

"9.21 p.m.—Manchester asks—'Is the harvest over?'"

(Here is rather a long interval, the Odessa clerk having been called away from his instrument.)

REPLY.

"9.32 p.m.—The harvest is over, and the grapes are now in season."

Odessa then joined up the Odessa and Nicolaev lines (it will be remembered Nicolaev is the Russian naval yard on the north-west coast of the Black Sea), when the usual compliments were exchanged by the two clerks; but the occurrence of a violent storm in some locality through which the telegraph line passed, and the currents of atmospheric electricity which it imparted to the wire, led to the abandonment of the intention to extend the circuit to Taganrog, on the north-east coast of the Sea of Azoff, which would have been about 3,100 miles from the Free-trade Hall. However, the communication with Nicolaev direct, *viâ* Berlin, St Petersburg, Moscow, and Odessa, is a feat which we believe to be unsurpassed in the annals of telegraphy. The last most distant station spoken to by the Electric and International Telegraph Company was Odessa, by a much more direct route, a distance of about 2,200 miles; whereas the distance by way of St Petersburg, &c., to Nicolaev, is over 3,000 miles.

After many other interesting experiments, the President proposed a vote of thanks to Mr Grove for his address, and to Professor Clifton for the arrangements which he had made. The vote was given by acclamation.

Ten words per minute were obtained between Manchester and St Petersburg, and seven words per minute were obtained between Manchester and Odessa.

One of the answers from Odessa was commenced in Manchester in less than three seconds after the message from Manchester was completed.

THE KRISUVIK SULPHUR-BANKS OF ICELAND.

BY CAPT. CHARLES S. FORBES, R.N.

The geologic aspect of the volcanic system is distinguished by the vast palagonite mountain-ranges of which it is formed; and they constitute the basis of thermal phenomena in Iceland. In the sulphur districts, volcanic and aqueous gases, especially sulphuric, bursting upwards, decompose the palagonite, and convert it into masses of ferruginous and fumerole clay of various hues. These sulphurous gases, on meeting the atmosphere, are decomposed, and the sulphur precipitated in banks varying in thickness and purity according to their age and position.

We found the ascent both greasy and arduous over the soft beds of white, red, and blue clays; the former containing from thirty to forty per cent. of sulphur, and the two latter, which form the lower and more extensive portion, about sixteen per cent. As we advanced, we were obliged to make a long *dêtour*, to avoid the sulphureous column of vapour swept down by the wind from this main centre of sublimation, and the stench was intolerable. The crust became hotter and hotter, and the clays lighter; and at every step we displaced whole barrowfuls in our struggle for a footing, vapour breaking out of the exposed surface, which was much too warm to bear the hand upon. Ultimately we arrived at the weather-side of the bank, and found it of considerable extent, covered with a crust two to three feet in depth, of almost pure sulphur; for in specimens we selected at random, only $\frac{4}{100}$ parts of foreign matter could be found.

In the valley beyond, about fifty feet beneath us, lay a huge caldron, twelve feet in diameter, in full blast, brimming and seething with boiling blue mud, that spluttered up in jets five or six feet in height, diffusing clouds of vapour in every direction. If a constant calm prevailed here, instead of ever-varying gales, the sulphur sublimated from these sources would be precipitated in regular banks: as it is, it hardly ever falls twenty-four hours in the same direction, the wind blowing it hither and thither, capriciously distributing the sulphur-shower in every quarter. What between the roaring of the caldron, the hissing of the steam-jets, the stink of the sulphur, the clouds of vapour, the luridness of the atmosphere, the wildness of the glen, and the heat of the soil increasing tangibly at every inch, I could not help occasionally glancing round to assure myself that his Satanic Majesty was not present, and nestled up to my companions to be ready in case of any such emergency as "Pull devil, pull governor," arising.

Such, with little variations save in locality, were the numerous soufrières and solfataras that we visited; and they extend over a space of twenty-five miles in length. The riches of the district consist not so much in these numerous crusts of almost pure sulphur, as in the beds of what I must be permitted to term sulphur-earth, which are promiscuously scattered in all directions, averaging from six inches to three feet in thickness, and containing from fifty to sixty per cent. of pure sulphur, the creation of extinct sublimatory sources in ages past.*

In the North, the sulphur is found in great quantities, in the more extended districts round Myvatn and Husavik; but it is far less pure, and not so easy of access; though in the past century a considerable amount was exported from those sources. The mud-cauldron of Krabla, situated amongst a range near the Myvatn, is, however, well worthy of notice, and hardly inferior as a natural phenomenon to the great Geyser. Its basin, literally a lake of boiling mud, is 300 feet in circumference, with numerous jets scattered about on its surface; the central one, about ten feet in diameter, erupts every five or six minutes, and attains an altitude varying from twelve to thirty feet. That caldron, it is needless to observe, is one *suffione.*

Apart from the natural phenomena of these districts, one cannot help wondering that Danish enterprise has never developed what M. Robert, in Gaimard's work, most justly terms a mine of wealth, and which must be done when the Sicilian supply is consumed: at least, at present we know of no other mines to take their place, unless it be the very remote ones recently discovered in Japan. M. Robert also adds that they ought never to be allowed to fall into the hands of Great Britain, on account of their importance in time of war. But this, I am happy to say, has taken place within the last few years,—the entire southern district being purchased by an Englishman, Mr Bushby, who likewise holds the refusal of that in the North. That gentleman visited the island in 1857, in H.M.S. 'Snake,'

* Dr Murray Thomson, analytical chemist, of Edinburgh, examined some of the crude sulphur or sulphur-muds from the sulphur-beds of Krisuvik. The first determination gave 98·20 per cent. of sulphur; the second determination, 96·39; the mean of the two analyses being 97·29. This is an unusually high percentage of sulphur, the crude Sicilian sulphurs usually containing not more than 80 to 90 per cent.

and explored the principal portion of it. Much struck with the dormant wealth of the sulphur districts, and their value to England in the event of the Sicilian supply being cut off during war, after considerable trouble he induced the present proprietors to part with their titles. Although the Danish Government wisely and liberally offers every facility and encouragement to foreigners to embark in the various branches of industry which the island affords, such was the tenacity with which the present owners clung to the titles of the sulphur districts, that European capital has until lately been prevented from stepping in, the original owners being content to collect and export from time to time a quantity sufficient to barter for their immediate domestic wants. To develop the Krisuvik mines capital would doubtless be required, as the track to the port of Grundevik, on the southern coast, would have to be improved for the transit of the sulphur or baggage ponies: or if this, the nearest route, were not adopted, it must be conveyed in barges down the Kleisavater Lake, which stretches from the foot of these hills to within seven or eight miles of Havna Fiord, a direction favourable for a track by the banks of the Kalda river, thereby avoiding the almost impassable lava district, across which twenty tons of sulphur we saw at Havna Fiord were this summer transported, to the ruin of forty or fifty ponies.

Judging by the trifling cost of production—moderate freight home—the numerous vessels coming from England with salt, returning in ballast,—sulphur gathered from these sources would be able to undersell the Sicilian market by almost a half.

NEW MANUFACTURES FROM HUMAN HAIR.

BY WILLIAM DANSON.

At the meeting of the British Association for the Advancement of Science at Manchester, I offered a few observations on the manufacture of human hair, as an article of consumption and general use, and submitted for inspection some useful specimens of articles made from human hair, of a very massive and heavy texture, like pilot-cloth, or that used for travelling or mountain wear. It is, however, capable of being spun into fine goods, like alpaca, which is but of comparatively recent use. Truth goes farther than fiction. My sister conceived the idea, and caused the collection of about 3,500 lb. of human hair, in a few months, in Liverpool, by one female, who was merely assisted by her husband and son in carrying it out, receiving 1*l.* to 2*l.* per week. We had two shawls made from it—cotton warp—(exhibited to the Section). It is extremely warm and durable clothing ; and with care and attention any quantity of the stuff can be obtained. It would appear fabulous to say that 100,000 bales might be obtained from Egypt, and 100,000 from Asia—perhaps 500,000 or a million bales annually, from all parts of the world, even within twenty-one years, and of all sorts, both long and short, all of which is at present wasted, and not enumerated in the articles of commerce or of general consumption. I am authorised to state that this hair has been in the possession of Messrs. R. W. Ronald and Son, of Liverpool, for some years, who will forward 100 lb. weight to any applicant on receipt of a post-office order for 2*l.* 15s. (The items making up this sum, commission, &c., are enumerated.) The article is as collected; and heavy foreign sheep's wool, in dirt and grease, being 6d. to 14d. per lb., shows its cheapness for consumption generally. The Manchester goods are exchanged for long hair in Germany, which is sold in London, at 4*l.* 4s. per ton; but the very shortest is applicable for cloth, and 10d. to 1s. per lb. is a safe price for imports. These 3,500 lbs. are in seven bales, insured in the Manchester Fire Office for 200*l.*; so any one can test their existence by policy No. 180,631. The manufactured goods may be shown at the International Exhibition in 1862; and if hair were collected in factories, the value could be quarterly divided, and added to the savings-banks deposit. I would suggest that specimens of these hair-manufactures should be placed in every museum in the kingdom, and trust that the Smithsonian Institution of America will give the question their ablest support. Is not the long hair of the Chinese mixed with silk and worked up by the common people?

[We may add to the foregoing remarks, that human hair is rather extensively used by savage nations, plaited into cords, for decorating their shields and other purposes.

In the Report of the Exhibition of Arts and Sciences at Paris in 1832, a statement of the trade in human hair was given, from which it appeared that the exports of unwrought hair in 1832 amounted to 36,412 lb., of the value of 5,300*l.*; and of wrought or manufactured hair, 30,232*l.*, of the value of 5,500*l.* A large portion of the hair exported goes to the United States and to Great Britain. We import on the average about 60 tons weight of human hair; the imports in 1859 were 14,905 lb., officially valued at 5,962*l.*

A considerable trade, it is well known, is carried on in hair for the manufacture of bracelets, rings, and brooches, as ornaments for ladies, as well as for artificial braids, coronets, curls, and plaits; whilst there is also a considerable consumption for false beards, moustaches, whiskers, and perukes. As the average weight of the full clip of hair when purchased from the French and Flemish peasant-girls is only about 5½ ounces, the quantity imported annually shows that fully 45,000 heads must have been polled to furnish the amount.

The hair, when it reaches the hands of the hairworker or hair-dresser, is sorted into lengths of 6, 12, 14 inches, &c. It is scoured or cleared from impurities with sand and sawdust. About three ounces in the pound is lost in the processes of cleaning and sorting. The waste hair-clippings of hair-cutting rooms is sold as manure, being worth from 3*l.* to 5*l.* per ton.

In the Animal Collection of the South Kensington Museum there is a very good display of the applications of human hair, and the successive processes which it undergoes of curling, dyeing, &c. There are also two muffs made of human hair—one of black and grey hair, the other of brown hair.—EDITOR.]

FLINT AND ITS APPLICATIONS.

BY THOMAS D. ROCK.

However true the proverb, that "*Familiarity breeds contempt,*" when applied to man and his puny wisdom, it certainly has no proper reference to the productions of Nature. In the vast treasure-house of Creation, the smallest and most common objects are unceasingly attractive, whilst even the old facts relating thereto acquire fresh interest from the new light which science constantly throws upon them.

What subject so familiar as flint? so almost universally met with in nature, or so generally known and understood? And yet, I may perhaps be excused for presuming that not every reader of the TECHNOLOGIST is acquainted with its history and applications, whilst I endeavour to portray, in simple language, what is at present known concerning the origin and utility of this valuable product.

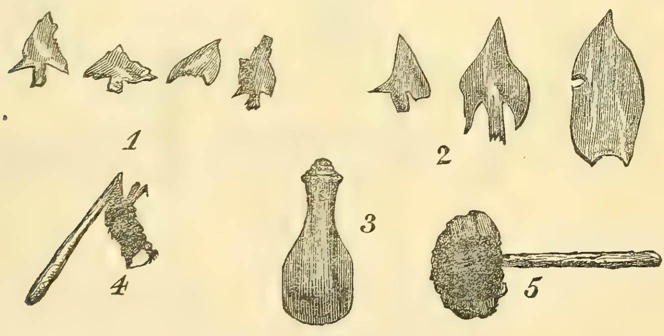
Flints are deeply interesting in a geological point of view. They are found principally in what is termed the chalk formation; most usually in conchoidal masses or nodules, and of very irregular shape, though sometimes in thin layers, or strata, disposed either vertically or horizontally in the chalk. The nodules are coated externally with a calcareous or argillaceous substance, and the colour of flint varies from a light grey to a deep brown or black. Many and warm were the arguments and propositions started in times "gone by" with respect to the origin of flint; its singular formation, and position in the chalk, forming the basis of such theories. Now, however, from recent discovery, we have clearer light upon this subject; and although it may not be safe to make any sweeping assertion, it seems to be generally supposed that the flinty nodules, at any rate, are organic remains of sponges, echinites, and other kindred fossils, so impregnated and incrusted with silex as to lose almost all trace of their original character. A Monsieur Boucher de Perthe, a French gentleman, has earned some reputation in investigations of this kind; and Mr Bowerbank has, with the aid of a microscope, discovered that all flints possess a fibrous tissue like that of the sponges; which is most confirmatory evidence in support of the modern theory.

Flint is, indeed, almost pure silex,—the following analyses showing only 3 per cent. of other substances.

	Klapr.	Vauquelin.
Silex	98·	97·
Lime	0·50	—
Aluminum	0·25	1·
Oxide of Iron	0·25	
Volatile Matter	1·	—
Loss	—	2·
	100·	100·

It is translucent, and has a flat conchoidal fracture; sp. gr. 2·58; and is so hard as to strike fire when struck heavily with steel or other hard substances: and this property was evidently known at a very early period. The Greek name of flint, *πυρίτης*, compounded of two words (*πῦρ* and *τρέφω*) signifying "*to nourish or support fire*," conveys this fact to our minds; likewise the Latin description, *lapis ignem emittens* (stone emitting fire). The modern appellations of this substance also embody the same idea. Our name "flint" appears to be a Saxon word, which in old German signified "*a gun*," the subject of my paper being termed "*flintstein*" or "*flintsteen*" (gunstone); so that in all probability the English word flint properly signifies *a gun*, and the silicious nodules would be far more appropriately called "*flintstones*." The French "*pierre à fusil*" and the German "*feuerstein*" perpetuate the same truth.

Long before metals became abundant, flint was very advantageously employed in the production of weapons of war by half-civilised races. Our own ancestors were famous for their celts and arrow-points of flint, vast numbers of which are continually disentombed in certain parts of the country.



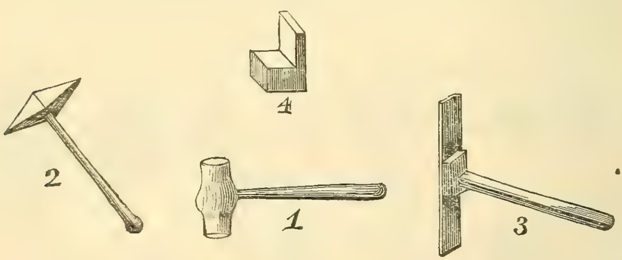
1 British Arrow Heads.
2 Canadian Arrow Heads.
3 New Zealand Stone Hatchet.
4 Stone Hatchet from Indian Archipelago.
5 Australian Stone Hammer.

France, Canada, Denmark, and other nations, have also their flinty relics; whilst stone implements of war and husbandry are commonly used by the aboriginals of Australia, New Zealand, &c.

The celebrated "*eagle-stones*," to which such marvellous therapeutic virtues were attributed by our forefathers, were likewise flinty formations around *organic matter*. It appears also that the instrument with which the people of Israel performed the rite of circumcision was formed of a flint, a wound from which might prove less dangerous than if given with the bronze weapons common in those early times.

Next in order to the appropriation of flint for spear-heads and arrow-points by our ancestors and other nations of antiquity, we have the venerable tinder-box, with which the good housewife kindled both light and fire not many years ago. For the benefit of younger readers of the TECHNOLOGIST, I may state that a tinder-box consisted of a round tin box, about 4 or 5 inches in diameter, and 2 inches thick, containing a piece of iron, usually in the shape of a common magnet, a flint, and some tinder (burnt rags). Upon striking the flint with the iron, the concussion set free a quantity of sparks, which falling upon the inflammable tinder, were quickly and easily fanned by the breath into a flame. Lucifer-matches have long since superseded this primitive method.

The most important application of flint came into existence with the invention of gunpowder; and until the modern substitution of percussion-caps, flint was the agent employed for producing the sparks which exploded all fire-arms. Gun-flints are small square pieces of flint, with sharp edges; and the yellowish-grey varieties are those most esteemed for the purpose.



1 Quartering Hammer.
2 Flaking Hammer.
3 Knapping Hammer.
4 Solid Iron Stake.

The English method of manufacturing gun-flints is based upon the natural cleavage of the stone; and not only is much labour thereby saved, but a superior article consequently produced; the flints having a smooth and purely natural surface and edge. Hammers of peculiar construction are the only tools employed in their production, and the process of manufacture is extremely simple, being limited to three distinct operations.

The first process, called "*quartering*," is performed with hammer No. 1, and is merely a separation of the flinty block, or nodule, as collected from the chalk, into several pieces according to its size and shape, the experienced workman knowing precisely where to strike the most effective blow.

The next operation, "*flaking*," needs the pointed hammer No. 2, as in striking off the flakes of a uniform thickness, which is the desired object, it is evident that whilst the blow must be heavy, it must also be concentrated. Both these operations are performed by the workman sitting, the flint blocks being held between his knees. Having obtained the flakes of a certain thickness, and which naturally, from the conchoidal fracture of the flint, taper down to a point, the third and last operation is that of squaring or "*knapping*," performed by resting the flakes on the neck of the solid "*stake*" or piece of iron (No. 4 in diagram), which is let into a block, and squaring them by means of the "*knapping*" hammer No. 3.

It must not be supposed, from my having termed the above method of gun-flint making, the English method, that other and Continental nations are behind us in their manufacture ; for I can hardly suppose the European States to be less skilful than ourselves in this simple industry. Yet it is certain that the Turks, and probably the Egyptians, accomplish their purpose in a very rude and tedious manner, by gradually chipping the flints into shape, without regard to the nature of the material, and thus spending an infinity of time and trouble over a result which a few well-directed blows on scientific principles would accomplish. The product also differs vastly, and instead of the smooth and regularly-cut English gun-flint, you have a flint with indented surface, bearing very strong evidence of the innumerable blows bestowed upon it.

I presume this manufacture, in consequence of the adoption of percussion-caps, is almost superseded, and therefore the very interesting case of flints, and their products, at the Crystal Palace (in the Tropical Department) under charge of Dr Price, which suggested to me the present paper, will prove extremely valuable in a few years, and keep alive the manufacture of gun-flints for many generations.

A further application of flint is one not likely to be superseded. I allude to its use as an ingredient in pottery, china, and glass ware. For this purpose the flints employed are chiefly selected from the southern and eastern counties. They are first calcined, and although infusible, become perfectly white at a high temperature ; afterwards they are reduced to a fine powder, and commingled with the clay in suitable proportions.

Without flint or silex in some form, it would be impossible to construct useful pottery or porcelain : its non-absorbent property and the resistance it offers to fire are the virtues which constitute its importance in the plastic art. Clay vessels without a proportion of silex would be almost shape-less, and much cracked, after undergoing the fire process. Sand is the cheapest and readiest source of silex; but flint is considered the better material.

In Persia, flint is ground up with other materials to form a very powerful cement. Occasionally flint stones beautifully marked are cut into brooches, cameos, &c.

POLYTECHNIC INSTITUTION.—Mr Pepper returned last month to the Direction of the Polytechnic Institution under the most favourable auspices. The Institution was crowded, and when Mr Pepper came forward to deliver his lecture upon the principles of Ventilation, he was greeted with a hearty welcome. He stated that although three years had intervened since he last appeared on that platform, the warmth of his welcome made him feel that the separation which had taken place between him and the Polytechnic audience was but then of yesterday. It assured him that he was among friends, and he would appeal to them to aid him in the arduous duties he had undertaken. He said arduous duties, because when amusement, in its most attractive form but totally devoid of rational instruction, was offered in other places to the public, it required no small degree of energy to manage an educational establishment in such a manner as to counteract the evil influences of the establishments to which he alluded. He would especially appeal to them to aid him, as they had aided his predecessor, Mr Phené, by sending works of Art and Art Manufacture to the Institution for exhibition, and so increase its attractions. It would no doubt be interesting to the public to know that the Rev. J. B. Owen was chairman of the board of direction, and that the Rev. Chas. Mackenzie had taken charge of the Educational classes. After this address, Mr Pepper gave an entertaining and instructive lecture upon the principle of Ventilation, illustrated by working models.

Reviews.

INFORMATION ON COMMON OBJECTS, FOR THE USE OF SCHOOLS. Home and Colonial School Society.

This admirable little work, the compilation of Mr W. B. Tegetmeier, a name well known in connection with industrial science, has reached a *fifth* edition—a clear evidence of its usefulness and popularity. The work embraces information on all the leading objects derived from the three kingdoms; and a careful perusal warrants us in stating that every fact and statement given can be relied upon, and that within a small compass is given an amazing amount of condensed information, the result of much research. In all its features the work may be specially commended as a cheap and useful manual of popular information for both teachers and learners. We have not detected a single error or misstatement; which is much to say in a work covering so wide a field of observation.

A Handbook to the Museums of Economic Botany of the Royal Gardens, Kew. London: W. H. Smith.

This new official guide to the Kew Museums has been prepared by Dr Oliver, Librarian to the Herbarium of the Royal Gardens, and Professor of Botany in University College. Although published at a cheaper price (6d.), it is scarcely, we think, an improvement on the old edition of this popular guide, issued by the Director, Sir W. J. Hooker. It contains (within a few pages) nearly the same amount of matter as the former 'Guide;' but it is printed in a larger type, and is deficient of any plan and woodcuts; whilst we also miss many interesting notes and remarks which added value to the 'Guide.' It is arranged on the same plan of the natural orders, and the prominent objects are indicated by numbers. The Museum has increased so largely of late years, having outgrown even the second building appropriated to the collection, that a system of compression has necessarily had to be used to keep pace with the enumeration; for nearly 530 objects are here prominently specified or described,—although necessarily but a very brief notice can be given to each. The statistics of import and consumption of the principal articles are added for the last year (1860); and there is a very full index, facilitating reference.

Annales de l'Agriculture des Colonies. Vols. I. to III., and No. 13, for July. Paris: J. Louvier.

A great deal of research is evident in the range of subjects and wide field of observations over which this semi-monthly publication extends. Although Algeria and the French Colonies are chiefly treated of, yet the products of other tropical regions receive due attention.

Besides several very excellent papers by the learned Editor, Mr Paul Madinier, including one on the Agriculture and Colonisation of Natal, there are interesting articles, in the present number, on the *Pandanus odoratissimus*, by M. Cuzent; on the Colonisation and Commercial and Political Value of Madagascar, by M. Léon Bequet; on the Culture of Coffee on the highlands in Guiana, by M. Vauquelin; and on the Culture of Vanilla in Reunion, by Capt. Lowther.

The Jamaica Quarterly Journal of Literature, Science, and Art, for July. Kingston: James Gall and Co.

This is the first number of a new series, under new management, and both the literary and typographical departments of the work reflect great credit on all concerned. The publication will bear favourable comparison with any existing Colonial publication. Our only fear is, that, judging from past experience of West Indian magazines, the field is too limited to insure such a measure of support as will maintain the publication successfully, especially as there appear to be other journals of a similar character in the field. The 'Jamaica Quarterly,' looking at the range of subjects it embraces, and the talented writers it has secured, ought to succeed. There are two papers especially deserving of attention;—one on the Cultivation of Cotton in the West Indies, and the other on the Parish of Hanover.

Notes on the Sugar-cane and the Manufacture of Sugar in the West Indies. By A. W. Anderson. London: Lockwood and Co.

This is a small Colonial *brochure* of forty-three pages, by Mr Anderson, Advocate, and Inspector of Schools in Trinidad. It is stated to have been written with the desire of assisting young persons wishful of becoming planters, and others who may be disposed to spend money in trying to effect improvements in the manufacture of sugar. In the few pages of which the pamphlet consists, are concentrated the results of observations in the cane-field and the boiling-house. The subjects treated of are—the vegetable economy, constitution, and culture of the Sugar-cane; manures, sugar-making, defecation, evaporation, crystallation, the action of lime, and fermentation. A careful perusal and a long West Indian experience as a sugar-planter warrant us in bearing testimony to the accuracy and usefulness generally of the observations and directions.

The Canadian Naturalist and Geologist. Vol. VI., Nos. 1 to 4. Montreal: B. Dawson and Son.

We would draw especial attention to the following technological articles in this periodical: A Popular Treatise on the Fur-bearing Animals of the Mackenzie River District, by Bernard T. Ross; on the *Cornus florida* (Dog-wood) of the United States, by Dr Blackie; and on the History of Petroleum, or Rock-oil, by T. Sterry Hunt.

The Pharmaceutical Journal for September contains, among other papers, articles on Oil of Sesamum, and its employment in Pharmacy; Norwegian Castor; the Colouring Matters derived from Coal-tar; Statistics of Beet-root Spirit Distillation here, and Chicory Consumption, &c.

The Chemist and Druggist, continuing the series of papers on the Natural Orders of Plants, treats in the present number of the uses of the Rose tribe: there is also an article on *Guacinæ*.

The Annals and Magazine of Natural History for September contains the first part of a paper "On the History of the Maté Plant, and the different Species of *Ilex* employed in the Preparation of the 'Yerba de Maté,' or Paraguay Tea," by John Miers, F.R.S.

From Brussels we have received a pamphlet, being "A Letter addressed to the Duke of Brabant on the Means of doubling the Prosperity of Belgium by encouraging Commerce and Industry." The anonymous writer argues strongly in favour of liberty of trade, and points out the advantages that would arise from making Antwerp, Ostend, and Blankenburgh free ports, like Hamburg, Trieste, and Singapore. He reasons forcibly and truthfully upon the question of the organisation of industry, in an imaginary dialogue between a father and son.

Publication Received.—The Forests and Gardens of South India. By Dr Cleghorn. Allen and Co.

THE TECHNOLOGIST.

THE POTATO AND ITS COMMERCIAL PRODUCTS.

BY THE EDITOR.

(Concluded from vol. i., p. 340.)

Perhaps there is no vegetable that has suffered more romantic vicissitudes in its fame and propagation than the potato. It has been successfully opposed, commended, and eulogised by priests and kings. This once insignificant production has succeeded in diffusing itself through almost every climate, and ministering to the tastes and appetites of the civilised world.

Scientific research has extended the numerous resources which this plant is so wonderfully calculated to furnish. Thus, besides the uses already stated, its tubers made into a pulp are a substitute for soap in bleaching. The torrified starch furnishes the British gum, or adhesive substance for our postage-stamps and other labels, and for stiffening fabrics. Roasted or cooked by steam, the potato is a most delicious, wholesome, and, at the same time, economical vegetable aliment. By different manipulations, it furnishes two kinds of starch—a gruel and a parenchyma, which in time of scarcity may be applied to increase the bulk of bread made from grain, and its starch is not inferior to arrowroot for the invalid.

We often hear potato-flour spoken of, but the roots contain no flour in the proper acceptation of the term; their starch is wholly destitute of *gluten*, a substance indispensably necessary for the production of a mass of dough, which, after being duly fermented and baked, becomes bread.

Mealy potatoes are more nutritious than those which are waxy, because of the greater quantity of starch which they contain. Thus, the microscope shows a potato to be almost entirely composed of cells, which are sometimes filled, and sometimes contain clusters of beautiful oval grains. Now, these little grains remain unchanged in cold water; but when the water is heated to about the degree that melts wax, they dissolve in it, and the whole becomes a jelly, and occupies a larger space than it did in the form of grains. When a potato is boiled, then each of the cells becomes full of jelly; and if there be not a quantity of starch in the cells, it will not burst. But if the number of grains or their size be very great, the potato is broken on all sides by the expansion of the little masses of jelly, and mealiness is produced.

Frost-bitten potatoes are sweet, from the spontaneous conversion of their starch into sugar. The same effect takes place when potatoes sprout in the spring, and they are consequently of less value as food. Potatoes should be stored in the fall with a portion of earth adhering to them, or at least mixed with them : this keeps them a little damp, and prevents the action of the atmosphere from causing a too powerful evaporation.

The French method of cooking potatoes affords a most agreeable dish. The potatoes are peeled, piped and cut into thin slices, then thrown into a frying-pan containing an abundance of hot lard. As soon as they become brown and crispy, they are turned into a colander to drain, then sprinkled with salt, and served up as hot as possible.

Starches are highly hygrometic : thus, ordinary potato-starch can combine with 3, 5, 11, and 16 equivalents of water. The starch as extracted from the potato contains from 35 to 25 per cent. when kept in a damp atmosphere, and 18 per cent. when stored in a dry place.

It is easy to distinguish starch which contains (say) 18 per cent. from that which contains 35 per cent., by placing a small quantity on a metallic plate heated to 212° ; for the starch with 18 per cent. will fly about, whilst that with 35 agglomerates and forms hard lumps. In fact, it is by means of this property of potato-starch that large quantities of artificial tapioca are made on the Continent.

In 1859 we imported 40,185 cwt. of potato-flour from the Continent, 593 cwt. of potato arrowroot, 7,832 cwt. of starch, 1,524 cwt. of semolina (chiefly potato), and 270 cwt. of potato-starch gum ; making, with 588,910 cwt. of potatoes imported, an aggregate value for foreign potato products of 138,500*l.*, exclusive of what is produced here. The imports of potatoes vary considerably according to the condition of our own crop : thus, in 1855, 1¾ million cwt. of potatoes were imported.

A great deal of potato-starch is made in America. At Stowe, in Vermont, there are five factories, which each consume about 20,000 bushels of potatoes per annum, and 8 lb. of starch is the yield of each bushel.

Dextrine.—This substance, which in the Board of Trade returns is with great propriety termed *starch gum*, has been called dextrine on account of its solution possessing the property of effecting the right-handed rotation of the plane of polarisation by a ray of light. Dextrine is prepared either by torrifying potato-starch, or by the action of heat aided by a minute portion of nitric acid. The latter method yields the most soluble and least-coloured product.

In the process of breadmaking, a portion of wheat-starch is converted into dextrine (torrified or gummy starch); of which, according to Vogel, wheat-bread contains about 18 per cent. In the process of brewing, the starch of the malt is converted into dextrine and sugar by the action of diastase.

Dextrine, in the form of a syrupy liquor, obtained by means of diastase, is employed in Paris in the preparation of some alimentary substances; as for sweetening and thickening *tisanes*, or diet-drinks, and for the manufacture of the *pains de luxe*, or dextrine bread. Pulverulent dextrine is used as a substitute for gum in calico-printing, and for a variety of other useful purposes—especially for adhesive labels, such as postage and receipt stamps.

However useful starch may be in stiffening certain articles of apparel, it appears to be much too largely used in the present day by the cotton and silk manufacturers to give body to their fabrics. It is, however, the rage for cheap goods that leads to this abuse. To meet this demand on the part of the public, and yet retain his profits, the manufacturer weaves his cloth with a proportionately less number of threads to the inch than before. To counteract this flimsy effect to the eye and touch, it is customary to run the cloth through a solution of starch, and until wetted the character of the fabric is not apparent; only when the article is washed, is the other side of the picture presented. Of course, with farina and fecula at 2d. or 3d. per lb., it must be very profitable to sell yards of starch at even a much lower price than the lowest cotton goods could be supplied. The fabric in some cases appears to be used merely as the vehicle for the starch, being woven extremely coarse or wide, and the interstices filled with starch.

Dextrine is now met with in commerce in three distinct forms—viz., as a pearly powder, as a syrupy solution, and in the form of exotic gum, in greater or less perfection, either broken into small fragments or made into rolls of various sizes. Some intelligent persons were apprehensive that, taking advantage of the resemblance, exotic gum, or gum-arabic, would be adulterated with artificial gum. This, however, is impracticable, as the smell and taste of potato-oil, which is always given out by artificial gum, are sufficient to betray its presence.

In making solidified potato-gum, the boiling syrup is poured into small flat tin vessels, placed upon a hot-air stove, kept at a temperature of 40° or 50°. At the end of twenty-four hours, the gum will acquire the consistency of jujube paste. It is then cut up into small oblong pieces with a pair of shears; and these pieces are rolled out upon a polished table, with a wooden roller dusted with pulverised artificial gum, placed upon wooden frames, and left for three or four days to dry. The artificial gum thus prepared is easily dissolved, and makes a very clear solution; over dextrine, in the state of powder, it possesses the advantage of being more readily packed; and over liquid gum, the advantage of not fermenting.

To prepare this "gum-substitute," the dry starch meal or farina is heated to a temperature of 250 to 300 degrees, either in a revolving cylinder or in iron troughs placed in a stove for several hours, where it acquires an amber colour, and becomes soluble in water. This change is entirely a molecular one, as the raw and calcined fecula have the same composition, notwithstanding which the raw fecula gives a blue colour when treated with iodine, and the calcined a purple.

The colour of calcined farina is an objection to its employment in many instances; but it has now been found that any amylaceous substance may be converted into soluble dextrine without any change of colour, by subjecting it to the chemical action of muriatic or other acid gas or vapour in a cylinder, the exterior of which is surrounded by an atmosphere of steam.

Under the name of polenta, in France, a large manufacture is carried on of potatoes, which are boiled or steamed, and peeled, and then passed through a pair of fluted cylinders, then bruised, and bolted or sifted through a searce or sieve, and separated into coarse grains, semola, or flour. If stored in a dry place, polenta may be kept a long time good. It is used for thickening soups, and making other food-dishes with eggs, milk, meat, or pulse. Potato-starch is known in French commerce as fecule; as usually met with, it contains from 18 to 25 per cent. of water. If we stir a parcel of fecule containing 20 per cent. of water, it makes a crackling noise, which is a characteristic of dryness to the dealers; and that which contains 25 per cent. of water will mostly be deficient in this crisp test, for if crushed between the fingers it will adhere or form a lump.

Good, wholesome bread may be made by mixing the starch with the dried pulp of peasmeal, beanmeal, oatmeal, or flour. On the Continent, the farina is largely used for culinary purposes. The famed gravies, sauces, and soups of France are indebted for their excellence to that source; and its bread and pastry equally so. The starch of potatoes, like all other kinds of starch, is unfit alone for the preparation of pastry; but a small proportion of potatoes, or of potato-starch, added to wheaten flour, is considered by some to improve the quality of bread. If the proportion of potato-starch exceeds one-fifth of the weight of the flour, a peculiar flavour is communicated to the bread, arising from a minute quantity of an oily matter contained in several amylaceous principles, which is supposed by M. Payen to be identical with the oil of potato-spirit, or fusel oil. This substance was discovered by Scheele in brandy obtained by distilling fermented potatoes. It is a colourless, oily liquid, possessing a very powerful odour, at first rather agreeable, but immediately afterwards nauseous in the highest degree. This substance is generally believed to be a product of the fermentation of the potato, and not to pre-exist in the tuber. If potato-starch is washed first with tasteless alcohol, and afterwards with cold water, it may be entirely deprived of its peculiar flavour, and loses in weight, at the same time, about one part in 2,000.

Some years since, grape-sugar or glucose used to be largely prepared in this country from potato-flour; and as it was sold much under the price of cane-sugar, it found a ready sale, grocers employing it for the purpose of adulteration. The Excise authorities becoming acquainted with the fact of the extensive manufacture of potato-sugar, imposed a duty upon it, since which I believe it has ceased to be prepared.

Potato-starch treacle, or grape-sugar, may be used with advantage in the manufacture of beer and vinegar. The syrup is extensively employed by the French confectioners. It is also used for adulterating cane-sugar, and for the manufacture of spirituous liquors. The treacle is purified so as to be free from any mixture of insalubrious substances. It is remarkable for its brightness, sweetness, and durability; and owing to these properties, and the large quantity of viscous matter it contains, is eminently suited for making beer, many German brewers actually using it. It is sold at 12s. to 15s. the centner or cwt. Ship-beer is brewed from this starch-sugar without malt, and is proof against change of climate. It is sold at 1*l.* the barrel. Owing to their being fermentable, potatoes are used along with barley by the Scotch distillers.

At the Loburg factory, in the district of Jerichow and Magdeburg, in Saxony, where the various potato products are made, the cost price of each some few years ago was as follows:

Potato meal and starch, per cwt.	14s.
Potato-groats	18s.
Potato-gum, in pieces and ground	30s.
Grape-sugar, No. 1	18s. 9d.
„ No. 2	18s.
Syrup—white and brown	17s 3d. and 13s.

At Neuwied, potato-meal was sold at 12s. the 100 pounds.

At Hoffmann's chemical works, Ingenheim, near Darmstadt, potato-starch meal for sizeing cotton weft and calico, &c., has been manufactured these twelve years past; and dextrine of two sorts—named gomelin and leiocomme—to replace gum-senegal and gum-arabic, for finishing various woven goods, and for stiffening woollen, cotton, and silk goods.

A great deal of the so-called cognac imported into France is the produce of the potato. Throughout Germany, the same uses are common. The consumption of potatoes for distillation in Prussia is about 7,000,000 bushels per annum. They are crushed to a complete pulp in machines, at the rate of two tons an hour, for brandy-distilling.

Stettin brandy, well known in commerce, is largely imported into England, and re-shipped to Australia and other of our foreign possessions as the produce of the grape, and is placed on many a table of England as the same; while the fair ladies of our country perfume themselves with the spirit of potato, under the designation of Eau de Cologne, in the cheap imitations of that perfume which are sold.

The cultivation of the potato in Poland appears of late years to have increased six-fold. The harvest in 1857 amounted to 8¾ millions of quarters, of which 1¾ millions of quarters (besides 214,723 quarters of grain) were used in the distillation of spirits, yielding upwards of 12 millions of gallons, or nearly 2¾ gallons for each head of the population. The distillation of potato-spirits is much encouraged in general by the large landed proprietors, who thus obtain a home-market for the produce of their estates without the expense and risk of transport. In Saxony there are 600 distilleries, which use about 1,500,000 bushels of potatoes annually, and make 2½ million gallons of spirit.

The potato-whisky (*wodka*) which they make in Poland is the most detestable stuff conceivable, and must be deleterious in the highest degree to the constitution, producing the same effect as new rum. The price of this pernicious compound some few years ago was 7½d. to 10d. per garniac—nearly equal to an English gallon.

In 1844, there were no less than 4,243 distilleries in Poland; and the consumption was about seven gallons per head to the population. A heavy duty was, however, imposed shortly afterwards, which somewhat checked the production and consumption. 2,505,585 gallons of potato-spirit were made in Saxony in 1851; and in Norway, in the season between 1st October, 1855, and 30th April, 1856, in 35 distilleries, 9,210,479 pots (1¾ pints) of spirit were made, principally from the potato.

When brandy is manufactured from potatoes, there comes over along with it, in the first distillation, a quantity of a peculiar spirit or alcohol, already mentioned, which is known as *potato-spirit.* It is called by the Germans fusel oil, and with us amylic alcohol. It gives a most disagreeable flavour to the brandy, but can be separated from it by rectification. It is more unpleasant to the taste and smell, and more maddening and intoxicating, than wine-alcohol. When this potato-spirit is distilled with oil of vitriol, it yields a peculiar volatile ethereal liquid,—the potato-spirit ether, or amylic ether. Many of the artificial sweet-smelling ethers are but chemical productions from this potato-ether. The essence of jargonelle pears of the confectioners, is a spirituous solution of acetate of amylic oxide, the compound of vinegar with potato-ether.

Apple-oil, again, is a compound of the same potato, or amylic ether, with an acid known to chemists by the name of valerianic.

Grape-oil and cognac-oil are also compounds of this amylic or potato ether with acids. They are used for giving the desired cognac flavour to British-made and other inferior brandies. Thus, the same potato-spirit which, because of its offensive smell and taste, is carefully removed by the rectifier from the ardent spirit he distils, under the hands of the chemist becomes possessed of the most agreeable and coveted fragrance.

By exposing potatoes to repeated alternations of temperature a few degrees below and above that of melting ice, the formation of sugar is so much promoted, that they grow soft, with the production of a syrup of so rich a nature that it will not permit the potatoes to solidify, even when cooled several degrees below 32° Fahr. This curious transmutation seems to depend, at least in its origin, upon a vital reaction; for when they are frozen very rapidly, no sugar is formed either during or after their thawing; but, on the contrary, potatoes so treated afford more starch than otherwise. Dilute sulphuric acid stops the progress of putrefaction. The diseased potatoes may be cut into slices of about a quarter of an inch thick, and immersed in water containing from 2 to 3 per cent. of sulphuric acid. After a day, or a day and a half, the acid liquor may be drawn off, and all remains of it washed away by steeping in successive portions of fresh water. The potatoes are easily dried. The pieces are white and of little weight, and can be ground to flour and baked into bread along with the flour of wheat.

The dry potato-starch met with in commerce is, as has already been shown, far from being entirely free from moisture. The quantity of water in it varies according to the temperature and the humidity of the air, but generally amounts to one-fifth of the weight of the starch. It is much more hygrometic than other kinds of starch, and hence not so well adapted for stiffening linen, &c.

Potato-starch is often adulterated with gypsum, chalk, and argillaceous substances. Sophistication from either of these sources may be easily detected by burning a small quantity of the suspected starch and incinerating the ash. Unadulterated starch leaves the merest trace of earthy matter. [Parnell.]

Potatoes make a palatable bread with wheat in the proportion of one-third, but one-fourth still lighter and bitter. Barley and potatoes, as well as oats and potatoes, have been made into bread. In some cases the potatoes were not boiled, but merely grated down into a pulp and mixed with wheaten flour, in which mode it made excellent bread. It has even been found that good bread may be made from equal quantities of flour and potato-meal, which has been greatly the practice in those countries most remarkable for the plentiful culture of the potato. Using the potatoes after boiling, steaming, or baking, and reducing them into a sort of powder, seems, however, to be the most ready method of making them into bread.

A mode has been suggested by a French chemist for converting potatoes into a substance resembling coffee. He mixes some olive-oil with a certain portion of dried potato-flour, and then adds a small quantity of coffee-powder. He asserts that this will produce a liquor more agreeable than coffee. The French have particular tastes in these matters, and are always endeavouring to find substitutes for tropical products : not content with chicory, so largely used, they have now acorn coffee, beetroot coffee, and a dozen other coffee substitutes.

Cheese is made from potatoes in Thuringia and Saxony. The large white potatoes are boiled and peeled, and reduced to a pulp. To five pounds of this pulp are added one pound of sour milk and some salt. The whole is kneaded together, and the mixture covered up, and allowed to lie for three or four days, according to the season. At the end of this time, it is kneaded anew, and the cheeses are placed in little baskets, when the superfluous moisture escapes. They are then allowed to dry in the shade, and placed in layers in large vessels, where they must remain for fifteen days. The older these cheeses are, the more their quality improves. Three kinds of them are made. The first, which is the most common, is made according to the proportion just given ; the second, with four parts of potatoes and two parts of curdled milk ; the third, with two parts of potatoes and four parts of cow's or ewe's milk. These cheeses have this advantage over other kinds, that they do not engender worms, and keep fresh for a number of years, provided they are placed in a dry situation and in well-closed vessels.

A variety of tapioca is prepared from potato-starch by heating the moistened fecula on a copper plate to near the temperature of the boiling point of water. Some of the granules of starch then burst, agglomerate, and form small, hard, and irregular grains, which closely resemble the true tapioca. It is said that potato-starch prepared in October or November is more easily digested than that made in the spring.

Potato-starch is at present employed to a considerable extent as a substitute for glue in the preparation of size for paper, being usually mixed for that purpose with a small quantity of a solution of resin and carbonate of soda in water. This application of starch may be easily detected by moistening the paper with an aqueous solution of iodine, when, if any starch be present, the blue iodide of starch will be formed.

Potato-starch mixed with chalk, and diluted in a little water, forms a very beautiful and good white for ceilings. This size has no smell, and is more durable.

The bye-products of the potato-starch manufacture are not without their applications. Thus, the water from which the starch is deposited is well adapted for irrigation. It contains the *débris* of the pulp, and holds in solution six parts in a thousand of azotised matter. It was formerly an inconvenience to the manufacturer, as it contains a poisonous substance, and produces an evolution of sulphuretted hydrogen gas, if kept a short time, from the decomposition of sulphates by the organic matter. The marc of the pulp which remains after the extraction of the starch is made use of in various ways, as food for pigs, horses, cows, and sheep. It must first be deprived of about half its weight of water by expression; for if simply drained, it retains too much water to be advantageously eaten by cattle in large quantities. In seasons when fresh alimentary vegetables are abundant, the pulp may be employed as manure; especially as it then contains a small quantity of solanine, and cannot therefore be given to cattle with impunity. [Parnell.]

But there are other uses to which this esculent is turned abroad. After extracting the fecula, the pulp is manufactured into ornamental articles, such as picture-frames, snuffboxes, and several descriptions of toys of the *papier-mâché* character. The water that runs from it in the process of manufacture is a most valuable scourer for perfectly cleansing silks and woollens, and such-like articles: it is the housewife's panacea; and if the washerwoman happens to have chilblains, she becomes cured by the operation. Potato-leaves have been occasionally fraudulently used to adulterate tobacco.

As the result of our researches, it will be seen that potatoes as a food product come before us in many forms,—as starch, or popularly arrowroot, as sago, semola, vermicelli, and maccaroni; as polenta; in the dried and preserved forms, suitable for ship use and transport; mixed with our bread, in cakes, and a hundred other forms, which the skill of the cook can accomplish.

From the potato we can get sugar to sweeten our beverages, and ardent spirits for those who like them; while elegant flavouring essences and scents are compounded from the refuse of distillation. For manufacturing uses we see how largely they come in for dressing or stiffening fabrics, and for gum in substitution of the more expensive African gum-arabic. You may make coffee, bread, arrowroot, cheese, paper, pasteboard, and *papier-mâché* articles out of the potato; and can also smoke the leaves for tobacco, if you are so disposed. The instances given are, however, after all but a tithe of the economic products that have been, or may yet be, extracted from this useful tuber.

ON THE SACK-TREE OF CEYLON (*ANTIARIS SACCIDORA*).

BY W. C. ONDAATJE.

The sack-tree of Ceylon is called in Singhalese, Rhete Gaha. It is a very remarkable forest-tree, growing in the districts of Badulla and Ouvah. By an ingenious though simple process, the natives prepare from the bark of this tree materials for very strong and elastic sacks, for carrying paddy, &c. The trees selected for the purpose are from three-quarters to one foot in diameter. Larger ones, sometimes measuring as much as four and a half feet and more in diameter, are not so suitable. The natives know, by experience, how to avoid aged trunks, which can be thus scientifically accounted for. In exogenous trees, by the increase of the stem from within outwards, the bark diminishes in thickness by exfoliation, or dies away and opens in fissures, &c., and is consequently not available for sack-making. When a tree has been fixed upon, the stem is cut down and divided into junks of the size required; and these having been firmly placed in the ground, the bark is well beaten with a stone or club, until the parenchymatous parts, or what is commonly called the *corticle*, comes off, leaving the *liber* or inner bark attached to the wood, which is then entirely separated from it by simply drawing it out with the hand. The bark thus obtained is of a fibrous structure, remarkably tough, presenting the appearance of a woven fabric, like that of a stocking. This is next sewn into sacks, and filled with sand, and dried in the sun to expand. These sacks, I have been assured by a native Kandian, are so durable as to last ten or twelve years. They are generally kept hung in the smoke until required for use. Another mode of separating the inner bark is by a process nearly similar, only the tree is not felled, but incisions are made in the stem, one above and one below, a space being left between according to the size that may be wanted. After the part of the bark to be removed has been well beaten, as before, two lateral incisions are made, and the fibrous or inner bark is removed in long strips, and sewn together into sacks. Thus, the important physiological function of the bark itself is still performed uninterruptedly by horizontal communications—that is, by means of what are called *medullary rays* or *silver grain*, extending from the centre of the stem into the bark.

This tree is interesting in regard to its vegetable structure, affording an instance of the useful purposes to which the *liber* or *endophlœum* may be applied; while its botanical characters involve the consideration of the affinity existing between two Natural Orders—namely, *Artocarpeœ* and *Urticeœ*. Its habit is that of an Artocarpeæ; but in some of its features it is allied to the Urticeæ. Indeed, it is at first sight like the upas-tree.

In Western India, a tree of a similar kind is found.

I much regret that my endeavours to obtain flowering specimens have hitherto been unsuccessful. I can only, therefore, state its botanical characters in general terms:

A very lofty tree, attaining to the height of 100 feet, and of slow growth. Root above-ground at the base of the stem. Stem straight, terete. Branches ascending, lateral, and crowned at the top, abounding in milky juice. Leaves oblong, acuminate, covered with a brownish down below, scabrous above like the leaf of a fig, articulated, alternate, most entire, with a little tendency to become crenulate, or coriaceous; 4 to 6½ inches in length from base to apex, and 1¾ to 2¾ inches in breadth. Petiole, very short, ¼ of an inch. Stipules, deciduous. Inflorescence, not seen. Fruit, a drupe, in size and shape like a marble. Seed, one. The pericarp is greedily devoured by bats; but they never touch the seed, which is intensely bitter.

Colombo, Ceylon.

ENAMELLED CLOTH, OR AMERICAN ARTIFICIAL LEATHER.

As we published in a former number (p. 64) a communication on the Japan imitation leather, it may be useful to give now a few details respecting the American imitation leather, or enamel cloth of commerce, which enters into many uses as a substitute for leather. It is light and pliable,—having all the appearance of leather, with some of its durability. The black enamelled cloth is the kind most largely in use; but the method of making the different colours is essentially the same, the black being the foundation, and the colours afterwards applied by hand. The basis of the black is cotton cloth of the best quality, made expressly for the purpose. It varies in texture and width, according to the kind of goods for which it is intended, the width being from thirty-four to fifty-four inches. The cloth is taken from the bale, and wound upon a large iron cylinder, in which position it is ready to receive its first coat, by being slowly passed through the machine across and between the huge iron cylinders, from the smaller of which, at the top, it receives its first coating of composition—a mixture of oil, lamp-black, rosin, and other ingredients, boiled together till about the consistency of melted tar. From between the cylinders, dressed in its black coat, the cloth is carried to the story above through an aperture in the floor, and wound upon a huge wooden frame, resembling in shape the old-fashioned reel. By an arrangement of spokes upon the arms of this huge wheel, each layer of cloth is kept separate, so that no two portions of the cloth will come in contact. The frame, with its contents, when filled, is passed into what is called the heater, an apartment kept at a high temperature, for the purpose of drying in the coating of composition. After remaining in the heater a sufficient time to complete the drying process, it is removed to the lower story, whence it originally started, to pass through the hands of workmen, who make all the rough places smooth. It is laid on long tables, and alternately sprinkled with water and rubbed with pumice-stone till the whole surface is made perfectly smooth. The cloth is then wound upon the cylinder again, as at first, and passed through the machine into the upper story, upon the huge reels, and into the heater, and again under the pumice-stone. The cloth is passed through the machine five times, or till the required thickness has been laid on. After the last scrubbing down, the fabric is taken to another department in the upper story, thoroughly varnished, and again passed through the heater. It is now a piece of cotton cloth, with a thick shining coat of black, very much resembling patent leather. But it has not yet received its leather finish; so, in another department, it is passed through the enamel machine, which consists of another set of huge rollers, one of which covers its surface with irregular indentations, resembling the grain of leather.

ON BITTER CASSAVA (*MANIHOT UTILISSIMA*).

BY LOUIS HOFFMAN, ISLAND CHEMIST OF JAMAICA.

The starch from this root is of such superior quality, its preparation so simple, and the juice of the root so valuable as an antiseptic, that it certainly deserves a high rank amongst our agricultural productions. The series of experiments which I have begun on this root have for their object the preparation from it of a substitute for wheaten flour, fit, of course, for the manufacture of good wholesome baker's bread. The results I have already obtained are very encouraging, and shall form the subject of a future article.

Most of the starch-bearing roots are very similar in their composition, and do not differ to any very great amount in the per-centage of starch which they contain; and even the amount of starch produced per acre of soil by the different root-crops does not vary to any enormous extent. Potatoes, for instance, yield about two and a half tons of starch per acre, while bitter cassava will yield as much as two tons and eight-tenths of a ton. The potatoes termed Connaught cups yield thirteen and a quarter tons of the tuber, corresponding to two tons and nine-tenths of a ton of starch per acre. In this calculation I have assumed a yield of ten tons of cassava per acre, which is about the average of different crops, if I am correctly informed. In this respect, therefore, there would not be any positive gain over potatoes, the material from which starch is manufactured in Europe. The prices of the different starches will sufficiently corroborate this fact. In the last Prices-current they are quoted—"Amylum pulv., 56s. per cwt.; St Vincent arrowroot (ordinary), 10d. per lb.; tapioca, 9d. per lb." I remember having bought potato-starch (amylum), by the ton, at the rate of 2d. per lb. This, however, may be ascribed to the superabundance of starch thrown into commerce during the prevalence of the potato-disease;—for diseased, frozen, and otherwise injured potatoes were, at that time, thrown in abundance into the starch-factories.

If, however, we could contrive, by some simple process, to convert the whole of the cassava into a wholesome flour, as a substitute for wheaten flour, we would then be able to produce from four and a half to five tons of flour per acre, while wheat barely produces half a ton of flour on the same area. This, therefore, is a question of the greatest economical importance for Jamaica, the solution of which is surrounded with many difficulties. The manufacture of flour from starch-bearing roots, in order to be of any benefit to the country and the manufacturer, would have to be worked on a gigantic scale, and would have to rely on a steady supply of raw material—a point on which any kind of manufacture is likely to be wrecked. However, the solution of the question has its attractions, and has, therefore, been attempted with partial success. The flour which I have produced is very fair both in colour and baking properties; but it has a slightly rancid smell, which would greatly depreciate its value. The process by which it was obtained is quite workable in this island. So far, then, the problem is solved.

As for the cassaripe, it amounts to about five and a half per cent. of the root, analytically; and an acre would, therefore, yield something more than half a ton of it, could it be completely extracted on a large scale.

The root of the bitter cassava is a beautiful tapering root, which, when well cultivated, has an average weight of about a pound and a half in its finest specimens. Its specific gravity was found between 1·124 and 1·158. It consists of three distinct parts: 1st, the outer, rough cuticle, of dull reddish-brown colour; 2nd, a leathery, yellowish-white tunica, of about one-sixteenth of an inch in thickness, immediately below the cuticle; and 3rd, the fleshy kernel, or pre-eminently starch-bearing part, which is beautifully and purely white. A root deprived of its cuticle and tunica, and allowed to remain in a damp room, turns yellowish-green, then green, and covers itself at last with a beautiful peach-coloured fungus, which very much resembles that of yeast.

The external portion, or cuticle, of the cassava root consists of areolar tissue, as well as the rest. It is evidently a simple metamorphosis of the tunica, which itself is a modification of the fleshy part. The tunica consists of hexagonal cells, interspersed with elongated parallelogrammatic cells, with comparatively few and very small starch granules, on some of which a hilum could be distinguished. This tunica contains also lactiferous vessels, which discharge a thick, white milk, similar in consistency to that from the rubber-tree. This milk presents also the characteristics of rubber to some degree, after having been exposed to the atmosphere for some time. The interior or fleshy part of the root is composed of elongated cells, which are perfectly crowded with starch-granules. Many of the granules have a hilum, which is one, three, four, and six-cleft, the latter description being rare. Most granules have a perfectly circular circumference: some, however, are plano-convex, others angular, forming trapezoids, and irregular pentagons and hexagons. It is surprising that, in several works in which the starch-granules of bitter cassava are described, no mention is made of the existence of a hilum similar to that of the rye-starch granule. Is it possible that the Brazilian cassava is a different species from ours; or is there a mistake as to the identity of the starch?

The first quantitative determinations were mainly undertaken to ascertain approximately the proportions of the three parts of which the root consists. The weights were determined with the greatest accuracy; but, of course, the proportions must vary from one root to the other. The section of a small root gave the following proportion between the tunica and the fleshy or central part:—Tunica weighed 1·863 grammes; fleshy centre, 10·978. Which gives the proportion of 10:59.

Second Determination.

Weight of the whole root.................. 118·734 grammes.
„ „ cuticle (not dried).......... 2·570 „
„ „ tunica......................... 14·966 „

The starch determination was lost by accident.

Weight of fibrous residue, exclusive of tunica... 11·953 grammes.

Proportion of tunica to fleshy centre, as 10 : 68.

Calculated for 100 parts, we have—

Cuticle (not dried)......... 2·16 per cent.
Tunica „ „ .... 12·61 „
Fibrous residue (dry) ...... 10·07 „

Proportion of cuticle to tunica, as...... 10:58 „

Proportion of cuticle to both tunica and fleshy centre, as 10 : 452.

Analysis of a small Fusiform Root.—No. I.

Weight of the entire root.................................291·903 grammes.
Volume of the same...252 cubic centimetres.
Specific gravity, therefore.................................. 1·158

Weight of the cuticle (not dried)	4·896	grammes.
„ „ „ (dry)	1·483	„
„ „ tunica (not dried)	368·58	„
„ „ „ (dry)	10·020	„
„ „ starch (dry), not including that of tunica	83·020	„
„ „ fibrous residue, not including tunica	30·950	„
„ „ dry residue from juice	10·150	„
„ „ cassaripe, of the consistency of honey	14·900	„

Composition of the Fusiform Root in 100 *parts.*

Reddish-brown cuticle	0·51	per cent.
Tunica	3·43	„
Starch, not including that of tunica	28·44	„
Fibrous residue, do. do	10·60	„
Dry extract (juice), do. do	3·48	„
Water	53·54	„
	100·00	

Per-centage of different items:

Cassaripe	5·10	per cent.
Cuticle (not dried)	1·68	„
Tunica (not dried)	12·63	„
Proportion of tunica to fleshy centre, as	10 : 68	„
„ „ fibre to starch, as	10 : 27	(nearly).

The cassaripe had a strongly acid reaction. Very little albumen coagulates on boiling the juice.

Analysis of a Tapering Root.—No. II.

Weight of the entire root	201·874	grammes.
Volume of the same	178	cubic centimetres.
Specific gravity, therefore	1·134	
Weight of the cuticle (not dried)	4·0535	grammes.
„ „ „ (dry)	1·212	„
„ „ starch (dry), including that of tunica	66·400	„
„ „ fibrous residue, do. do	19·450	„
„ „ dry extract from juice, ditto	8·380	„
„ „ cassaripe, ditto, ditto	11·600	„

Composition of the Tapering Root in 100 *parts.*

Reddish-brown cuticle	0·600	per cent.
Starch, including that of tunica	32·900	„
Fibrous residue, do., do	9·640	„
Dry extract from juice, do	4·150	„
Water	52·710	„
	100·000	

Per-centage of various items :

Cassaripe	5·75	per cent.
Cuticle (not dried)	2·01	„

The reaction of the cassaripe was strongly acid, and it appeared much more gummy than the one obtained from the fusiform root without the tunica.

Proportion of fibre to starch, as... 10 : 34.

Analysis of a large-sized Tapering Root.—No. III.

Weight of the entire root	709·92	grammes.
„ „ cuticle (dry)	3·22	„
„ „ tunica (dry)	27·28	„
„ „ starch, not including that of tunica	167·35	„
„ „ fibrous residue (dry), do., do	72·95	„
„ „ dry extract from juice, do. do	25·42	„
„ „ cassaripe	44·93	„

Which corresponds to 6·33 per cent. cassaripe, whose reaction was strongly acid.

The proportion of fibre to starch, as 10 : 23

Composition of the large-sized Tapering Root in 100 *parts.*

Reddish-brown cuticle	0·45	per cent.
Tunica	3·84	„
Starch, not including that of tunica	23·57	„
Fibrous residue, do., do	10·28	„
Dry extract from juice, do., do	3·58	„
Water	58·28	„
	100·00	

The general process of analysis was as follows :—After the root had been thoroughly washed, so as to remove all sand and soil, it was allowed to dry again spontaneously. After this, the entire root was weighed. The cuticle was then carefully removed with a penknife, and pushed into a deep and narrow glass vessel (to prevent evaporation), in which it was also weighed. In No. I. and II., the tunica was also carefully removed, by slicing it off with the back of a table-knife, after having made an incision throughout the length of the root. The starch was determined by grating the root, with or without tunica, on a common grater, mixing with sufficient water to form a thin paste, then pressing it in a linen bag, and repeating this process three times to obtain the juice ; after which the remaining pulp was well kneaded in a linen bag under water, till clean water did not become milky any more. The starch which settled from the different liquids was collected, washed, and dried at a temperature a little above the boiling point of water. The juice was evaporated, first to the consistency of honey, and weighed; and, finally, it was boiled down to dryness, and heated till it gave off no more water, and then weighed again.

It is, of course, impossible to obtain the whole of the starch by grating the root: I have, therefore, paid some attention to the time which the pulp is allowed to remain undisturbed, before the starch is washed out of it. No. III. was pressed and washed six hours after grating, so that little time for the maceration of the cell-walls was allowed, and it only yielded 23·57 per cent. of starch. No. II. was allowed to macerate during two days, and yielded 32·9 per cent. of starch, including, however, the small quantity contained in the tunica, which could not amount to much, as the tunica altogether forms but three and a half to four per cent. of the root. No. I. was allowed to macerate one day, and it yielded 28·44 per cent. of starch, not including that contained in its tunica. This amount of starch is almost exactly the arithmetic mean between the percentage of No. II. and No. III., which is = 28·24; thus corroborating my surmise, that prolonged maceration, by weakening the cell-walls, will give a larger yield of starch. The quality of the starch, however, suffers somewhat by prolonged maceration,—an accident which no doubt can be prevented. The tunica and fibre have been kept back, in order to determine the starch remaining in them.

During the process of my experiments on cassava, I had occasion to get acquainted with the very remarkable antiseptic power of its juice when undiluted with water.

Being desirous to see what structural changes the cassava would undergo in contact with fermenting urine, in connection with the subject of potato-disease, I mixed one volume of the pulp of cassava with three volumes of recent urine, and allowed the whole to remain in a warm room, in a vessel covered with paper. The whole mass dried up, without the urine undergoing fermentation; which is decidedly a great test of the antiseptic qualities of cassava-pulp, and should cause it to be more frequently employed in Surgery, as an antiseptic.—('West India Quarterly.')

THE STEEL SEA-BEACH OF TARANAKI, NEW ZEALAND.

An instance, as remarkable as any which could be named, of the discovery of the true character of some useful product of nature, after it had lain long unknown and unemployed by man, though close beneath his hand, has recently occurred in the district of Taranaki (New Plymouth), New Zealand. For about seventeen miles along the coast of this province, there is nothing to be seen but a dull, smooth beach, of a dreary black hue, which is deepened by contrast with the snowy foam. The beach is half a mile wide at low water, and its constituent particles or grains have a slight metallic lustre, and are so small as to resemble fine gunpowder. They are much heavier than ordinary sand, whence the beach is very much smoother than our own sandy sea-boards. So smooth and glossy is it, that nothing that the waves can wash on to it can remain on it. Its black monotony is therefore unrelieved by shells or sea-weed, much to the increase of its dreariness of aspect.

Strange to say, this long and naked strand consists of myriads of tons of steel, in a granular form—pure, excellent steel, of very fine quality. Yesterday the black dust was thought to be valueless, and was trodden under foot by the careless native, and regarded by the unconscious colonist as of no more worth than the materials of which ordinary sea-beaches are composed. To-morrow, it will be knives, needles, chisels, swords, bayonets, gun-barrels, implements of peace or weapons of war, and will be bought and sold for many pounds per ton.

The origin of this wonderful tract can only be conjectured. The supposition which has most to recommend it is, that volcanoes containing pure steel in a state of fusion must have existed near this spot; that the sea at some time broke in upon the molten mass; that an eruption was thus caused, which sent enormous clouds of metallic particles into the air; that these particles fell back into the sea, and have thence been washed on to the shore, layer after layer, until the present vast beach has been formed.

Nothing resembling these metallic particles is known to exist elsewhere in nature.* The native steel which is found at times in mining, and which differs materially from ordinary iron ore, constitutes the nearest approach to them. It occurs in the shape of "button ingots," with a finely-striated surface, and is supposed to have been produced by "the spontaneous combustion of seams of coal in the neighbourhood of ferruginous deposits"—the burning seam acting as a smelting furnace, the adjacent ore being smelted in it, and the natural steel thus formed having gradually cooled, assuming the rounded form, whence the name "button ingots." Something of the same sort is what is supposed to have taken place with the Taranaki metal; except that, instead of the Taranaki metal having tranquilly cooled, the breaking in of the sea is thought to have caused a sudden interruption, and a violent explosion, which burst the metal into comminuted particles.

It has been carefully analysed in this country by several well-known metallurgists, and has been pronounced to be the purest ore at present known; it contains 88·45 of peroxide of iron, 11·43 of oxide of titanium, with silica, and only 0·12 waste in 100 parts.

Taking the sand as it lies on the beach and smelting it, the produce is 61 per cent. of iron of the very finest quality; and, again, if this sand be subjected to what is called the cementation process, the result is a tough,

* There are many other localities in which this iron-sand is found, although not perhaps so extensively as in Taranaki,—such as Victoria, King George's Sound, Western Australia, Assam, and parts of India.—EDITOR.

first-class steel, which in its properties seems to surpass any other description of that metal at present known. The investigations of metallurgical science have found that if titanium is mixed with iron, the character of the steel is materially improved. But titanium being a scarce ore, such a mixture is too expensive for ordinary purposes. Here, however, nature has stepped in, and made a free gift of both metals on the largest scale. To form some idea of the fineness of this beautiful sand, it will be enough to say that it passes readily through a gauze sieve of 4,900 holes or interstices to the square inch. When this steel-sand is placed in a crucible or retort, and reduced to a state of fusion, it can be immediately moulded into ingots of steel: for it is not simply iron requiring to be manufactured into steel; it is ready-made steel.

In order to a due appreciation of the value of the Taranaki sand, it is necessary to understand the process by which iron is converted into steel. Steel is iron chemically combined with carbon or charcoal. There very often exists a *mechanical* mixture of carbon with iron; but for the making of steel a more subtle, because chemical, combination of the two elements must take place. This is accomplished by the process of "cementation." The difference between iron and steel may be easily perceived by comparing the places of fracture of a broken bar of each. The former will be found to present a fibrous, and the latter a granulated or crystalline structure. The difference in character is even greater than that of appearance; it is the difference between a piece of iron wire and a needle of the same thickness, or between a piece of iron hoop and the fine Damascus sword-blades, so famous in history and Oriental romance,—pliant enough to be twisted into a knot, tough enough to be driven through a helmeted head, and keen enough to sever the lightest fabric.

For the process of "cementation" the best iron ores are chosen, and certain districts are celebrated for yielding good steel iron, such as the Dannemora, about thirty miles from Upsal in Sweden, the Wootz in India, the Forest of Dean and Ulverstone in England. The ore having been smelted and converted into soft iron bars, these are buried in some carbonaceous substance, usually wood charcoal; the whole is tightly compacted together, and covered with clay so as to exclude the air. The furnace in which they are placed is then fired, and continued at a given heat for a certain time. During this heating, carbon is gradually absorbed by the iron, until throughout the substance of the bars a crystalline formation takes the place of the preceding fibrous arrangement. When the bars are drawn from the furnace, they are covered with blisters, or air-bubbles; hence they are named "blistered steel." In this state the steel is fit for the manufacture of rough articles; but other processes are necessary to perfect it either as "shear-steel" or "cast-steel." For the former, the bars are submitted to continual "tilting," or *hammering*, to attenuate them into rods, which are then clamped into bundles, heated, and then hammered again into an homogenous mass. For cast-steel, the blistered ingots are broken up into fragments, and placed in retorts of Stourbridge fire-clay.

Great care is taken in making these retorts. The clay is trodden out with the naked feet, by the sensibility of which grits and air-holes are detected, and got rid of. With the steel fragments is mingled a little manganese, and the mouth of the vessel is closed with bottle-glass, which melts in the fire, and hermetically seals the retort. These charged crucibles or retorts are placed in a furnace, and the steel melted, and poured out, in the form of a glowing fiery liquid, into moulds. The ingots thus made are then ready for forging into any of the thousands of articles for which such metal is used. The tempering, which is done by heating the manufactured article and suddenly cooling it, is an after process, regulated by the degree of hardness required.

From this indication of the labour and expense involved in making iron into steel, the peculiar characteristics and value of the Taranaki sand will be readily understood. It has merely to be fused, and may then forthwith be moulded into bars ready for forging. It does not require to undergo any of the intermediate workings above described. We have seen, at the shop of a London cutler, some specimens of articles wrought from it. They are dagger-blades, table-knives, cold chisels, &c. : their appearance is equal to that of the finest samples of ordinary steel, and their temper is pronounced to be excellent.

The discovery of this singular deposit may lead to improvements in the manufacture of steel, and to new views as to the constitution of that curious compound.—'Johnson's Register of Facts.'

MR H. MEAD ON THE PRODUCTIVE RESOURCES OF CEYLON.

A lecture on this subject was given by Mr Mead in August, at the Council Chamber, Kandy, to a numerous and distinguished audience ; his Excellency Sir Charles J. MacCarthy, the Governor, presiding on the occasion. The Lecturer commenced by defining the object of his address, which was an exposition of the nature and value of such substances found in the island as could be converted into sources of trading profit. For example, the dyewoods found in the hills had no place in the catalogue of Productive Resources, for this reason, that it would cost more than they were worth to carry them to a market ; and, in like manner, many articles intrinsically valuable must be left in the jungle to perish, because, either from the want of means of transport, or the difficulty of finding labour at hand, it was not worth while to meddle with them. The island was in reality one of the richest in the world, so far as regarded the extent and value of its natural productions, but inquiries as to their commercial value were beset with difficulty. It was needful, in the first place, to have the chemist's knowledge of their nature and properties ; next, to have a thorough acquaintance with the localities in which they were to be found, and of the facilities for collecting them; and lastly, the knowledge of the merchant was requisite, as to the value of the articles in the world's markets. Those chief obstacles in the way of forming right conclusions were enchanced, in the case of Ceylon, by the incorrigible idleness of the Singhalese population. Their knowledge of jungle growths was extraordinary; and if they would only turn it to account, their incomes would be largely increased. Oils and gums, which abounded, were always saleable even in small quantities, but they would not take the trouble to gather them. Their condition was that happy state as pictured by certain writers, where each man raised his own food and sat under the shade of his own trees. They were not troubled with the hatreds of religion, the passion of politics, or the disturbing influence of literature. They had faith only in the utility of cock-fighting, and the pleasures of the grog-shop. In those localities where they formed the sole population, it was idle to attempt the development of forest resources.

The impulse and the power to open up new fields of industry must come from the European, and it was a painful but curious study to note the character and consequences of the numerous efforts which had already been made in that direction. When one thought of the docility of Eastern races, their ingenuity and cheapness as workmen, the almost total absence of machinery, and the paucity of capital amongst them, it seemed impossible to adopt any other conclusion than this—that the wealth, the energy, and the mechanical skill of our countrymen must of necessity achieve a brilliant success. Yet scores of enterprises, starting with every apparent advantage in their favour, had failed, and that so utterly, that if a balance could be struck between the fortunes lost and fortunes won in the East, it was doubtful which would outweigh the other. In all such cases there was some element needful to prosperity wanting, which no one had thought of, and the absence of which was fatal. It was of the utmost importance that the nature of these chronic defeats should be examined, and laid bare, so as to deter such speculations for the future.

Mr Mead proceeded to illustrate the position of foreign industrial enterprise in the East. Whenever machinery took the place of manual labour, the work was done quicker and better; but these advantages were often found not sufficient to compensate for the cost entailed in purchasing expensive plant and maintaining skilled workmen in all seasons. The manufacture of coco-nut fibre and coco-nut oil were examples in point. The native methods of producing both were the simplest imaginable. Women and children buried the husks of the nut in water or mud; and when the pulp was thoroughly decomposed, they dug them up and beat out the fibre with a few blows given with a stick. Where ordinary attention was paid, the product was scarcely inferior to that of the fibre machines, and would realise nearly the same price at home, whilst the cost of making it bore no comparison to the expense entailed in producing the same quantity by machinery. In the case of oil-making there was no comparison between the working power of the *checkoo,* and that of the crushing mill and the hydraulic press; yet it was beyond question that to manufacture a given quantity of oil, a sufficient number of bullocks and checkoos could be purchased at one-fifth of the price that would have to be paid for setting up the European mill. In the matter of working expenses, the native manufacturer could save twenty per cent., and his oil realise the same price in the English market. In the seasons when it was expedient to stop the manufacture, the mill-owner was at the same expense, except in the item of fuel, as in the busy time; for he must keep his staff of skilled labourers in pay, for once dispersed they could not be obtained again when wanted. The native competitor placed in the same circumstances would lose nothing. He would put a covering over the checkoo to protect it from the weather, turn the bullocks into the field to plough, or yoke them to a cart, and either dismiss the driver or find other occupation for him. This was a somewhat ungracious topic to dwell upon, but the truth must be told, that in certain departments of industrial effort, we could not compete with advantage against the despised natives, working with imperfect tools, and considered to be in every way beneath us.

But underneath the story of those laudable but fruitless efforts, a great lesson was hidden, that large manufactures could only exist when they were in gear with the state of things by which they were surrounded. Our laws, our arts, our literature—nay, even our religion must suffer a change, in being adapted to the wants of strange nations. All that could hope to live must grow, and become racy of the soil. The only exceptions were the railway, and to a limited extent the steamboat, and steam machinery for agricultural purposes. The first was complete in itself; and once made, it asked no aid from native brains or native resources. Wood and water were to be found everywhere; and having these, the engine went on its way and did with certainty its appointed work.

The Lecturer then discussed the subject of fibrous plants, with which the country abounded. He exhibited specimens of the Plantain, the Sanseviera, the Aloe, and the Pine Apple, and said that no one who handled those beautiful products, and reflected that they grew wild everywhere, could wonder that immense sums of money had been spent in endeavouring to perfect machinery for extracting them. The man who could devise a simple method of drawing out fibres would not merely make his own fortune, but confer an inestimable benefit on his country, by relieving the perpetual strain on the cotton market. But there were as yet no signs of such a desirable result. The last experiment was that of the Messrs Sturge, who spent 10,000*l.* on a machine which was no improvement upon all previous efforts, in a pecuniary sense. Fixed machinery, requiring steam power to drive it, could scarcely pay under any circumstances, owing to the fact that the average weight of fibre in textile plants was only four per cent. To make a ton, it was necessary to cut down, cart, and pass through the mills, no less than twenty-five tons; so that it would require an immense breadth of land to furnish material, and a large establishment of carts and labourers to work it up. Hand-labour was out of the question in fibre-making, for a man could not make, at the outside, more than eight ounces a day: what was required, was a simple machine, such as the village carpenter and blacksmith could make and keep in repair, cheap, portable, and efficacious; and he was not without hope that such a result was within reach. Mr Mead here exhibited the diagram of a French invention for extracting fibres, which consisted of a wheel carrying round six arms, each of which in turn delivered a blow on the plant, which latter was inserted in a slit cut in one of the posts of the framework. It had been found to answer extremely well in the French colonies, and he intended to have a trial of it made in Ceylon.

The subject of dye-stuffs was next adverted to. The Milille and the Jack, both of which gave a yellow dye, were too valuable for building or furniture work to be exported with advantage; but the *Morinda citrifolia*, the Gorakaha of the Singhalese, and Cassa of the Tamils, grew as a common weed over the whole country, and gave a good yellow colour, in addition to being an excellent tanning material. It was in all respects equal to sumach, of which 14,000 tons were annually imported into England at a cost of about 14s. per cwt. The Orchilla weed had now become well known. It grew plentifully along the whole extent of seaboard, a few localities excepted, and commanded in the case of a recent shipment 60*l.* per ton. The Sapan wood of Ceylon had been driven out of the home market by the Siam article, which could be had much cheaper in that country, and commanded a better selling price. The Chaya root, *Oldenlandia umbellata*, which gave a dark red, fetched more money in the local market than could be obtained for it in England; so that Orchilla and the Morinda were the only dyes worth notice on the part of the merchant.

Tanning substances held a chief place in the list of productive resources. The bark of the Kahatte (*Careya arborea*) was one of the most powerful astringents, and so was that of the *Terminalia alata* (the Koombook of the Singhalese). The fruit of the Timberi (*Embryopteris glutinifera*) contained 60 per cent. of tannic acid. He had discovered the true *Acacia Catechu* in the Northern Province, but believed that it was confined to a single locality. The *Cathartocarpus Fistula* (Tiriconda), the barks of the Mangrove (Kadol) and *Anacardium occidentale* (Caju) were also extremely serviceable to the tanner. Many other astringents doubtless existed, but the above list was sufficiently comprehensive.

With regard to oils, Mr Mead said there were but two in addition to those already known in commerce which used to be referred to. The seed of the Margosa (*Melia azedarach*) could be had in great quantities in Jaffna for about 10d. a bushel, and medical men had declared that in cases of consumption its curative qualities rival those of cod-liver oil. Cardole, a powerful vesicant, procured from the pericarps of the cashew nut (*Anacardium occidentale*), could be had in abundance for the mere cost of extraction, as the husk was universally thrown away. Other oils could be procured in various parts of the island; but they were either to be obtained only in small quantity, or were absorbed by local demand. Gingelly seed could be had at the commencement of the season at about 5s. per cwt.

The Lecturer brought his address to a close by pointing out the fields which were open to European enterprise in the cultivation of oil-seeds and dry grains by steam machinery, and the curing of tobacco. A ploughing machine at home could turn up seventeen acres a day; and here, where the land was merely scratched with a stick, it could get through at least twenty-five acres. Gingelly seed, which was sown broadcast, gave sixty fold of increase; and it could be cultivated, reaped, and threshed out by the sole aid of steam. In all cases where steam could begin and end the work, its employment could not fail to be beneficial. It would be far better that the people should look to the dry crops generally, for the country was not suitable for paddy cultivation; in proof of which he stated the fact, that whereas the Government in Pegu assessed the land for taxation on a presumed increase of forty for one, paddy-fields in Ceylon returned but six bushels of crop for one of seed. As for tobacco, it was grown extensively in the Northern Province and the district of Negombo, and was considered fully equal to the best of foreign growths, so far as the leaf was in question. But the mode of curing it was most imperfect. In order to develop the best qualities of tobacco, it was necessary, after the leaves had been carefully dried, to press them down upon each other with heavy weights, until the sweating process was finished, when it would be found that the leaves were all of one colour, and greatly improved in flavour. It would cost but a trifle to erect drying sheds, and prepare in the above manner the leaf purchased from the cultivator. Not less than a ton of tobacco must be pressed at one operation, and it was therefore hopeless to expect that the cultivator could effect the needful improvements.

Samples of arrowroot, tapioca, cassava, and semolina, the latter a substitute for sago, were shown. The yield of arrowroot was 21 cwt. to the acre, giving 15 per cent. of starch. The grower sold his produce at 6s. per cwt., and allowing 1*l*. for the rent of land, his profit was 3*l*. 3s. The prepared starch sold at 9d. per lb., and gave a profit of 21s. per cwt. Tapioca yielding 10 per cent., sold for local consumption at 1s. 3d. per lb. The roots were paid for at the rate of 4s. per cwt., and the manufacturer's profit upon a hundredweight of the starch was within a fraction of 4*l*.

Mr Mead brought his observations to a close by expressing a hope that Government would secure the assistance of qualified persons to analyse and report upon the countless mineral and vegetable resources of the island, and he should rejoice to hear at a future period that the work had been accomplished during the administration of Sir Charles MacCarthy. In the course of the evening, Mr Mead took occasion to remark that the whole of the fibres, starches, &c., had been prepared at the Lunatic Asylum, under the care of its highly-accomplished and energetic superintendent, Mr Wambeek. The dyed fibres looked very brilliant, and a pair of mats, woven in gold by the lunatics from the aloe and coir fibre, deserve especial notice. We had almost forgotten to say that various medicinal substances were cited by Mr Mead as being easily and cheaply procurable, which were now imported at much expense to the colony.

INDIGENOUS VEGETABLE PRODUCTIONS OF THE COLONY OF VICTORIA.

BY DR FREDK. MUELLER, F.R.S., GOVERNMENT BOTANIST.

Gums, Resins, and Dyes.—The gum of the "wattle" acacia is principally obtained from *Acacia mollissima*, *A. dealbata*, and *A. pycnantha;* these being not only more universally diffused over the colony than most other arborescent species, but also more prolific in their yield of gum. This gum, although generally less transparent and pale than the genuine gum arabic and of less solubility, is nevertheless very valuable for gluing purposes, cotton-printing, &c., having the advantage over the Arabian, Nubian, and Senegal acacia gum, in being less brittle after application. In transparency and solubility it is surpassed by the gum of *Pittosporum acacioides* and other *Pittosporums*, none, however, being sufficiently gregarious to render their products readily obtainable.

The sandarac resin can be rather abundantly gathered from the *Callitris verrucosa* (*Frenela crassivalvis*, Miq.), a pine which is not unfrequent along the sandy tracts of the Murray, and is scattered also sparingly through the interior, extending westward and northward to Shark's Bay and Arnhem's Land. The similarity of its exudation with that of the Mediterranean sandarac pine is evident.

From the balsamic resin of the grass-tree (*Xanthorrhœas*), in many aspects akin to benzoin, a fragrant spirituous varnish can be prepared. The resin has been used for fumigation and in the preparation of sealing-wax. It has also been employed as a Nankin dye for calico. Investigations seem hitherto not to have pointed out any important dye-plants indigenous in Victoria, although it may be presumed that some of our various woods and herbs may yield such; and, indeed, the berries of *Hymenanthera* have already been found to furnish a lasting violet pigment.

Fibres.—The Victorian and South Australian stringy-bark tree claims particularly our attention amongst those indigenous plants yielding fibres. The thick fibrous bark, employed by settlers whenever obtainable as their first roof, is devoid of tenacity, but may, as experiments have shown, be employed for the manufacture of a rough kind of paper, although of brittle texture.

The bark of *Sida pulchella*, and of various *Pimeleas*, and of *Brachychiton*, affords to the natives the means of making cordage; but none of these fibres can be compared in yield to those which European culture has now made universally available.

Medicinal Plants.—For investigations into the medicinal properties of plants, a wide field is evidently still open. What we have hitherto learned in this direction has been principally through the guidance of systematic botany, which, whilst it reveals the structural affinities of plants in a comprehensive view, points also generally to the close similarity of their properties. Thus, we learn that, for the European gentianeous plants, used so extensively as tonics, Australian species may be substituted, such as the *Sebœa ovata*, which abounds during the spring in our meadows, or *Sebœa albidiflora,* an annual plant scattered over the subsaline pastures of the coast tract, or *Erythrœa Australis*, occurring in humid localities. It appears also that the closely-allied order of Goodeniaceæ offers, in numerous species, a substitute for gentianeous plants.

Pervaded with tonic bitterness are also most of the Comespermas, which in our colony replace the Polygalas.

The root of *Lavatera plebeia* has been brought into practical use instead of Althæa. The bark of the well-known Australian sassafras-tree is employed as a tonic and stimulant. Its powerful bitterness, probably depending on an alkaloid, is combined with a pleasant peculiar aroma. As this valuable and beautiful tree abounds in many of the fern-tree gullies of Victoria, New South Wales, and Tasmania, it is not unlikely that it will some day, when its medicinal properties are more appreciated abroad, form an article of export from these colonies.

The numerous Diosmaceous plants which ornament in varied froms almost every part of the colony, from the summit of the alps to the scrubs and forests of the lowlands, deserve notice, as possessing more or less sudorific and diuretic properties, in which respect some of them may be compared to the Buchu.

More attention should be directed to the circumstance, that all the myrtaceous plants, which throughout Australia constitute the main part of the timber, and generally also of the scrub vegetation, yield in a greater or smaller degree an essential oil. Unlimited quantities of Eucalyptus and Melaleuca leaves might be turned to account by the simple process, by which in India, from the leaves of *Melaleuca Leucodendron,* the Cajeput oil is obtained. The oil of the leaves of the red-gum tree is similar in flavour to the Cajeput oil, and may be safely used instead of the latter in spasmodic and rheumatic affections. The Eucalyptus leaves have, on account of their abundance of volatile oil, been used already for the manufacture of gas in lighting the township of Kyneton.

It is also worthy of record that a bark of equal properties with that of mezereon may be obtained, as the natural system prognosticated, from our Pimeleæ. Nothing, for instance, can surpass the mezereon-like acridity of *Pimelea stricta.* The gum resin of *Eucalyptus resinifera* and other species has, since the early days of the Australian settlement, been occasionally exported as New Holland kino ; and, being a powerful astringent, it is entitled to our attention, particularly when we remember in what vast quantities it is obtainable in every part of Australia. In domestic medicine it has been often employed against diarrhœa. It is not improbable that the Gipps Land *Smilax latifolia* may serve the purpose of sarsaparilla, this being the only Victorian plant allied to the genuine American drug. The pungent juice which pervades all parts of the so-called pepper-tree, *Drimys aromatica* (*Tasmania aromatica*, R. Br.) affords another instance how felicitously the natural system of phytology can be applied for ascertaining properties of allied species, although they may belong to very distant countries. This tree supplies us here with the Winter bark of the Magellan Straits.

The saccharine secretion known as Australian manna is occasionally, during the hottest months of the year, obtainable in considerable quantities from the leaves and tender twigs chiefly of the *Eucalyptus viminalis;* but, containing no mannite, it cannot be regarded as a substitute for Ornus manna. The exudation which encrusts now and then the bark of *Myoporum platycarpum*, a small desert tree, resembles raw sugar.

The wattle bark, chiefly from *Acacia mollissima* and *pycnantha*, is used medicinally as an astringent; but technically it is employed in all our tanneries, and formed, previous to the Australian gold era, an article of export to the English market. The gum resin of the Eucalypti is likewise employed for tanning. The abundance of salsolaceous plants, as well inland as along the coast, favours evidently the manufacture of soda.

Perfume Plants.—There are few plants indigenous to Victoria, as far as known, which may be regarded practically valuable for their perfume; none of them would supersede in odour or in yield of essential oil any of those already elsewhere in use; but it should be remembered that many of our native plants are as yet imperfectly examined in this respect, and it is, therefore, possible that future experiments may prove the existence of plants possessing a sufficiently copious supply of scented oil to render them available for distillation.

The great prevalence of myrtaceous trees and shrubs throughout Australia is a well-established fact. All, without exception, are characterised by the presence of a greater or lesser quantity of essential oil, pervading leaves and flowers. This applies not only to the huge masses of Eucalypti which mainly constitute our forests, and all yield, as stated before, an aromatic volatile, often, however, somewhat camphoric oil, but also to the "tea-trees," species of Melaleuca and Leptospermum, so called because their oil, which gives to an infusion of their leaves an aromatic taste either strong or pleasant, was used by Cook and other early Australian navigators as an antiscorbutic tea.

More important as perfume plants are some of the species of Bæckia and Chamælaucieæ, embracing numerous handsome and common shrubs of the Myrtle family, of which some are impregnated with large quantities of truly well-scented oil. But of their actual yield we have no exact record.

How far the plants of the Rue tribe, which are all strongly odorous from essential oil, are of value for perfume distillation, future experiments must prove. The impression, however, will probably be correct, that they furnish an oil useful for medicine rather than for the toilette.

The plants of the Mint tribe deserve here particular notice; for our three kinds of native mint possess an exceedingly pleasant odour, very different from that of the crisp or the peppermint. The species of Prostanthera are nearly all strongly and agreeably scented. Their oil could be cheaply enough obtained, but would be only useful for admixture with other scents. The *Humera elegans* has been recommended as a plant perhaps worthy of distillation on account of its balsamic fragrance. Very many of the Acaciæ, indigenous to this country, produce flowers of a most agreeable odour, and a useful distillation may possibly be obtained from them. If so, this point will require more attention, as these trees and shrubs are very gregarious, and produce flowers in the utmost profusion.

Melbourne.

NOTES ON THE ECONOMIC PRODUCTS OF THE MALLOW FAMILY.

BY JOHN R. JACKSON.

Amonst the many natural families of plants, which contribute so largely to the wants and necessities of man, the Mallow Order claims a prominent position. There are few, perhaps, which abound in such a variety of economic products as this order does, unless we look to the Leguminosæ, Graminaceæ, &c.

Plants of the Mallow family are found abundantly in the tropics, few of them reaching a higher latitude than that of our own country. They are remarkable for the entire absence of all noxious properties, and for the great quantity of mucilage and abundance of fibre contained in nearly all the species. Thus, the marsh mallow (*Althœa officinalis*, Lin.) gives in decoction a plentiful supply of a tasteless, colourless mucilage, obtained from all parts of the plant, but chiefly the root; it is given as a demulcent to children, but is more used in France than in this country, being a favourite medicine with them. They form it into lozenges, combined with gum arabic, sugar, and white of egg, and in this shape it is known by the name of Pâte de Guimauve. They also employ it in poultices, &c. In 1821, 280 acres of land were planted in England with it for the sake of its fibres. The leaves of the hollyhock (*Althœa rosea*, Cav.), another well-known garden plant, furnish a blue dye resembling indigo.

The common mallow (*Malva sylvestris*, L.) abounds in mucilage, and is used in medicine in the same manner as *Althœa officinalis.*

The petals of *Malva alcea* are astringent, and a black dye is also obtained from them. The leaves of *Malachra capitata*, L. are said to be anthelmintic, and are employed as such in Panama.

Several species of *Sida* yield medicinal properties, and are used by native practitioners in India; while the root of *S. retusa*, L., boiled in oil, is used externally and internally in rheumatism, and a decoction of its leaves as a head-wash.

An infusion of the root of *Sida acuta*, Burm., is also employed in India in intermittent fevers, and is in great repute amongst the Hindoos, who value it as a specific in chronic bowel complaints; while a juice obtained from the leaves, when mixed with honey, is considered efficacious in dysentery, and a supposed remedy in snake bites.

In Brazil, a soap is made from the ashes of the so-called "Broom plant" *Sida lanceolata*, Retz., *Abelmoschus moschatus*, W. et A., also abounds in mucilage, and is used to clarify sugar in the N. W. of India; from this plant a tough fibre is procured. The seeds have a strong odour of musk, and are used instead of animal musk for scenting pomatums, &c., as well as by perfumers in this country for like purposes. In the West Indies they are reduced to powder, and in combination with rum, are considered of great value in snake bites. The Arabs use them for scenting their coffee.

Another species of this genus, *A. esculentus*, W. et A., has similar properties, and its young fruit is known in the West Indies as "Ochro," and in the East as "Bendi-kai." These are much esteemed in both places for thickening soups, and for this purpose are sometimes met with in the form of a powder. In the unripe state they are also cooked and eaten as a vegetable, and occasionally pickled like capers; while the seeds have been recommended as a substitute for coffee, for which they appear ill-suited. They are, however, commonly used in the same manner as pearl-barley is in England, being boiled for the purpose of extracting their emollient and demulcent properties. The leaves are applied in poultices. According to Dr Roxburgh, the fibre from this species is not of such great strength as the former, yet it is used in the manufacture of ropes, gunny bags, &c., and is also made up into paper. The flowers of *Abutilon esculentum*, St Hil., known to the Brazilians as "Bençao de Dios," are used by them as a vegetable.

Pavonia diuretica, St Hil., is as its name implies diuretic, and is used as such in Brazil; but it is supposed to act more as an emollient.

The Brazilians also employ a decoction of *Sphæralcea cisplatina*, St Hil., in inflammation of the bowels; indeed, its properties are very similar to those of our own marsh mallow.

A decoction procured from the root and stem of *Urena lobata*, L., is esteemed in the same country "as a remedy in windy colic;" while the flowers are used as an expectorant in dry and inveterate coughs; and the bark of the plant affords a good cordage.

The leaves of *Hibiscus cannabinus*, L., are employed in the East Indies as a vegetable, having a slightly acid taste; while from the bark a strong, soft fibre is got, which is manufactured into ropes, coarse cloths, &c.

The calyces and capsules of *Hibiscus sabdariffa*, L., are known in the West Indies as red sorrel, and are used for making tarts, the seeds being previously taken out. They are said to form an excellent jelly, a decoction of them is also employed—sweetened and fermented—as a drink, and is called "Sorrel cool-drink." This liquor is often used in our sugar colonies, it being a very pleasant, cooling beverage. The leaves are used in salads.

The Chinese employ the showy flowers of *Hibiscus rosa sinensis*, L., in the formation of festoons and garlands on festive occasions, and also in their sepulchral rites. The petals have astringent properties, and are used by Chinese women to blacken their hair and eyebrows, and also as a substitute for blacking. The bark of *Hibiscus arboreus* furnishes a fibre from which whips are made in the West Indies.

It is stated that the bark of *Paritium tiliaceum* is sucked by the natives of the South Sea Islands, when the bread-fruit crop fails, or in times of scarcity, and a good matting is produced from it by the Otaheitans, who also form it into ropes and cords, which are reputed to be fit for any purpose, even the rigging of vessels; but it has been found that it does not nearly equal the strength of rope made from hemp. The Fiji Islanders employ it in the manufacture of articles of clothing.

The wood of the "Blue mahoe" (*Paritium elatum*, Don.) is used in Jamaica for cart, carriage, and waggon bodies, and also for furniture and inlaying fancy work. The Cuba Bast, so much employed in gardens as a substitute for Russia matting, for tying plants, is the inner bark of a variety of this species.

Thespesia populnea, Corr., furnishes a tolerably durable wood, which is used in Ceylon for carriage-wheels and other purposes. Perhaps the most useful of all the products of this order is Cotton, procured from several species of *Gossypium*. It is cultivated to an enormous extent in North and South America, and the East and West Indies, from whence we receive immense quantities, as also from Egypt, Western Africa, &c. So much has been written on this commodity, that it would be vain to enter into any details here, except that during the past year the total amount of raw cotton imported into this country amounted to 12,419,096 cwt. Of this quantity, the United States supplied 9,963,309 cwt., and British India 1,822,689 cwt., the remaining portion being derived from Egypt, Brazil, and other countries. Cotton-wool, although the most valuable, is not the sole product of this plant, for from the seeds an oil is expressed which is used like Olive oil, as well as for burning in lamps. It is manufactured in large quantities at Marseilles. The refuse after the oil is expressed has also been lately turned to account in the manufacture of oil-cake for cattle, being cheaper than that made from linseed. About two gallons of oil is procured from a cwt. of seeds, leaving a residue of about 96 lb. of cake.

Kew.

Reviews.

The Forests and Gardens of South India. By Hugh Cleghorn, M.D., &c. W. H. Allen and Co.

This is a work which, if not all that is wanted for a due appreciation of the woods of the Indian forests, is certainly a valuable addition to our scanty stock of information on the subject. That the work is faulty and deficient on many points, that a heterogeneous mass of rough material is jumbled together without much condensation or arrangement, and that there is some confusion and discrepancy in the native names and various accounts, cannot be denied. But the Author himself admits many of these faults and blemishes, pleading, however, in extenuation, that the book has been compiled under the disadvantages of the scanty leisure afforded by a short furlough on sick leave.

With all its shortcomings, we are, however, glad to see the publication of such a work containing a mass of practical and very useful information on the Asiatic forests, especially of Southern India, and their economic products. The want of such a handbook has long been felt; indeed, there is an urgent demand for a work furnishing full information on the woods of various countries, their availability, probable price, and properties Such a work, appearing concurrently with the International Exhibition, in which there will be very large collections of woods, about which little or nothing is known, would find a ready sale, and prove of inestimable value to builders, cabinet-makers, turners, and other workers in woods. How little is known generally of the various woods of North America, Asia, Ceylon, and the Eastern Archipelago, Africa, South America, or Australia. We began to collect long since, for our own information, all the current matter available about these.

Dr Cleghorn, who was appointed Conservator of Forests for the Madras Presidency by Lord Harris, when Governor there, has long given great attention to this important subject. In 1850 he was nominated one of a Committee appointed by the British Association to investigate the system of forest administration in India; and the result of this inquiry, submitted to the meeting at Ipswich in 1851, was, that neither the government nor the community at large were deriving from the Indian forests those advantages which they were calculated to afford. Not only was there a most wasteful and uncalled-for destruction of useful material, but numerous products—valuable to science, and which might be profitably applied to the interests of social life—lay neglected within the depths of the forests. This report recorded evidence bearing on the state of the forests in Malabar, Canara, Mysore, Travancore, the Tenasserim Provinces, the Indian Archipelago, and the wooded districts which skirt the base of the Himalaya. If this subject was important ten years ago, it is much more so now, when the supplies of oak having failed, the Government are at their wits' end for good ship-building woods, and are causing inquiries to be made in every direction for useful substitutes.

Looking at the extermination of the Teak-forests in Moulmein, and at the injurious "kumara" practice which destroys vast quantities of the most valuable timber, a code of forest regulations for all India is much wanted. Dr Cleghorn well observes that "of all European nations, the English have been most regardless of the value of forests, partly owing to their climate, but chiefly because England has been so highly favoured by vast supplies of coal; and the emigrants to the United States have shown their indifference to this subject by the reckless destruction of forests in that country, of which they now feel the want. If conservation be needful in temperate climates, how imperative is it in the tropics, where the supplies of water, and, consequently, of food and other produce, are in a great measure dependent on the existence of forests, especially in all the elevated parts of that vast country."

The bulk of the present work is made up of Dr Cleghorn's several official reports to the Government—the Jury reports on timber and ornamental woods of the Madras Exhibitions—forest rules, &c.; and there is appended to the volume a useful, but very incomplete, list of systematic works on the subject, suitable for reference by inquirers. A forest chart is given, and a great number of interesting illustrations.

This effort of Dr Cleghorn to diffuse information on Indian woods, is certainly to be commended, and the work will be read with interest in many quarters.

The Channel Railway Connecting England and France. By James Chalmers. E. and F. N. Spon.

We live in an age of mechanical progress where, with great feats accomplished and staring us in the face, it is scarcely possible to be sceptical. Who that considers the Thames Tunnel, the Menai Bridge, the Victoria Bridge across the St Lawrence, the Great Eastern, the submerging the Atlantic Cable, and other engineering works of the past, will assert the impossibility of forming a communication by a tunnel with France. It scarcely falls within our province to investigate the plans and data set forth, but Mr Chalmers reasons calmly and deliberately upon the matter; and setting aside the enormous difficulties of construction, his estimates seem to be moderate and carefully framed.

An Essay on the Beautiful and Sublime; or, Elements of Æsthetic Philosophy. By Vincenzo Gioberti. Translated from the Italian by Edward Thomas, Esq., Pupil of the Author at Brussels. Second Edition. London: Simpkin, Marshall, and Co.

The thoughtful and philosophic portion of our readers will thank Mr Thomas for the translation of Gioberti's celebrated work on the 'Beautiful and Sublime.' Mr Thomas, in his preface, states that it is not intended as a novel to satisfy the idle and the curious, but, on the contrary, is published for the consideration and study of men of science, and those who are capable of appreciating its inestimable value. No small pains have been taken in translating a work extending over 400 pages, and we doubt not but that the industry and care displayedwill meet with the success deserved.

The West Indian Quarterly Magazine. No. I. Edited by Hugh Croskery, Esq. Henderson, Savage, and Co., Kingston, Jamaica.

Besides several medical articles, there are a few interesting technological papers, one of which, that on Bitter Cassava, we have extracted into our pages. The following remarks have also our hearty concurrence; and the more such truths are pressed upon public notice, the better for the interests of the West Indian Colonies.

"Of all the islands in the Antilles, there is none so rich in Nature's gifts as Jamaica,—and yet little is done to cultivate so fertile a vineyard. Thousands, aye, hundreds of thousands of broad acres of the richest land, remain grown up in brushwood; while their proprietors—and many of them rich men too—are absentees, who care not for their properties, because they know not what a mine of wealth the judicious expenditure of a little money might discover. After the abolition of slavery, and the unjust admission of slave-grown products into the English market, years of depression succeeded years of prosperity; sugar estates, coffee and pimento plantations were thrown up, and their proprietors became either bankrupts, ro left the island to seek the means of livelihood elsewhere.

"Again, when there was a chance of improvement, and it was proposed to add to our labour market by the importation of foreign immigrants, we were denied the opportunity even of getting these, and the tide of immigration was ruthlessly arrested. Now, however, we are told that these restrictions will be removed, and that the British Government will give every encouragement to the importation of foreign labourers; and why? because England must have cotton and other staples, which, hitherto, she has sought elsewhere, and which she knows cannot be cultivated here without increased facilities of labour. This very pressure will, we hope, be the means of raising England's West Indian possessions from that slough of despair and poverty into which most of them have fallen."

De la Culture, de la Canne, et de la Fabrication du Sucre a l'Ile de la Reunion. Par M. Malavois. Paris: J. Louvier.

A well-written and intelligent treatise on sugar cultivation, as practised in Bourbon or Reunion, by a colonist of thirty years' experience, who has seen the products of his labour and industry doubled by scientific culture and improved processes of manufacture. A translation of this *brochure*—from the systematic manner in which the subject is treated—would even prove useful in many of our own sugar-producing colonies.

The Edinburgh New Philosophical Journal for October contains a paper entitled, Notes upon the Cocoa-nut Tree and its uses, by Dr Cleghorn; and two articles, by Dr James Hector, On the Central Part of British North America—one on its Physical features and Botany, and the other on its Capabilities for Settlement.

The Technologiste (Paris) for October contains some excellent papers on the Composition of Iron and Steel, by Messrs Fremy and Caron; on the White Beet-root of Silesia, by H. Leplay; and on the Manufacture of Oils from Boghead Mineral and Schiste.

We would draw attention to a new Monthly Journal, recently started, under the title of 'The Institute,' edited by Mr Joseph Simpson, many years Librarian of the Islington Literary Institution, intended as a special organ for Lecturers and Institutions, and which promises to prove a useful medium of communication.

Publications Received.—Synopsis of the Edible Fishes of the Cape of Good Hope, by L. Pappe, M.D. Sylva Capensis, a Description of South African Forest Trees and Arborescent Shrubs, by L. Pappe, M.D. Papers and Proceedings of the Royal Society of Van Diemen's Land, vols. I to III. The Chemist and Druggist for October. The Pharmaceutical Journal. Annales de l'Agriculture des Colonies. The Technologiste (Paris), vol. 22, and number for October.

NEW TECHNOLOGICAL WORKS.

Bermuda: its History, Geology, Climate, Products, and Agriculture. By Theodore L. Godet, M.D. 8vo, 9s. Smith, Elder, & Co.

India-Rubber, or Caoutchouc: its Past, Present, and Probable Future. By E. T. Dunn. Wilson.

Elements of Chemistry, Theoretical and Practical. By Dr W. A. Miller, Professor of Chemistry, King's College. 2*l*. 12s. 6d. Parker, Son, & Bourn.

Beasley's Druggist's General Receipt Book. Fifth Edition, 6s. Churchill.

Chemical Technology. By Knapp, Richardson, and Watts. Alkalies and Acids, 10s. Baillière.

THE TECHNOLOGIST.

NOTES ON THE FEBRIFUGE PLANTS OF CEYLON.

BY WM. C. ONDAATJE, COLONIAL ASSISTANT-SURGEON.

For many years past my attention has been directed to the examination of a large number of medicinal plants growing in Ceylon. I have from time to time, while on duty, at the various stations, noted down the names of such as are reputed to possess valuable medical properties, with a view to future experiment.

It need hardly be mentioned to those who are acquainted with our Indian Materia Medica that the physicians of the East, have from the earliest times, greatly exaggerated the remedial effects of plants, ascribing to them many varied and wonderful properties, which the light of Modern Science has shown to be mere creatures of a fertile imagination.

It would be, comparatively, an easy task to repeat here the properties, and uses which are assigned by the natives to plants of this country, as well as to those found in India. But this having been frequently done, and many absurd and unfounded statements being only thereby propagated, I shall confine myself on this occasion to the consideration of the subject practically—as it refers to a few indigenous plants. That our jungles do abound with plants which may be converted into useful febrifuges none can doubt, who has any acquaintance with the vegetable productions of this beautiful island. A kind Providence has scattered in all directions the means of removing a disease, which may be regarded, as more or less endemic, and which of late has prevailed to so fearful an extent. I mean fever—to the cure of which by medicines procurable on the spot our best efforts ought to be directed. One of the highest botanical authorities says "that every country spontaneously furnishes remedies for those maladies which the people of the soil are naturally subject to."

But as the European pharmacopœia affords the necessary drugs for combating the many evils to which flesh is heir, few look beyond it for any new remedies, or for efficacious substitutes, for those already in use. We are often satisfied with possessing so powerful and invaluable a remedy as the disulphate of quinine ; and, with the present facilities for procuring it, we feel little inclined to extend our researches into the jungles, with a view to discover useful native febrifuges. "No one will be bold enough to assert that the physician already possesses the most powerful agents produced by the vegetable kingdom; for every year is bringing some new plant into notice for its energy, while others are excluded because of their inertness. In tropical countries, where a fervid sun, a humid air, and a teeming soil, give extraordinary energy to vegetable life, the natives of those regions often recognise the existence of potent herbs unknown to the European practitioner. (Lindley in 'Flora Medica.') But here scientific investigation becomes absolutely necessary, as we cannot altogether depend on the statements, either oral or written, which we find made by the people themselves, of the curative properties possessed by plants, which from time immemorial have been employed as remedies against local complaints.

The botanical characters of plants, their physical properties, their chemical constituents, their physiological and therapeutic action on the human system, are to be ascertained by laborious careful investigation, such as modern science enables us to use. This is the only way of arriving at any correct and practically useful conclusion in regard to the medicinal virtues of Indian plants.

In looking over my papers on this subject, I find noted down, the names of a goodly number of febrifuge plants,—of these, I may hereafter furnish a list. I shall here make a few remarks only on the more important ones, such as I think deserve prominent notice.

It is a remarkable fact, that the large majority of febrifugal remedies used by the natives in various parts of the island, contain a bitter principle with tannic acid and fecula or starch, which latter form also the principal chemical constituents of the best kind of Cinchona bark.

I am indebted to my brother, the Rev. S. D. J. Ondaatje of Matura, for the following list of the principal febrifuges mentioned in the Manjusa, a Pali work, compiled by a celebrated Brahmin for the use of the priests in the 13th century A. D.

Dummella—Trichosanthes cucumerina.
Venevel—Coscinium fenestratum.
Deeya mitta—Cissampelos Pareira.
Rasekinde—Tinospora cordifolia.
Bingkhomba—Munronia pumila.
Handung—Santalum album (Sandal-wood).
Kohemba—Azadirachta Indica (Margosa).
Bulu—Terminalia Bellerica (Gall nuts).
Aralu— do. Chebula (do.)
Wadakaha—Acorus calamus.
Belimul—Feronia elephantum (Wood-apple).
Lunuwele—Herpestis Monnieria.
Kaha—Curcuma longa (Turmeric).
Adhathoda—Justicia Adhatoda.
Samadera—Samadera Indica.
Sevendara mul—Andropogon Nardus.

Erevarea—Ocymum sanctum.
Kalanduru—Cyperus hexastachyus.
Kattowelbatte—Solanum Jacquini.
Kudu Meris—Toddalia aculeata.
Moodilla—Barringtonia racemosa.

I will now proceed to notice briefly two of the anti-febrile remedies indigenous to the island which I have used extensively in cases of intermittent fever. Although it must be admitted, there is no remedy as yet discovered equally efficacious with quinine, and to be used with so much certainty as a febrifuge ; nevertheless, as already remarked, remedies against fever are found in various parts of the island, especially in the more pestilential districts, where fever is doing the work of depopulation.

1. *Trichosanthes cucumerina*, Linn. — This is a valuable febrifuge plant, and much used by the natives of Ouvah, as one of the active ingredients in their fever decoctions, and which I consider, after extensive and careful trial, to be an efficacious remedy for fever. This statement may be startling to some, especially as the plant belongs to the family of Cucurbits, which has not a single member possessing anti-febrile properties, but, as it is well known, furnishes some of the most powerful cathartics of the Pharmacopœia.

The plant in question is an annual creeping plant, is known to the Singhalese by the name of "Dummella," and grows plentifully in the fever-generating districts of Wellasse and Bintenne. It yields to boiling water a bitter principle almost like gentian or chirayta.

Chemical Composition.—It contains tannic acid, which is also one of the principal constituents of the best kind of cinchona bark. Bichloride of mercury throws down a precipitate, which is also a test for the cinchona alkaloids. An infusion of the dried plant is the form in which I use it after the bowels have been freely moved by a dose of the compound powder of jalap or senna, and Epsom salts.

Infusion of Trichosanthes cucumerina.—Take of the dried plant, leaves and stem, 1 oz. ; boiling water, 2 oz. Infuse for four hours in a covered vessel, and strain. I use a copper decoction-pot. Dose, 2 oz., three times daily. It may be given during any stage of intermittent fever : when given in the cold or hot stages I have found it efficacious in abating the severity of the symptoms. No more than the quantity required for each day ought to be prepared at once, as the infusion begins to ferment when kept beyond a few hours.

As the plant grows plentifully in various parts of the Island, and is thus easily procured, I think there can be no difficulty in using it largely in all cases of ordinary intermittent fever. I have used the infusion of this plant in the Civil and Pioneer Hospitals at Badulla and elsewhere. It has proved a safe anti-febrile remedy. The result of my trial of this remedy was so favourable, that I brought the subject to the notice of Dr Bradford, February, 1854, while he was acting Principal Civil Medical Officer.

2. *Samadera Indica*, Gærtn.—This is a valuable indigenous tree,

which is found in great abundance in the neighbourhood of Colombo, and belongs to the family of Simarubaceœ. The inner bark of the wood is almost white, shrivelling up into quills when dried in the sun. An infusion of the bark is intensely bitter, and throws down a black precipitate by the tincture of iron. An infusion of the wood rasped is also very bitter with slight traces of tannin. I have tried an infusion as well as a decoction of the dried bark, but from its producing vomiting a few minutes after it had been taken, I have desisted from using it. But the rasping of the wood I have used very extensively in the Government Civil Hospital at Colombo under my charge. The wood of the tree is not unlike that of quassia, being remarkably light, of a white colour, and of a bitter taste. The number of cases of intermittent fever chiefly of the quotidian and tertian type, treated from February to July 1861, amounted to eighty-four; sixty-six of these were treated by the samadera wood, eighteen required quinine. The patients were chiefly Malabars, and Singhalese from Kornegalle, Kandy, Putlam, Taldinia, Chilaw, Hambantotte, and other fever-generating countries. In cases complicated with enlarged spleen, quinine was had recourse to, in order to check the febrile paroxysms. But in cases complicated with jaundice, of which there were two or three, the fever yielded under the use of the samadera wood. There were, however, cases in which, after the failure of the wood, even quinine itself did not succeed in checking the accessions of fever until after a long time.

The decoction of the rasped wood in combination with an infusion of galls (*Myrobalans*) is more effectual than the simple decoction which I first used ;—then there were more cases which needed quinine.

I propose to call the decoction with galls—

Compound Decoction of Samadera Wood.—Boil two ounces of the rasped wood in one pint of water, over a slow fire, for two hours—then strain.

Infusion of Myrobalan (Gall-nuts).—Infuse one ounce of powdered gall-nuts in one pint of boiling water for half an hour, in a covered vessel, and strain.

To make the Fever Decoction of Samadera Wood.—Take of the decoction one pint, infusion of gall-nuts ten ounces—mix. One ounce for a dose, to be taken three times daily.

Although we have succeeded in curing a large number of cases in hospital, it must be admitted that the process is slower than with quinine. I have remarked that, in a few cases of private practice, where the patient applied early, the fever subsided sooner than in long standing cases, such as those that are admitted into Hospital. It must at the same time be remarked that, as a valuable indigenous febrifuge, and as a cheap remedy, it may be used in all ordinary cases of fever, and in hospital practice. By thus using it, I must not omit to mention we have been able to save a large quantity of quinine, which would otherwise have been necessary. As a valuable tonic, and a succedaneum for quassia, it is unrivalled. We use it in our hospital practice largely as a tonic, with tincture of iron. The infusion is prepared in the same proportion as the infusion of quassia ordered by the 'London Pharmacopœia,' to prevent any precipitate with the preparations of iron. It is also used in combination with iodide of potash.

Chemical Composition:

Tinct. Ferri—dark precipitate.
Tinct. Iodine—beautiful blue.
Oxalic Acid—grey precipitate.

Govt. Civil Hospital, Colombo, September, 1861.

ON STIBICONISE, A NATURAL OXIDE OF ANTIMONY FROM BORNEO.

BY T. L. PHIPSON,
Phil. Nat. Doct. Bruxelles University, Member of the Chemical Society of Paris, &c., &c.

We get from Borneo a compact mineral, somewhat resembling certain varieties of Leptynite feldspar, and which is found more or less abundantly among the Stibine (sulphide of antimony) which the Island of Borneo launches into European commerce. It was at first looked upon as a portion of the rock which enveloped the native sulphide of antimony, and I believe many smelters have thrown it aside as such. It results from the examination to which I have submitted this mineral, that it is an oxide of antimony often very pure, and constitutes an ore sometimes superior in value to Stibine itself.

The mineral in question presents itself in form of a compact matter with a crystalline structure, yellowish-white or reddish, always giving a yellowish-white powder, and showing here and there crystals about half-an-inch in length, of a peculiar pearly lustre, and having numerous horizontal stripes; these striped crystals are straight rhomboïdal prisms, terminating with two facettes (biseau), and modified upon two of the perpendicular edges.

This substance is not volatile in a tube closed at one end (by which character it is distinguished from oxide of antimony SbO^3); before the blow-pipe, the purer samples are entirely volatilised in the flame of reduction, but are not volatile in the outer or oxidating flame. It cannot be melted before the blow-pipe (by which it is distinguished from *Exitelite*, or antimonic acid SbO^5 which is fusible); with carbonate of soda upon charcoal it gives a button of metallic antimony.

These characters prove the substance in question to be SbO^4—the *Stibiconise* of mineralogists, the *antimoniate of antimony* of some chemists. The samples which I have examined contain, as impurities, sulphur, stibine, oxide of iron, &c., but they were sometimes so pure that one of them gave me 65 per cent. of metallic antimony; whilst Stibine seldom yields more than 45 per cent.

Mineralogists are not agreed upon the quantity of combined water contained in Stibiconise, but the analyses I have made of the Borneo mineral appears to leave no doubt as to that question. The following record of one of the best analyses will show in what ratio the water stands to the antimonious acid :—

STIBICONISE FROM BORNEO.

		Oxygen.	Ratio.
Water	3·75	3·33	1
Antimonious acid, SbO^4	65·00	12·30	4
Oxide of Iron, Alumina	10·00		
Sulphur, silica, &c.	21·25		
	100·00		

From this we may, therefore, deduce as the formula of Stibiconise :—

$$SbO^4, HO.$$

The specific gravity of Stibiconise, according to several authors, is 3·80 ; but all the samples of the Borneo mineral gave me densities, varying from 4·64 to 4·68, whence I concluded they would probably contain silver. However, I could not find in them sufficient silver to account for this increase of specific gravity. Neither does the Borneo Stibiconise show more than a trace of arsenic.

As the Stibiconise (antimonious acid) of which I speak, accompanies Stibine (sulphide of antimony) in Nature, and affects the same crystalline form as the latter, it is very probable that the oxide in question has been formed in Nature at the expense of the sulphide, by means of water or steam heated under pressure, as we see it act in the beautiful experiments recently made by my friend, M. Daubrée, where Wollastonite, and some other minerals, were artificially formed in perfect crystals by the mere action of superheated steam upon glass in closed tubes. The chemical reaction which Nature appears to have used in forming Stibiconise from Stibine is as follows :—

$$SbS^3 + 3HO = SbO^3 + 3SH.$$

Stibine. Water. Oxide of anty. Sulph. hyd.;

and SbO^3 combining with one proportion of oxygen from the air gives SbO^4 antimonious acid or Stibiconise.

If we suppose, for a moment, that the transformation in question was effected by air (oxygen), instead of water, we find that it would require nine equivalents of oxygen to produce the same effects as three equivalents of water :—

$$SbS^3 + 9O = SbO^3 + 3SO^2$$

Stibiconise has been regarded as a somewhat rare mineral in Europe, but Borneo seems to possess large quantities of it. Another argument in favour of its formation from Stibine is, that it always accompanies the latter in Nature.

The Stibiconise of Borneo is readily dissolved in a warm mixture of hydrochloric acid and tartaric acid. To transform it into metallic antimony, I succeeded best by fluxing the pulverised mineral with a mixture of charcoal, bitartrate of potash, and carbonate of soda.

It occurred to me that by mixing equivalent proportions of Stibiconise and Stibine, and applying heat, I should get metallic antimony thus:—

$2\,SbS^3$	+	$3\,SbO^4$	=	$5\,Sb$	+	$6\,SO^2$
Stibine.		Stibiconise.		Antimony.		Sulphurous acid.

But such is not the case: If the air has free access into the crucibles, the sulphide is converted in SbO^3 which volatilises ; and if the crucibles are nearly closed the whole melts and forms a mobile liquid, which, in cooling forms a bluish, metallic, crystalline mass, giving a brown powder when pulverised. The compound thus formed I ascertained to be an oxy-sulphide of antimony, analogous to what is called mineral kermes.

The Borneo Stibiconise has lately been employed as an oil paint; for which purpose, as recommended by Dr Stenhouse, it is calcined and pulverised. It is said to possess certain peculiar advantages for house-painting, &c. According to what I have said above, the purer portions of the mineral constitute an ore of antimony of greater value than the sulphide which is generally used as such.

ON BLEACHING.

BY HENRY ASHWORTH.

The art of bleaching may be considered to have taken date from the earliest ages, probably from the time when human knowledge had become extended to the fabrication of clothing ; and the inventor may have been the first housewife whose personal feelings induced the desire to enjoy the comeliness and the comfort of clean linen. Primarily, the operation has been accomplished by soap and water, the friction of the human hands, and exposure to the whitening effect of the atmosphere. Theoretically speaking, the bleaching of the present day, in all its enlarged proportions, is accomplished out of the same elements, although in their application they may have been altered and modified to suit the economy of modern chemistry, and the mechanical appliances which now supersede the manipulations of a bygone age. The interesting character of the progress of these changes it will be our province to endeavour to trace. The ancient writers do not appear to have left us any details on the subject, and the knowledge we possess extends only as far back as the middle of the last century. Previous to that time, the cotton manufacture was scarcely known, and the linen manufacturers of the north, who knew nothing of bleaching, used to send their brown fabrics to be bleached in Holland, and they weie received again in the course of eight months, and sold under the definition of Brown Holland. In the year 1749, the practice of lime-bleaching was introduced, and the cloth was then steeped in alkaline lye, which was called "bucking." The subsequent process of bleaching was done by exposure on the grass, which was called "crofting," and these operations were repeated five or six times, extending over a period of eight or ten weeks. The first advance upon this tedious process was made by Dr Home, of Edinburgh, who substituted a very weak solution of sulphuric acid for the butter-milk, the rye-meal, and the bran operations previously employed, and by this means he accomplished the same result, and in a shorter time than by the buttermilk process, which had required two months. In the year 1787, an important change took place in consequence of the discovery by Mr Scheele, of Sweden, of a chemical compound, such as is now designated chlorine, and this was used as a substitute for exposure to the atmosphere. The repeated experiments of Berthollet added considerably to the facts already known ; but the practical effects of these discoveries were more fully brought out by Mr Watt and Dr Henry, and it is to them that the chief merit is due of introducing the new mode of bleaching cotton goods. To those who are familiar with the history of the cotton manufacture, it will be apparent that bleaching, as a distinct pursuit, had by this time become a neccssity of the trade ; therefore, the manufacturer consigned to the bleacher, who was originally called a whitster, his woven fabrics in the state in which they came from the loom, loaded as they were with impurities ; and the following is described as the course of operations by which he undertook to whiten them. The loose fibres of cotton, adhering to the surface of the cloth, were removed by passing the whole length of the piece over a curved plate of iron heated red hot,—an operation that required to be done with great velocity to prevent any injury being sustained to the goods. The cloth was then deposited in a cistern of water, or in a weak alkaline lye, where it would remain, perhaps, for some weeks until the flour paste, used as dressing by the weaver, had become softened by fermentation. The removal of the paste and other matter contained in the web was accomplished by the agitating process of a dash wheel, or cylindrical box revolving on its axis, having four compartments, or internal divisions, radiating from the centre, in which the bundles of cloth were deposited. A supply of water was being injected at the sides of these compartments, to carry off the impurities as they were liberated by the jolting concussions created at every revolution of the wheel. This invention was deemed a great advance upon the previous practice of dragging the pieces by hand through a stream of water in the water-pits constructed for the purpose. The cloth was next boiled in lime-water, and another operation of the dash-wheel succeeded. The lime-water had to be expressed from the cloth by passing the whole length of each piece betwixt a pair of revolving rollers, called "squeezers." It was then immersed in a composition called "chemical," and when taken out was carefully washed in cold water. These operations, more or less varied in their character and arrangement, were repeated a number of times ; the cloth had some weeks of exposure in the grass fields, with an occasional sprinkling of water to aid the process of whitening, and was then considered to have received a bleaching ; the process of drying was in long sheds, constructed mostly of wood, having openings at the sides with sliding doors, and the pieces were suspended by hand upon lines of railing, until they had become sufficiently dried by the atmosphere. When taken down, every piece was neatly folded and compressed by screw pressure, and this was deemed the finishing process before delivery at the warehouse of the manufacturer. It is from such a beginning, and within living memory, that I shall endeavour to trace the successive changes which, in the course of sixty or seventy years, have led to the establishing of that important branch of trade, now so intimately connected with the cotton manufacture of this and other countries. The chemical preparations originally adopted were somewhat primitive: the acids were derived, in some extent, from an immersion of the cloth in sour milk, although the use of a weak solution of sulphuric acid was the more prevailing practice. The alkali, which is the basis of soap, was derived from the ashes of burnt fern, sea-weeds, or other similar products. The oxygen of the atmosphere was employed to whiten the grey fibre of the cloth, and a decoction of sorrel was used to remove the stains and iron-moulds. About the year 1795, it had become obvious that the growing demands of commerce required a more efficient agency than could be derived from such rude elements. Severe pressure on the trade was felt from the enormous amount and cost of labour required, the heavy expense and the inferior quality of the drugs then in use, the rental paid by the bleacher, for so large an extent of grass land as he found it necessary to occupy with the exposure of his cloth to the atmosphere, together with the unavoidable delay, uncertainty, and pecuniary losses, which were constantly occurring from unfavourable weather and other causes. The manufacturer also suffered greatly from the frequency of his disappointments, and the inconvenience and loss he sustained from the necessity of having his capital in goods lying three months in the bleach grounds. The emergency which had now become so apparent had the effect of bringing out inventions and improved processess. These succeeded one another with great rapidity, and those proprietors of works who possessed intelligence and capital made rapid progress ; although there were other instances in which the want of capital or the absence of enterprise prevailed, and in these cases there remained a lingering adherence to those antiquated usages which were being superseded in other concerns. Everyone knows that in whatever manner bleaching is done, it must be effected by means of true chemical agency ; and, therefore, it was to the chemist that the bleacher had, in the first instance, to look for the discovery of more potent agents to effect his object. The first great triumph in this department was the discovery, in 1798, by Mr Tennant, of Glasgow, of a method of making saturated liquid chloride of lime,—an article which was found to answer quite perfectly all the purposes required by the bleacher. This invention, for which he took out a patent, consisted in the substitution of lime for potash. His patent right was resisted by the bleachers of Lancashire, and was set aside by the verdict of a jury. The grounds of this decision were, that the patent included a mode of "bucking" with quicklime and water, which was not a new invention; and because one part of the patent was not new, the whole of the claim must be set aside; and by this decision the use of liquid chloride of lime in bleaching was thrown open to all. It was deemed an unfortunate circumstance that, in consequence of an error of expression in describing his process, Mr Tennant should be deprived of the fruits of a laborious investigation, extending over several years. There was a strong feeling of sympathy manifested, and the bleachers of Lancashire presented him with an expression of their grateful acknowledgment by a service of plate, which Mr Tennant accepted; but it was most in accordance with the character of his original design to press onward with his discoveries, and to bring his first invention to a still more practical issue. He therefore adopted a new method—one which at length he completed and secured by patent, for impregnating quicklime in a dry state with chlorine, and in this instance his right remained uncontested. He lived to enjoy his pecuniary reward; and the manufactory which he established in Glasgow is at this time the largest in extent of any of the kind in Great Britain. The supply of alkali, which was being derived from the burning of fern, and from the incineration of sea-weed on the coasts of Scotland and Ireland, having become insufficient, it was supplemented by the importation of barilla, an article produced in the same way upon the coasts of Spain, Sicily, and Sardinia. The alkali procured by such means was very crude and very unreliable in its action, and the use of it was at length superseded by potash obtained from the clearing and burning of forests in the United States. At length the consumption of the article had become so greatly enlarged, and the price so enormously high, that the demand for the production of alkali became an object of mercantile attention. Chemical science stepped in, and very quickly responded to this appeal on the part of the bleachers. The consequence was that an artificial soda was invented, called "soda ash," or British soda, which, in regard to cheapness and efficiency, has caused the bleachers to dispense with the use of potash; and the quality of the article has so successfully commended itself to the consumers, that the manufacturers are now annually exporting British soda of the value of one million sterling over and beyond the requirements of the bleachers, soap-makers, and glass manufacturers of our own country. It is worthy of remark that the great bulk of our shipments of British soda are to the United States, from whence, only a short time ago, we were importing very large quantities of potash, the production of their forests. Thus, by an art which half a century ago was almost unknown, and by the agency of our coal as fuel, we have succeeded in converting certain products which we dig from under out feet, such as salt, pyrites, and lime, into one of the most important branches of manufacturing chemistry. These discoveries in chemistry may appear extraordinary, although they are not more important in the economy of bleaching, than are the mechanical arrangements which have superseded the exposure of labourers, in all states of the weather, to the accustomed drudgery of the "crofters" of old. The "crofters," of whom we have spoken, bore the appearance of remarkably strong men; their working dress was of thick white flannel, called "gladding;" the cut of the coat was peculiar, having a loose, open appearance, and a low, flat collar, on which the shirt collar usually rested. They had their necks uncovered; and, from their employment being so much exposed to moisture, they seldom wore stockings. Altogether, they assumed a bearing of unconcern about the state of the weather, and were quite regardless of the splashing of water. Their employment consisted mainly in the handling of wet cloth, and in removing it, either by hand or by wheelbarrows, from one operation to another. Perhaps the most distressing part of their labour was that of carrying upon their shoulders a pile of wet cloth, rising to some height above the head, which they conveyed to a considerable distance in the fields, and spread upon the grass. In the severity of the winter season there would be drippings from the cloth, forming icicles, which would be adhering to the skirts of their clothing. It has been through a succession of mechanical inventions that these laborious operations have been dispensed with, and one after another they have been handed over to the power of the steam-engine. The machinery of the dash-wheels is in a great measure superseded; the use of wheelbarrows, for the removal of cloth from one operation to another, is not now required: the suspension of wet pieces upon wood railing in an open shed for the purpose of drying, has passed away; all this work is now done under cover; the drying process is carried on in heated rooms; and the suspension of the cloth is accomplished by an ingenious application of machinery. Practically speaking, bleaching operations have been revolutionised; and probably the most efficient labour-saving invention has been a mechanical arrangement, or, as it is termed, a continuous system of cloth working. By this method it is not now necessary to conduct the bleaching of individual pieces singly, one by one, but to have the ends of them sewed together by hundreds in a consecutive string, and have them drawn through a number of operations in their ordinary succession; the regularity of the work being attended to by boys, and the superintendence by men. It will be obvious that, by the various means referred to, the operation of bleaching has been much simplified, and the expense reduced; but, meanwhile, there have been great changes, and eventually an increasing demand for what is usually termed "finish," which consists of a skilful application of calendering, pressing, rolling, and otherwise rendering a piece of plain cotton as near as possible in accordance with the design of the manufacturer or the exporter, who may undertake to gratify the taste of the consumers in the various markets of the world. To such an extent has this rivalry or competition by "finish" been carried, that the machinery, labour, skill, and cost of extraneous materials required, have occasioned an expenditure that is said to exceed all the other expenses previously incurred in the bleaching. Dyeing has also been associated with bleaching and finishing; and the class of goods which are embossed and figured by pressure now belong to this department, and afford another variety in the attractions of cotton fabrics. The result has been that the time required for the operation of bleaching is now about as many days as formerly it required weeks to accomplish. Honour to British genius that these advantages have been derived to our country. The general public will no doubt feel curious to ascertain whether any and what proportion of the money saving thus effected has reached the consumer; some other portion of the public will inquire in what extent the advantages thus achieved by science and art have been shared by the operative class employed? It is not expected that much concern will be manifested about the interests of the proprietor, and it is not unreasonable to suppose that a still more minute inquiry will be raised about the "human machine," more especially, whether, during the progress of these advances in manufacturing art, the material, moral, and intellectual condition of the working class has been made to keep pace with all these improved manipulations, which, amidst the struggle of changes, have destroyed the character of many employments, but have greatly increased the whole number of persons employed? These inquiries it will be my endeavour to satisfy. The advantages shared by the consumer will easily be reckoned. I have before me a printed card, or list of prices for bleaching, issued by a leading firm in the year 1803. At that time the charge for bleaching a well-known description of cloth was 7s. 6d. for a piece of 28 yards, and it is now 6d. The case of the labourers employed in bleaching sixty or seventy years ago was, as before stated, a very harassing one—they suffered severely from exposure to wet and cold, and, as a consequence, from rheumatism and asthma. The earnings of a "crofter" would be from 10s. to 15s. per week. Upon wages so scanty, and with some uncertainty of employment, their mode of living was necessarily inexpensive. Oatmeal was the staple commodity of their food. They used it as porridge; their bread was of oatmeal, either in leavened oat-cakes or baked in the form of a loaf called jannock, which is said to have been introduced by the refugee Flemings; and animal food, with the exception of bacon, was seldom found at the working man's table. Now-a-days, the workmen in bleach-works perform all their work in-doors, and are therefore no longer exposed to the coldness and moisture of the former period. Their wages are increased in a proportion which cannot easily be estimated, and their employment is one of great regularity. They have nearly ceased to consume oatmeal; jannock is unheard of; oat-cakes are seldom seen; and their tables are now daily spread with wheaten bread, animal food from the shambles, and all the other articles which usually enter into the consumption of families in the other grades in life. The social condition of the operative bleacher of early times cannot easily be separated from the rest of the working population of that day, neither could they now be described in any other manner than that which would apply to the operatives around them in other pursuits.

ON SOME EDIBLE FUNGI.

BY M. C. COOKE, F.S.S.

At this season of the year, when fungi are showing themselves everywhere, and certain of them are present at the tables of the poor as well as the rich, it may not be altogether out of place to call attention to a few of the species of this extraordinary tribe of plants, at the same time so admired and so dreaded. Admired for the delicious flavour of such as may be consumed as articles of food, and dreaded for the poisonous properties of others, concerning which many a tale of terror has been told. Without attempting to deny that there are species of fungi deserving to be characterised as suspicious, and others which merit the designation of "poisonous," I am yet disposed to think that we have been frequently guilty of charging them with crimes of which they are innocent, and of fostering prejudices to their and our mutual disadvantage. Without approaching the species that are known to be innocuous, but are unassociated with evidence sufficiently strong in their favour to warrant their recommendation as indiscriminate visitors at our tables, there are many which are allowed to rot away year by year, unregarded, except by a favoured few, and which are equally, if not more, delicious than any which ever appear in our markets. To a few of these the present paper will be devoted.

Whoever has read Dr Badham's 'Esculent Funguses of Britain,' will not fail to recognise the following passage: "I have this autumn, myself, witnessed whole hundredweights of rich wholesome diet rotting under trees; woods teeming with food, and not one hand to gather it; and this, perhaps, in the midst of potato blights, poverty, and all manner of privations, and public prayers against imminent famine. I have, indeed, grieved when I have considered the straitened condition of the lower orders this year, to see pounds innumerable of extempore beefsteaks growing on our oaks in the shape of *Fistulina hepatica; Agaricus fusipes*, to pickle, in clusters under them; puff-balls, which some of our friends have not inaptly compared to sweet-bread, for the rich delicacy of their unassisted flavour; *Hydna*, as good as oysters, which they somewhat resemble in taste; *Agaricus deliciosus*, reminding us of tender lamb kidney; the beautiful yellow Chantarelle, that *Kalon Kagothon* of diet, growing by the bushel, and no basket but our own to pick up a few specimens in our way; the sweet nutty-flavoured *Boletus*, in vain calling himself *edulis*, where there was none to believe him; the dainty Orcella, the *Agaricus heterophyllus*, which tastes like the craw-fish when grilled; the red and green species of *Agaricus*, to cook in any way, and equally good in all." If any apology were needed for addressing the TECHNOLOGIST on the subject, this would be ample.

It would not, perhaps, have been altogether out of place to have premised our individual notices of the British Esculent Fungi with a brief account of the history, structure, development, and scientific arrangement of this alliance (Order it should scarcely be called, for it has higher claims), but fearing such a sketch might, under the most careful condensation, have occupied too much of the space which should be devoted to the more practical part of the subject; and having already done this elsewhere,* I must beg my readers to trust to the accompanying woodcuts and descriptions to guide them, in the absence of more scientific distinctions, in the recognition of the various species.

In the present paper will be included (with one exception) only such species as are equally available for domestic purposes in the dried as in the fresh state. It is true, that in France one or more species of *Agaricus* are dried for after-consumption, but such a course is not adopted here, although available, especially in the case of the little champignon, as lately pointed out in the 'Gardener's Chronicle.' For the present no reference will be made to esculent fungi found and economised abroad, where there are other and greater devourers of fungi than ourselves.

MORELLS (*Morchella esculenta*).—This fungus, though not one of the commonest, is found with us in some localities in considerable numbers. Hitherto, however, our supplies have been drawn principally from the Continent whence they are imported in the dried state. The accompanying illustration will give a very fair idea of the external appearance of this delicious condiment. It is generally cylindrical or conical in shape, having the surface covered with pits or cells formed by the ribs or folds of the hymenium. In this species the lower portion of the pileus is attached to the stem. Although the morell is chiefly employed as a seasoning for soups, gravies, &c., it affords an excellent ketchup of much more delicate flavour than that ordinarily obtained from the mushroom.

Owing to the demand for morells in certain parts of Germany the peasantry were in the habit of burning down the woodland in immense tracts, on account of the productive nature of the burnt soil. To such an extent was this practice at one time carried, that laws were enacted in order to suppress it. In the English market dried morells realise from fifteen to twenty shillings per pound.

Morchella patula is sometimes found in woods in Britain, but must be considered rare.

Morchella semilibera is not uncommon under hedges, and may be distinguished from *M. esculenta* by having the pileus free half the way, whilst

* 'A Plain and Easy Account of British Fungi.' London: Hardwicke.

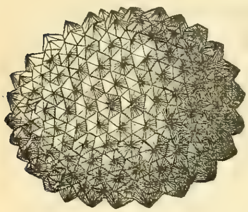
that of the latter is attached to the stem at its base. It is equally esteemed on the Continent.

Helvella crispa.—The best substitute for the expensive morell may be found in two of our indigenous species of *Helvella* (*H. crispa* and *H. lacunosa*). Like the morell, they may be collected during the season, dried, and preserved for use all the year round. He must be, indeed, an excellent judge, who can detect the difference in flavour between the *Morchella* and the *Helvella*, for both are equally good. Berkeley enumerates four species found in Great Britain—*i. e.*, *H. crispa*, *lacunosa*, *elastica*, and *ephippium*. Doubtless all of them would be esculent, but the first two only have presented themselves in my experience.

Helvella crispa has a lobed and deflexed pileus, pallid above and ochraceous beneath. The stem is fistulose or hollow ; when dried the texture is tough and leathery, and in this condition it resembles crumbled-up pieces of wash-leather, that have been saturated with water and allowed to dry. It is a common species in woods, and may occasionally be found growing on banks in the autumn. It is almost impossible to confound these with any other species of Fungi found in Britain, so that they may be enjoyed without fear.

Helvella lacunosa is also a common species found in similar localities to the last. It much resembles *H. crispa* in everything save the colour of the pileus, which in this instance is cinereous-black. I have not met with this kind so large, or so plentifully, as the other. For all purposes to which the morell is applicable, these species may, either of them, be substituted. They impart an excellent flavour to gravies and soups, and in establishments where they have been once introduced and tested, will, I doubt not, for ever afterwards hold the supreme sway, to the exclusion of the more aristocratic Morell. Unlike the Agarics, there is no necessity for the Helvellas to be used as soon as gathered; for this reason, superadded to an experience of their excellent qualities, one can but

feel surprised at their absence from our markets, while the Truffle and Morell obtain at times most extravagant prices. During the present summer a country gentleman, living remote from town and railway, has assured me that his own kitchen, and the kitchens of many of his friends, are kept with a supply of Helvellas for culinary purposes, from year to year. In Sweden and Germany they are considered equal to the Morell, and are known in the latter country under the name of *Gemeine Morchel*, or *Stumpf Morchel.*



TRUFFLES have at least the advantage of being possessed of many friends, who prize them so highly that they commonly give as much as sixteen shillings per pound for them. The common truffle of our market is *Tuber œstivum* (the *T. cibarium* of some authors), but Berkeley enumerates eight others found in Britain—viz., *T. brumale, macrosporum, bituminatum, rufum, scleroneuron, nitidum, puberulum,* and *dryophilum.* I am not prepared to affirm that these are all equally good; indeed, I believe that they are not, and that in this instance the best kind is that which is best known.

These fungi being subterranean in their habits, the ordinary method of searching for mushrooms will not succeed in discovering them, and, instead thereof, dogs are trained to hunt them out by the aid of that peculiar odour which makes itself evident, even at the surface of the soil, to the acute canine olfactory nerves. In some of the continental countries of Europe, where truffles are found, pigs are employed as hunters.

Efforts have been made to obtain crops of truffles by sowing truffle-parings in a chalky soil,* but these efforts have only been partially successful. In the present volume of the TECHNOLOGIST an account has already appeared of another experiment in Truffle culture.

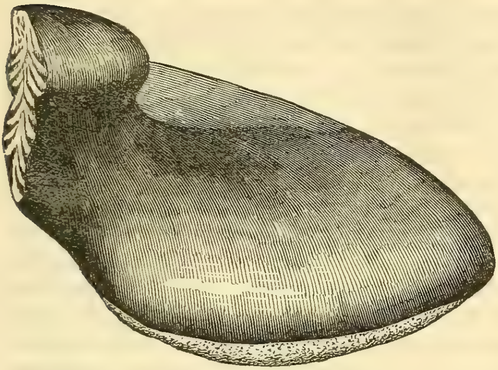
In form and general appearance these fungi differ much from the popular type. They look like rough, dark-coloured, warty nodules, sometimes nearly as large as the fist, and in the interior mottled with a remote resemblance to the section of a betel-nut, or a nutmeg.

Truffles are doubtless far more common in calcareous districts than is generally supposed. In England they are found chiefly on the downs of Wiltshire, Hampshire, and Kent, but the ordinary truffles of the Parisian markets are much larger and better flavoured than those found in Britain.

The RED TRUFFLE (*Melanogaster variegatus*) is not a truffle at all, but an allied subterranean fungus, having somewhat the flavour, but is much inferior. It is found in the neighbourhood of Bath and Bristol, and is occasionally sold in the markets of those towns under the above name.

* An interesting Paper on Oak Truffles, by M. de Gasparin, appeared in the *Technologist* vol. ii., p. 17.

Fistulina hepatica assumes a great variety of forms. In its earliest stages it sometimes resembles a strawberry. When more advanced, it has often the appearance of a tongue. Hence one of its continental local names (*Lingua di Castagna*), for it is known and appreciated abroad much more than it is with us. "So like a tongue is it in shape and general appearance," says an author whom we have already quoted, "that, in the days of enchanted trees, you would not have cut it off to pickle or eat on any account, lest the knight to whom it belonged should afterwards come to claim it of you." It is a fleshy, juicy fungus, with an undivided pileus, and, when cut, presents bright reddish streaks, like beetroot. The *Fistulina* is very common on the trunks of old oaks, and occasionally attains an enormous size. When old, it becomes rather tough ; but in all its stages it affords an excellent gravy, and, when young, if sliced and grilled, would pass for a good beefsteak. Specimens are now and then met with, that would furnish four or five men with a good dinner, and they have been collected weighing thirty pounds. The liver-colour (whence the specific name, *hepatica*), combined with its streaky interior and red juice, are sufficient guides whereby to recognise this species under all its Protean forms. Owing to its juicy nature, it shrivels up, and reduces very much in size by drying, and I doubt whether a good-sized specimen could be dried effectually otherwise than in slices. No instance of its being thus preserved for use has come under my notice, and I should scarcely think it available for that purpose.



ON THE ALTO-DOURO WINE DISTRICT OF PORTUGAL.

BY H. P. T. BARRON.

The growth of Port wine is confined by law to the so-called "Demarcaçao of the Alto-Douro," a narrow strip of land extending for about thirty miles along both banks of the river above the town of Pego da Regoa. This "demarcation" contains 178 parishes, or parts of parishes, 16,193 houses, and about 64,000 inhabitants. No other wine is, to this moment, allowed to be shipped from Oporto. On this account, the wine grown here is termed *par excellence* "vinho do Porto," or Oporto wine. The nature of its soil is the most valuable privilege of this district. Granite quartz forms the basis of the whole Douro basin. In the celebrated demarcation this granite is coated with a schistous stratum blended with argil. In the uplands there is no soil but that which is created by the action of the atmosphere on the saturated schistous rock, which, bursting afterwards from the heat of the sun, becomes pulverised, and forms the only soil on which the vines grow. The schistous formation extends some short distance above the present limits of the district, but is still limited in extent. This is one reason why Port wine, properly so-called, can never become a very cheap wine. There are other causes which also tend to enhance its cost, quite independently of any legislative enactments. The "demarcation" is an unhealthy, thinly-inhabitated district. There are very few springs, so that the want of water is severely felt, and is doubtless the principal cause of the limited population of this part of Traz-oz-Montes and Beira. During the hot weather, dense fogs rise from the Douro and its tributaries, causing a prevalence of ague in their particular neighbourhood. As the whole district is essentially dedicated to the culture of the vine, bread and provisions are both dear and scarce. The soil is turned, and the grapes trodden, entirely by Gallegos (natives of Gallicia). The fruit is cut by women and children from the adjacent country, the only work done by the resident-farmer being the pruning of the vines.

The vintage season varies from the 15th of September to the end of October. After the grapes are cut, they are carried in open baskets to the "adega," or shed, where they are thrown into large, open stone troughs, called "lagares," containing from ten to thirty pipes. When the "lagar" is filled with grapes, a gang of men jump in, and forming a close line with their arms on each other's shoulders, advance and retire with measured step, treading the fruit to the sound of the bagpipe, the fife, and the drum. This operation is continued for about thirty-six hours, when the grapes are fully crushed, and fermentation commences. If the must be green, or not superabundant in saccharine, in thirty-six hours it will become a perfect wine ; if the saccharine abound, double that time may be necessary to produce the desired result.

The regulating, the drawing off the wine into large "tonels," or vats, in which it undergoes its second fermentation, is by no means an easy operation. If rich wine is required, brandy is added in the "lagar," and the fermentation is thus checked. If a dry and pure wine, the fermentation is allowed to take its natural course, and a small quantity of brandy will suffice to keep the wine in a sound and improving state. No wines are made for being kept beyond the year, without some admixture of brandy. Formerly, this was applied to the wine in the "lagar," but since the general use of sulphur, and the consequent taste adhering to the wine, less spirit is now poured into the "lagar," it having been found to confirm the sulphurous taste. The wines lose this taste if not brandied in their early stage : on the other hand, the wines of late years all require and consume larger doses of spirit than the healthy growths of former times, and receive it, therefore, in the "tonel" and in the pipe. The old plantations in the lowland district, called the "feitoria primordial," or the "Baixo Corgo," supply the lightest wines, and those which require the smallest admixture of extraneous spirit. These are the wines originally known abroad as Port wine. They are still light, delicate, tawny, and lightly brandied. The more recent additions to the "demarcation," all higher up the river, and called "Cima Corgo," supply a wine naturally more full-bodied, and alcoholic, but requiring at the same time a larger admixture of extraneous spirits for its preservation. This difference is owing in a great measure to the different castes of grapes, but also to the different geological and topographical conformation of the soil. The whole region of "Cima Corgo" is a series of precipitous rocks, cultivated at great expense and unfit for any other crop but the vine. There is little depth of soil, consequently these grapes superabound in saccharine, and are deficient in water, the result being a wine of full body, high in flavour and colour, and rich in natural alcohol generated from the saccharine of the grape. The only regions available now for an extended growth of Port wine are the banks of the Douro, a little above the present "demarcation," but not those below it. In this locality is situated the largest wine-farm on the river—viz., the Quinta do Vesuvio, belonging to the Ferreira family. It has produced, in healthy years, 800 pipes, or 92,000 gallons of wine. It lies outside the legal "demarcation," yet the wine is of prime quality, and has always been sent to Oporto for shipment by means of false "bilhetes." There is still a limited extent of territory adjoining the "demarcation," of the same geological formation, and producing good ripe wines. Beyond Sao Joao de Peschiera, however, these wines soon lose the distinctive flavour of Port.

All Douro wines leave a thick sediment on the cask or bottle, being much richer in tartar than those of any other country. As far as is known, young Douro wine contains the greatest amount of tartaric acid, and holds in solution the largest amount of colouring matter. When quite clear, and drawn off into bottles, it still deposits, without intermission, and during a series of years, a sediment of organic matters, which may be loosed from the bottom of the bottle in complete cakes. This is possibly the cause of the rapid decomposition of this wine, notwithstanding its intrinsic richness in alcohol. It is certain, that all the wines of this river, and of Portugal in general, are very perishable, and require adventitious spirit for their preservation. It might be supposed that this large proportion of solid ingredients is owing to the rudeness of the process of manufacture.

But I am informed that the same excess of tartar has appeared in a Douro wine, manufactured carefully, by way of experiment, on the French principle, by means of a wine-press. The best castes of grapes, such as the "Alvarilhao" and "Bastardo," will degenerate if removed to the Minho Province. They will at first produce a ripe wine, but in a year or two wil yield what is termed green wine. Even the best Douro wines are, in their raw state, tart, rough, and, from their large solid ingredients, probably unwholesome. In this state they would hardly be recognised as Port wine. Before being fit for bottling, they require to be kept at least four years, and to undergo during that time constant manipulations, such as racking, fixing, blending, brandying, &c. All wines are fortified with brandy to a large amount; most of them are mixed with various other vintages of different qualities, in order to bring the whole quantity up to a certain required standard.

By the law of 1843, every vat of wine must be registered, sampled, and tried by a jury of tasters. That licensed for export to Europe, called wine of the first quality, received a bilhete or pass costing 15 milreis per pipe, or 3*l.* 6s. 8d. The export duty was 12 milreis per pipe; but with the numerous additional imposts, it was swelled to 15 milreis, or 3*l.* 8s. 8d., making a total of 6*l.* 15s. The second-class wine intended for America, &c., required no bilhete, and paid only 6d. export duty. In order to evade the high export duty to Europe, some houses shipped wine intended for England first to North America, and reconveyed it from thence to England. The Portuguese Government endeavoured in vain to check this trade by pursuing the wines and prosecuting the exporters. The consequence was an important reform, and abandonment of the most obnoxious restrictions in 1852.

The Port-wine trade is now regulated by the law of 1843, and by the decree of the 11th October, 1852, issued by the Duke of Saldanha's ministry without being submitted to the Cortes. By this decree the classification of the wines was reduced from four to two qualities—viz., exportable and non-exportable. The "Commissao Reguladora" was instituted, in the place of the Company, for the purpose of regulating the growth and export of wine. The Company was deprived of all its authority, and was allowed to exist only as a mercantile corporation.

The first formality required by the law is that of "arrolamento" or enrolment. This is effected by official gaugers immediately after the vintage, who register the contents of every vat. The amounts recorded for the years 1859 and 1860 were, 17,353 pipes, and 25,602½ pipes, showing an improvement in the vintage of 1860 of 8,249 pipes. These figures are not, however, to be relied upon, for the "arrolamento" has of late years invariably exceeded the amount really produced, sometimes by 100 per cent. Each farmer has an interest in enrolling a larger amount of wine than he has really grown; for, if his sample is approved, he will receive a number of "bilhetes" corresponding to the number of pipes which is recorded under his name, which bilhetes have a marketable value. This fraudulent over-statement is effected either by tampering with the gaugers, smuggling in wine from outside the "demarcation," or by removing the same wine at night from one parish to another in order to enrol it twice. To prevent these frauds, a military cordon has had to be drawn round the "demarcation," and the enrolment took place this year on the same day over the whole district.

In January, the sample-bottles are all opened and tasted by the "provadores" of the Commission, and "bilhetes" are delivered to the approved wines, each "bilhete" enabling a pipe of wine to be brought down to Rigoa, and there to obtain another passport called a "guia," insuring admission to the Villanova export stores. These bilhetes and guias certainly limit the numerical quantity of pipes admitted to exportation; but, like other passports, they offer little or no guarantee of identity or character. The bilhetes are transferable from hand to hand as publicly as the wine itself, and once fetched twenty to thirty milreis—*i. e.*, as much as a pipe of wine. Now, they seldom attain half that price, and are even procurable at four milreis. This is easily accountable for by the dearth of wine. They used to be purchased more principally for the purpose of passing the rejected wines of the "demarcation," than for exporting wines from outside, thus proving that the Traz-oz-Montes wines, of which much is said, cannot compete even with the rejected wines of the legal district. Only some few quintas adjoining the latter, such as the Quinta do Vesuvio, can afford to buy bilhetes for their produce. The wines, when sold, are drawn off into pipes, sent for that purpose by the merchants, but cannot be sent down the river till March. The boats perform the voyage generally in three days from Rigoa to Oporto.

One of the most obnoxious features of the restrictive system is the so-called "Corte quantitativo." This is regulated by the 4th and 5th articles of the decree, which provide, that when the quantity of a vintage pronounced exportable, shall exceed that actually exported during the preceding year, the Government shall be authorised to reduce the quantity to be actually licensed for exportation, which quantity is never to be less than the medium exported during the preceding five years. This limitation is carried into effect by means of a proportionate curtailment applied to the produce of each farm already approved as exportable. Thus, there were 94,122 pipes of the 1851 vintage, submitted to trial, and 41,403 pipes were classified, as of the first quality; therefore, eligible for export to Europe. In order, however, to raise the value of the wines abroad, and to keep down deposits, the Government decreed that only 20,000 pipes should be exported to European ports. Consequently, 21,403 pipes, originally recognised as first class, were degraded to the second, making a total of 39,876 pipes of good wine allowed to be shipped only to trans-Atlantic ports; while the total demand of all such ports together during half a century has little exceeded 5,000 pipes per annum. The consequence was a glut of wine in the country, an excessive demand for bilhetes, and a great inducement to evade the law, by first shipping to America wine intended to be afterwards sent to England. It used thus to happen that prime wines, prepared at great expense, and approved as first class but reduced by the Corte to the second class, could be bought for almost nominal prices.

Various circumstances have led to the production of the present type of Port wine as exported to England. One of them was the extraordinary vintage of 1820, which, by its intrinsic richness and ripeness, gained the highest approbation. Since then, rich, ripe, full-bodied, and highly-coloured wines came into fashion, and these qualities had to be imparted by artificial means. The law itself here, and the high duty in England, encouraged this tendency. The provadores always classified dark, thick, syrupy wines as first class and pure, light wines as second. It thus happens that the Alto-Douro wine changed its character completely. The change in the taste of the principal consumers, and the ready sale which dark, full-bodied wines obtained, induced the growers to sacrifice flavour and bouquet to colour and strength. It is well known that the newer upland plantations now only consist of vines called "Tintas," producing a rich and full-bodied juice, but one which when made without a certain portion of brandy in the process of manufacture, is (excepting in the very best vintage) rough, astringent, and of little flavour. These wines all appear black, strong, and sweet. The growers of light wines endeavoured by sugar, spirit, elder, and gerupiga, to imitate the produce of their neighbours.

Elderberry is grown and used extensively for the sake of its colouring matter. It is trodden with the grapes in the "lagar." Gerupiga, another product of the wine district, is a sweet syrup, or port wine liquor, made of must, stopped in its fermentation by a large admixture of brandy in the "lagar." The result is a strong, sweet cordial, composed of one-third brandy, and two-thirds must of wine, coloured with elder-juice, and sweetened with a large portion of muscovado sugar. Two or three almudes of this cordial give sweetness, body, and strength to weak wines, covering their natural defects, and making them, for a time, to resemble ripe, full-bodied wines. But the specific gravity of the mixture soon causes it to precipitate, and leave the wine above almost in its primitive state.

Much of this gerupiga is sent to America. The "oidium" again fastened with extreme severity on the grape-crop of 1860, receiving additional stimulus from the wet weather prevalent in the blossoming season, as was also the case during June, 1859. The use of sulphur was, however, more generally resorted to, and has tended to increase the produce beyond that of 1859. The drug was washed off by the rains at the period when it was most required—*i.e.*, while the fruit was too delicate to resist the attack of the parasite, and to be reapplied at much expense. Those who did this have reaped a half crop, unripe, and impregnated with sulphur. Others have lost all, or four-fifths. The ravages of the disease may be estimated by a comparison of the figures recorded for 1856, 1857, and 1859, the three worst years with the average production of the nine years preceding the blight. That average was, in reality, about 90,000 pipes per annum; that brought to the "provas" was 84,208 pipes. The amount enrolled in 1860, was 25,602, and shows an undoubted improvement over the produce of 1859, which was 17,353 pipes. Both of these figures are, however, deceptive and exaggerated. Eight vintages have now been attacked more or less by the *oidium*, and yet the latter seems to have lost nothing of its intensity. The distress of the poor farmers deserves consideration, the more so from the patience with which they have borne it. This privileged district has never been remarkable for its wealth of prosperity, but it is now steeped in poverty and ruin. The other wine districts of Europe seem to have suffered less, and to have recovered entirely from the visitation. The yield of the Mediterranean vineyards has been abundant, and generally of fine quality. The vintage through France and Germany has been, it is true, most deficient ; but this is attributable to the remarkably low temperature and constant rains which prevailed during the summer, not to the inroads of the *oidium*. In Portugal, this disease seems to have undergone little or no abatement.

In the Baixo Corgo, it has been so intense, that some quintas, exclusively dependent on wine, and once producing 200 pipes, in 1860 yielded 200 almudes ;* in spite of the heavy outlay entailed by the cultivation and partial sulphuration of the plants. Some lands have even been sequestered by the Government for arrears of taxes. On the other hand, farmers who could afford to sulphur thoroughly, have obtained as much as half crops.

FOSSIL HYDRO-CARBONS, THE SOURCE OF LIGHT, HEAT, COLOUR, &c.

BY THOMAS D. ROCK.

PART II.

Any subject, to be well understood, must have a clear and comprehensible basis ; for the value and beauty of all superstructural argument depends mainly upon the soundness of the foundation fact. The theme upon which I am now about to dwell a second time, in continuation of the paper at page 64 of this volume, is, as regards its starting-point, fully free from obscurity ; for the fossil hydro-carbons are clearly derived from organic sources, a truth so manifest that I presume it is never called in question. This simple pivot fact, whilst establishing the common origin of the hydro-carbons, also easily accounts for the marvellous resemblance which they bear to each other, and invests the subject with intenser interest, from the knowledge that materials so unattractive to the external senses of man were once teeming with life and beauty. The ceaseless mutations of matter, without any loss, are likewise well illustrated by the changed condition of those organisms from which the hydro-carbons have receded ; and it is in such kaleidoscopes of science, perpetually rotating, that we learn something of the Infinite, and gain deeper experience of the power, and wisdom, which sustains and preserves our busy globe and all its belongings.

* Twenty-one and a half to the farmer's pipe.

With a few, and those rather questionable, exceptions, the fossil hydro-carbons were originated by the vegetable kingdom; and I shall, therefore, at once proceed to enumerate the most prominent, and briefly describe their peculiarities.

COALS.

Coal is by far the most considerable, as well as the most important, of the fossil hydro-carbons. It is found disseminated in different parts of the earth's crust in layers, or strata, of varying thickness, but chiefly in that geological formation termed, from this very circumstance, the carboniferous system. Scarcely a country on the globe but possesses coal-beds to some extent, yet to England has fallen the lion's share of these useful deposits, as the dark portions of our geological maps abundantly testify. In many instances, the vegetable origin of coal is so evident, that perfect trees are sometimes found imbedded in the mass, completely carbonised ; and so abundant are these plain indications of former vegetable life, that geologists are thereby enabled accurately to describe the different species of plants which flourished in those remote ages. The Coniferous order, or Pines, contributed largely to our supplies of coal : Tree-ferns, Palms, Reeds, and other plants, mostly of gigantic size, also entered freely into the formation of our coal-fields.

Of coal there is a very great variety, as might be naturally expected from the several peculiarities of the plants producing it ; and, although I have no space sufficient to include any elaborate account of the different sorts of coal, the following table will convey some general idea of the special varieties as well as the chemical constituents of some of the principal coals of Great Britain :

	Carbon.	Hydrg.	Oxygen.	Nitrog.	Sulphr.	Ashes.	Sp. Gr.
NON-BITUMINOUS, OR ANTHRACITES.							
Valais - - - -	92·56	3·33	2·53	—	—	1·58	1·348
Vizille - - - -	94·09	1·85	—	2·85	—	1·90	—
	91·44	3·46	2·58	0·21	0·79	1·52	1·375
Pembrokeshire -	94·18	2·99	0·76	0·50	0·59	0·98	1·4119
SEMI-BITUMINOUS.							
Cannel Coal - -	76·25	5·50	13·83	1·61	—	2·81	—
„ Wigan - -	79·83	6·08	7·24	1·18	1·43	4·84	—
BITUMINOUS.							
Llangennech - -	85·46	4·20	2·44	1·07	0·29	6·54	—
Ebbw Vale - -	89·78	5·15	0·39	2·16	1·02	1·50	1·275
Broomhill - - -	81·70	6·17	4·37	1·84	2·85	3·07	1·25
Wallsend - - -	76·09	5·22	5·05	1·41	1·53	10·70	1·20

The most valuable coals for general purposes are those which are bituminous ; whilst, for obtaining the various products by destructive distillation, the cannels, or semi-bituminous varieties, are most esteemed, from the large proportion of volatile matter they contain ; and the anthracites, or non-bituminous coals, are useful as fuel for steam-ships, &c., also in the manufacture of iron, where the intense draught required stimulates the combustion, and developes the intense heat which, from their greater proportion of carbon, they possess naturally.

The manufacturing industries connected with coal exclusively are not at present very extensive, although, from the great attention now directed to the hydro-carbons, many more will doubtless spring into existence. Gas is manufactured from coal pretty generally throughout the United Kingdom, and a large quantity of the bituminous coals are consumed annually in this way. The manufacture of gas in its minute details has been so often described, that I shall content myself with the briefest possible notice of it. The coal is introduced into clay retorts surrounded with fire, and as soon as the temperature is sufficiently high, the gas begins to disengage itself, and enters a receiver, where it is condensed, and afterwards it is purified by various processes. Besides the gas, there are other products of this manufacture, as coke and coal-tar, in about the following proportions :

Gas - - - - -	$\frac{1}{5}$
Coke - - - - -	$\frac{2}{5}$
Coal-tar - - - -	$\frac{2}{5}$

The coke is the principal fuel employed in heating the retorts for the production of the gas, and the coal-tar is the base of a separate industry of the most attractive character. This coal-tar is of the consistence of honey, densely black, and disagreeable in smell, and by distillation can be separated into no less than fifty or more different products, each possessing its specific characteristic, and many of them already proved to be of inestimable value in the arts. A few of these I enumerate in the following table :

Napthaline - -	C_{20}	H_8		Sp. gr. 1·048
Paraffine - - -	C_{20}	H_{21}		Sp. gr. ·87
Carbolic acid - -	C_{12}	H_5	O, HO	Sp. gr. 1·062
Creasote - - -	C_{26}	H_{16}	O_4	Sp. gr. 1·040
Naphtha - - -	C_6	H_5		Sp. gr. ·765
Benzole - - -	C_{12}	H_6		Sp. gr. 0·85
Aniline - - -	C_{12}	H_7	N	Sp. gr. 1·020

Coke-making, for foundry and locomotive purposes, is a further industry connected with coal by no means contemptible. It is effected by means of closed ovens, where the volatile products are separated and exhausted without destruction of the carbon, which remains unconsumed in the form of coke. The non-bituminous coals are best suited for this manufacture.

Another deeply interesting industry connected with coal is that carried on for obtaining various volatile products by the destructive distillation of Cannel, Boghead mineral, &c., at low temperatures. When the temperature is raised very high, gas is the principal result ; but at a temperature of 212° Fahr., or thereabouts, a series of interesting and highly valuable products pass over in succession. The Boghead mineral is largely treated in this manner, and the proceeds are well known in the commercial world—light paraffine spirit, of sp. gr. 0·650 to 0·700 ; paraffine oils for burning, of very fair colour, and only moderate smell ; solid paraffine, for candle-making ; a lubricating grease of no little merit, and other minor products. The demand for these commodities is daily increasing, and I look forward to an immense consumption of many deposits of coal hitherto reckoned of little value.

Peats.

The next in importance of the fossil hydro-carbons is peat, or turf, extensively distributed over the habitable globe. It is formed by the successive growth and decay of inferior orders of vegetable life, lichens, mosses, reeds, &c., until a considerable thickness, or solid mass, is formed, exhibiting at different depths various degrees of decomposition. One species of moss (*Sphagnum palustre*), which is a principal ingredient of this substance, affords in itself a capital illustration of peat-bogs as a whole ; for the upper portion of this moss exhibits life and vigour ; whilst below the surface, the same plant is in process of decay. Northern Europe is abundantly furnished with peat grounds, and cold climates generally are possessed of supplies of this material more or less important ; but, perhaps, nowhere is there so much peat-bog, in proportion to the total number of acres, as in Ireland ; and thus Great Britain finds herself in possession of another hydro-carbon in almost unlimited abundance.

Peat is known to be possessed of many valuable properties, but no successful plan has hitherto beeen devised for developing its virtues, or distributing its benefits beyond the immediate localities where it is found. As a fuel, turf, when well dried, is by no means to be despised ; and on the continent, in France especially, whole districts may be seen studded over with piles of peat-bricks, or clods, of different sizes ; the contents of each lot being chalked on the sides, in bold characters. The peat best suited for fuel, is neither dug out from the surface, nor at too great a depth below ; the upper portion being too green, and the lower too much decayed ; but that which is intermediate is best suited for the purpose. After being dried, peat is sometimes compressed so as to exclude all moisture, and render it more dense as a fuel. There is also a moderate quantity converted into charcoal, and in this state it is famous as a deodoriser, and excellent as a manure.

Gas has been successfully made from peat, at certain places in Ireland, and towns lighted up by its agency ; but the most important attempt at utilising the peat-bogs of that country, on an extensive scale, was that made by the Irish Peat Company, long since broken up. In a paper read before the Society of Arts, by Mr W. G. Newton, in May, 1860, the following list of products was given as the result of this Company's operations on 775 tons of peat: viz.—

Ammonia - - - -	1 ton, 4 cwt., 1 qr.
Naphtha - - - - -	77½ gallons.
Lubricating oils - - -	1,162½ „
Paraffine - - - - -	2,325 lbs.
Peat charcoal - - -	——

Mr Newton also mentioned the purchase of the Company's plant, by a private individual, who proposed carrying on the manufacture, and it would be interesting to know if this Irish industry has really survived.

Two principal products attend upon the distillation of peat. 1st, a watery liquor, in which are found the ammonia, carbonic acid, acetic acid, &c.; and, 2nd, the tar which contains the naphtha, oils, and paraffine—the residuum being peat-charcoal. The various products obtainable from peat, may be enumerated thus: inflammable gas, sulphate of ammonia, acetic acid, pyroxylic spirit, light and heavy oils, solid paraffine, humic acid, or peat umber, &c., &c. The following table will show the general composition of this valuable hydro-carbon:

	Carbon.	Hydrogen.	Oxygen.	Nitrogen.	Ashes.
Fichtelgeberge - -	66·55	10·39	18·59	2·76	1·70
Abbeville - - -	57·03	5·63	29·67	2·09	5·58
Friesland - - -	57·16	5·65	33·39		3·80
Holland - - -	50·85	4·64	30·25		14·25

Bituminous Shales.

Besides the true coals and peats, there exists in nature other supplies of the fossil hydro-carbons, termed bituminous shales, &c., being porous rocks, or strata, saturated with bituminous matter; but I observe a very nice and proper distinction made by Mr T. Sterry Hunt, of Canada, in a recent publication, between those rocks which contain true bitumen, and those which are simply intermixed with carbonised organic matter, allied to peats or coals. Mr Hunt proposes that the former be called bituminous shales—as of old—and the latter, lignitic shales.

Several of these hydro-carbon shales are largely distilled in America and on the continent, more especially in Germany, for their volatile products. Burning oils, lubricating oils, and solid paraffine, are the results, all of which, in moderate quantities, find their way to this country, and to all appearance are quite equal to our own English manufacture.

Bitumens.

Bitumens form another most interesting group of fossil hydro-carbons, and they are causing no small stir, both in scientific and commercial circles. They are not, like coals and peats, primary deposits, but are the result of a spontaneous decomposition of those substances, or are distilled from them by the agency of volcanic heat. The precise conditions under which nature effects the distillation of these fossil hydro-carbons cannot be accurately explained, but that they vary considerably, the results afford striking evidence. Sometimes a gas is evolved from the springs or wells, which burns with great brilliancy if ignited, and if there be any analogy between the operations of nature and art, the presence of this gas indicates considerable heat below. Accompanying the gas, there is usually an oily ejection, of dark-coloured, bituminous matter, and of varying consistency, partly dependent on the time of its exposure to the atmosphere. The oils of America (United States), and Canada, just now exciting so much attention, are of this class; also the petroleum of Rangoon, and of the Caspian Sea; the tar of Barbados, &c. In Asia Minor, this substance exists to a considerable extent, in what are termed slime-pits; indeed, an abundant supply seems forthcoming from most parts of the world. Another variety of bitumen is of the consistency of pitch—solid, but slightly unctuous, as the Trinidad pitch; and, lastly, there is the solid and brittle form of bitumen in the shape of asphaltum. Thus we have the different gradations distinctly marked in the natural as well as in the artificial products—gas, light naphtha, petroleum, pitch, and asphaltum.

Coal-tar, and peat-tar, which may be not inappropriately called artificial petroleums, are strikingly analogous to the liquid bitumens, both in external characteristics, and chemical composition; and the various products which each contain, are, I believe, only combined mechanically, and can be easily separated. The original difference existing in the vegetation, from which all the fossil hydro-carbons have sprung, is equally illustrated by the bitumens, as by the coals. Some are of great value, whilst others are comparatively worthless, yet all possess certain properties in common, which proves further their intimate relationship.

Rangoon Tar, of which there is almost an unlimited supply to be had, is of the consistency of treacle, of a dark, green colour, and powerful tarry odour.

Barbados Tar, and Baku Petroleum are of a similar consistency to the Rangoon product, their colour, however, being of a dark brown, and odour tarry.

The American Rock Oils are much more liquid, of a green colour, and not very powerful odour; fabulous quantities of these hydro-carbons can be supplied from Canada and the United States.

Trinidad Pitch, although at first in a fluid state, quickly hardens by exposure, and is generally received here in a solid form; there is a great abundance of it in the Island.

Asphaltum Proper, so called after the mysterious lake (Asphaltites), upon whose leaden waters it is found floating, is imported into this country in moderate quantities.

Besides these few enumerated Bitumens, there is an immense variety of kindred products, too numerous to mention within present limits, but many of which will doubtless be in industrial requisition before long.

I have compiled the following table from various authentic sources, and the reader will therein see at a glance the main chemical differences of the bitumens of commerce.

	Carbon.	Hydrogen.	Oxygen.	Nitrog.	Ashes.	Sp. gr.
Petroleums	88·3	11·9	—	0·011	—	
	88·7	12·6	—	0·04	—	0·87
	78·50	8·80	2·60	1·65	8·45	
Ojokerite	86·07	13·95				0·94
Asphaltum (Peru)	88·66	9·65	1·69			1·1 to
,, (Auvergn)	76·13	9·41	10·34	2·32	1·80	1·2
Elastic Bitumen	52·25	7·50	40·10	0·15		1·23

As an illustration of the manufacture of bitumens, I may just mention that carried on at Price's Candle Company, under the able superintendence of Mr G. F. Wilson, from Rangoon Tar. The tar subjected to distillation by super-heated steam, yields up in succession the following products: 1st, a light fluid, somewhat analogous to Benzole, termed by the makers, Sherwoodole, and sold as a valuable detergent; 2nd, a burning oil called Belmontine, with scarcely any colour, and hardly perceptible smell, and certainly the very best Paraffine oil yet presented to the public; 3rd, a heavier oil, containing doubtless a small quantity of solid paraffine in solution; this product mixed with some other oils is found highly serviceable as a lubricant; 4th, an oil containing much solid paraffine, which latter substance, on being separated by pressure is manufactured into a beautiful class of candle.

There is one singular feature connected with the manufacture of the fossil hydro-carbons, whether coals, peats, or bitumens, which is deserving of notice. The raw materials are simply compounds of hydrogen and carbon, and the products are likewise the same, the sole difference being in their chemical proportions. Such being the case, it becomes a question, how far, if at all, the results can be influenced by improved or altered methods of manufacture, so as to secure a larger supply of the more valuable, and diminish proportionately those in less demand, or less remunerative.

It is subject-matter for no mean measure of gratitude, that Great Britain engrosses to her share so large a proportion of the fossil hydro-carbons; the coals of England, Scotland, and Wales; the peat-bogs of Ireland; the petroleum of Rangoon, Canada, and Barbados, as well as the pitch of Trinidad, will furnish us with raw materials sufficient to supply all Europe and Asia, if need be, with hydro-carbon productions.

(To be continued.)

ON THE MANUFACTURE OF STRINGS FOR MUSICAL INSTRUMENTS, AND OTHER USES OF GUT AND SINEW.

BY THE EDITOR.

A manufacture of which comparatively little is known, is the preparation of the substance usually termed catgut, though for the most part made from the dried, twisted, peritoneal coverings of the intestines of sheep. Catgut-cord is used for a variety of purposes where strength and tension are required, as for the strings of musical instruments, for suspending clock-weights, bow-strings, for hatter's use, and for archers bows.

The manufacture of musical strings requires a great amount of care and skill, both in the choice of materials and in the manufacturing processes, in order to obtain strings combining the two qualities of resistance to a given tension and sonority. Until the beginning of the last century, Italy had the entire monopoly of this trade, and they were imported under the names of harplings, catlings, lute-strings, &c.; but the trade is now carried out with more or less success in every part of Europe. However, in the opinion of musicians, Naples still maintains the reputation of making the best small violin strings, because the Italian sheep, from their leanness, afford the most suitable material ; it being a well-ascertained fact, that the membranes of lean animals are much tougher than those of high condition. The smallest violin strings are formed by the union of three guts of a lamb (not over one year old), spun together.

The chief difficulty in this manufacture is, in finding guts having the qualities before mentioned—namely, to resist tension, and giving also good vibrating sounds. It is far more easy to arrive at the proper point in the making of harp, double-bass, and other musical strings, and the manufacturer is not so much circumscribed in the choice of the proper material. The tension upon the smallest string of the violin, which is made of only three guts, is nearly double that on the second string, formed by the reunion of six guts of the same size.

In the preparation, the sheep's guts, well washed and scoured, are steeped in a weak solution of carbonate of potash, and then scraped by means of a reed cut into the shape of a knife. This operation is repeated twice a day, and during three or four days, the guts being every time put into a fresh solution of carbonate of potash, prepared to the proper strength. In order to have good musical strings it is indispensable to avoid putrid fermentation ; and as soon as the guts rise to the surface of the water, and bubbles of gas begin to be evolved from them, they are immediately spun.

In spinning, the guts are chosen according to their size ; combined with three or more, according to the volume of the string required, they are fastened upon a frame, and then alternately put in connection with the spinning-wheel, and submitted to the required torsion. This operation performed, the strings, left upon the frame, are exposed for some hours to the vapour of sulphur, rubbed with a horse-hair glove, submitted to a new torsion, sulphured again, further rubbed, and dried.

The dried strings, rolled upon a cylinder and tied, are rubbed with fine olive oil, to which one per cent. of laurel oil has been previously added. The oil of laurel is supposed to keep the olive oil from becoming rancid.

The gut-strings employed by turners, grinders, and for cleaning cotton, &c., are made with the intestines of oxen, horses, and other animals. These, clearedby putrefaction of the mucous and peritoneal membranes, and treated by a solution of carbonate of potash, are cut into straps by means of a peculiar knife, and spun in the same way as the musical strings. The uses of bladders and gut for holding lard, for covering gallipots and jars with preserves, as cases for sausages, polonies, &c., and other domestic purposes, are well known. Lately, however, the vegetable parchment, as it is termed (which is ordinary paper steeped in sulphuric acid), has come into extensive use for this purpose.

Insufflated, or inflated guts, are chiefly employed for the preservation of alimentary food. They have to pass through a long series of modifications and processes, before becoming fit for use. The end of these preparations is, to free the muscular membrane of the intestine from the two other membranes covering it, the peritoneal and the mucous.

The first operation of scouring, consists in freeing, by means of a knife, the gut from the grease attached to it, and also of the greatest part of the peritoneal membrane. The scoured guts are washed and turned inside out, then tied together, put into a vat without any more water than that adhering to them, and left in this state to undergo a putrid fermentation. The time required for this operation will be from five to eight days in winter, and two or three days only in summer. If the fermentation were pushed too far, the guts would be disorganised: to avoid this inconvenience, the workmen are often obliged to add some vinegar, in order to neutralise the ammoniacal compounds formed, and also because fermentation is slow in the presence of acids.

After this fermentation, the mucous membrane is completely decomposed, and the remaining portions of the peritoneal membrane are easily taken off. The guts are then well washed, and insufflated (inflated).

This operation is performed in the same way as swelling a bladder, with this difference, that the extremity of the gut is tied by a ligature serving also to join a new gut insufflated (inflated) in the same way. During this operation, the guts exhale the most noxious smell, and workmen employed at such work could not blow or insufflate many days in succession without having their health affected.

In order to prevent that inconvenient, unhealthy process of manufacture, the *Société d'Encouragement* of Paris proposed a premium for a chemical process enabling the manufacturers of these articles to dispense with putrid fermentation. The process suggested by Mons. Labarraque, the successful candidate, is remarkable for its cheapness, and the facility of its application. In following the method recommended by this chemist, these animal matters can be worked more easily, and kept for a longer time without evolving any noxious smell.

The guts, previously scoured, are put into a vat containing, for every forty guts, four gallons of water, to which $1\frac{1}{2}$ pound of (*Eau de Javelle*) oxi-chloride of sodium, marking 13° on the areometer of Baumé, is added. After twelve hours of maceration, the mucous membrane is easily detached, and the guts are free from any bad smell; by this method, the process of insufflation is more easily performed.

The insufflated guts are suspended in a dry room until the dessication is complete; and, once dried, the extremities by which they were tied together are cut, and in pressing the hand over the length of the insufflated (inflated) gut, the air inside is completely taken out. The guts are then submitted to fumigation by sulphur, in order to bleach and to preserve them from the attacks of insects. After this last operation, the guts are fit for use. Besides our large home supply of bladders, we import several hundred thousand a year, packed in salt and pickle, from America and the Continent, and the aggregate value of the bladders used in this country is stated at 40,000*l.* or 50,000*l.*

The use of the reindeer-sinew for lashing or binding purposes on implements, &c., is common from Norway and Lapland, along the entire coast of Asia and America, even as low as 36° N. in California, and continued on the coast-line up to the easternmost point of America, and again at Greenland. Sir E. Belcher, in Transactions of the Ethnological Society of London, states, he traced this custom of using the reindeer-sinews continuously on the western coast as far south as the thirty-sixth parallel on the coast of California, where the Mexican Indians soak it and form it into layers, in which they enclose the wood of the bow entirely. The horns of the bow are also moulded of it; and when dry, it presents the dull-grey translucent features of horn.

Review.

A Manual of Structural Botany, &c. By M. C. Cooke. R. Hardwicke.

Being purely scientific, and not touching at all upon economic botany, this little work scarcely comes within the scope for notice here. But its author being one of the most frequent contributors to the pages of the Technologist, we cannot withhold some favourable mention of this manual, remarkable alike for its excellent systematic arrangement, cheapness, and numerous illustrations. It is chiefly designed as an introductory class-book for students and operatives in the botanical classes of the Department of Science and Art, of which Mr Cooke is a teacher, and will prove an excellent prelude to more elaborate and expensive treatises.

Publications Received.—Notes on the District of Badulla (Ceylon), and its Natural Products, by W. C. Ondaatje. Technologiste (Paris). Pharmaceutical Journal. Chemist and Druggist.

THE TECHNOLOGIST.

ON THE MANUFACTURE OF MATCHES IN NEW YORK.

'Behold what a great matter a little fire kindleth.'

There are a great many people in the world who never think ; they take "the goods the gods provide them," and ask no questions. It is enough for them to know that the means of their comfort, convenience and enjoyment exist, without stopping to inquire who has been the cause of their existence; and until something occurs that places articles of every-day consumption out of their reach, they never wonder how the world used to go on without them. These people, as they walk along the streets, or are dashed through the country at the rate of forty miles per hour, see the telegraph posts and wires, and think the telegraph "a great convenience." They read the news, which it is the means of having spread before them, with their tea and toast, and never stop to consider the vastnesss of the results of the invention, or the revolution it has worked, and is still working in the social, political and commercial world ; and though, perhaps, they may have heard of Morse, his struggles, his disappointments, the antagonism he met with from ignorant incredulity or learned bigotry, the sleepless nights, the weary days, the headaches and heartaches, and brain-throbbings that he felt, bore, and suffered ere the world would allow him to confer upon it the great good he had created, never enter their thoughts. They do not "look the gift horse in the mouth," but, unlike honest Sancho, they do not "bid God bless the giver."

Steam ships and railway carriages, and printing presses, and ponderous machines that work like sentient things they know exist, because they see them every day and their effects every moment; but they never stop to think who called them into being, how they are made, or what the world would do without them. They are like *Lady Macbeth*, in the play—"Their eyes are open but their sense is shut." As the little miseries of human life are, in the aggregate, the most important, so the little things of everyday use, those things we constantly handle, see and wear, and never bestow a thought upon, contribute oftentimes most to our comfort and convenience. What should we do without pins? Go back to the days of clumsy skewers, or to the primitive fish bones of the South Sea Islanders.

We use them by hundreds, and so little are they esteemed, that "I care not a pin for him," expresses almost the superlative degree of contempt; and yet there is a vast deal to write about, talk about, and think about in the pin. Who values a match? What so important as a single match?

"Ding-dong," rings out from the great fire-bell in the alarm tower, upon the crisp, cold air of midnight; it falls upon the sleeper's ear and wakes him with a start. A crowd of men rush from their houses to the street, the engines rattle over the hard stones; the air is filled with shouts and cries; a lurid glow is in the sky, and volumes of dense smoke wave like the black banner of destruction above a burning pile. The flames increase, the din grows louder, a ruddier glow is in the sky, and falling beams and crackling walls mark the course of the fire-fiend as he licks up with his forked tongues the result of years of toil and energy, A city is in flames, the millionnaire is pennyless; the wealth of "Ormus or of Ind" vanishes in a moment; hundreds are homeless, the stately monarch of the waves "lies a sheer hulk" upon the waters, and a wail goes up from all over the land.—"What has done all this? The incendiary's torch!" We call it that, but it was nothing half so great or dignified.

It was that single match, which within its little gummy point contained the cause of all the havoc. The slightest friction irritated the fiend within —with a hiss he awoke from his hiding-plaee; with a ghastly, sickly glare he grew into full life, and in a moment it was beyond the power of man to quell the demon he had raised.

We all use matches. What should we do without them? Let us see.

Wayworn and weary since the early dawn, a party of emigrants have toiled on across the barren plain, and now, as night begins to draw her dark curtains, they halt beside a river's bank, and unpacking their mules, prepare to make their camp. The tents are pitched, and now for supper. Supper is easily cooked. Fuel is plenty; it only needs fire to set it ablaze. Aye, there's the rub—how to obtain that fire. "Light a match, to be sure." "But matches there are none!" "What, no matches?" "No; the matches were wet crossing a rapid stream this morning, and will not burn." "But we must have fire; the night is cold and dark; coffee must be boiled; the venison must be cooked. Besides, without fire we shall perish with the cold."

How valuable now becomes the poor despised little match. What would we give for one? But as none are here, and they do not grow on trees, what can we do? Why, go back to the days when we had none—*when nobody had thought matches out.* Do as the Indians do—draw the fire from its hiding-place. It exists in everything—even in ice and snow. It lies there latent, and must be wakened from its sleep and made to crackle and to burn. Come, let us rouse our servant—so faithful while in servitude, so tyrannous and cruel when we are slaves to it.

Take two dry pieces of wood, and placing the end of one against the body of that tree, bear against it with your breast to keep it firm; now take the other by both hands, and bearing down, with all the force you may, upon the other, rub rapidly up and down. Faster and harder, keep rubbing ; the exertion takes away your breath and tries your arm. Never mind ; rub away, faster and harder yet ; stop not a moment or your labour is in vain. Rub on. Ah ! at last the success of your labour is indicated by your olfactories. You *smell* fire. A thin, vapory smoke begins to show itself ; rub harder yet ; the smoke increases, and, at last, a little flame bursts forth and fire is created. You have stirred up the mysterious genius which we call fire, and which book-wise people call "*Caloric.*" But be careful, for fire gotten in this way is coquettish and hard to keep ; deal gently with it, or you will lose it, and have your labour for your pains. Apply your splinters and dry leaves gently and with a careful hand ; nurse it tenderly into strength, and then you may warm yourself at will, and cook your venison and boil your coffee, all of which you might have done long ago, and without any trouble, had you only been provided with that "unconsidered trifle"—a *match.*

It is hard to tell when matches were first invented ; but the great improvements which have been made in them, have all been made within about twenty-five years.

The old-fashioned curled-shaving matches, tipped with brimstone, were poor things at the best ; they were used with the time-honoured tinder-box and flint and steel, so much in vogue among our grandsires, and which are yet to be found among some of the old Dutch settlers, in New Jersey, who look upon friction-matches as a Satanic invention. How many knuckles have suffered from the edges of the sharp flint which missed the steel, and cut the flesh, and many curses loud and deep have been vented over damp tinder.

Just imagine one of our modern "fast" young men, returned from having a jolly good time with a lot of jolly good fellows. Very shaky on his pins, he staggers up the stairs, and feels around for the tinder-box and matches. After making the circuit of his "genteel apartment" half-a-dozen times, he puts his hand upon the desired articles and hiccoughs, "Haz-all-right." He takes off the lid, and seizes the flint and steel, and endeavours to strike them together. Alas ! vain attempt ; he only succeeds in destroying his equilibrium, which it takes any quantity of "see-sawing" about to recover, and after many fruitless attempts, manages to knock the skin off his knuckles, and upset the tinder-box. With the patience and perseverance which nobody but one "half-seas-over" can possibly command, he recaptures the lost "arrangement," and after many like disasters succeeds in throwing a spark upon the tinder, the smoke from which gets into his eyes and blinds him. He essays to light the match, the fumes of the burning brimstone suffocate him. He wheezes and sneezes, swears and curses, and at last ends his troubles by getting a light, which he might have had long ago, if he had only possessed that modern invention, "a friction match," which by a slight rub on the sand-paper, would have "lighted him the dusky road" to bed.

The first improvement that was made upon the old tinder-boxes, we believe, was what were called "phosphorus boxes." These were long cylindrical cases, containing at one end some fifty wooden matches tipped with an inflammable preparation, which, when a light was wanted, were dipped into a small bottle of phosphorus in the other end of the box. These were, however, expensive, and never got into general use.

The first introduction of friction matches into the United States, was in the year 1836. They were, however, very different from those now in common use. They were called "lucifers," and were at first used exclusively as cigar lighters. This match consisted of a preparation of phosphorus, upon a narrow strip of brown paper, saturated with saltpetre, and fire was obtained by drawing it briskly between two pieces of thick sand-paper. These matches did not blaze, but burned slowly like a fusee. Within a short time after, such improvements were made as to render them capable of producing a flame, but as they were all imported from Europe, they were too expensive for general use, and the old tinder-box still held its own.

American ingenuity, however, soon set itself to work to discover how this important improvement in the means of obtaining fire could be made of general service, and it was not long before a shrewd Yankee, by the name of Phillips, took out a patent for the "combination of chalk and other earthy substances, with glutin and phosphorus," in the preparation of matches. In a very short time, too, the mechanical skill of the country was taxed to produce such machinery as should be able to make an article destined for such universal use as rapidly and cheaply as possible. This resulted in the invention of various machines, all tending to the same result, and in less than a year after the first introduction of foreign lucifer matches, a better and more useful article was in general use through the country at less than a third of the price at which the imported matches were sold.

The manufacture of matches now gives employment to a large number of persons in almost every city in North America, and matches are exported from thence to the farthermost ends of the earth.

The rapidity with which these useful articles are made is really astonishing, and the machinery is among the most ingenious ever invented. Few who draw a match across some rough surface, and, after obtaining a light, forget the means which produced it, know that each match passes through no less than eight different hands before it is fit for use, or that a box which contains matches, passes through a like number of hands, so that *sixteen* different persons are employed in making up a box of matches.

The wood used for matches was formerly obtained from old ship-spars; but it was found that the destruction of tools used in cutting it, from contact with the number of nails, spikes, &c., which these spars contained, made the use of this timber more expensive than new lumber, and consequently none but the best clear three-inch white pine-joist is now used. This is cut into blocks by a circular saw, each block being just twice the breadth of the length of a match. This block is placed in a box, beneath which is a set of knives which score the block, with the grain, the exact thickness of the match, while another knife passes through it and cuts off the sticks as they are scored. So rapidly does this machine work, that no less than twenty-two match-sticks are cut by each revolution; two hundred revolutions are made a minute, which amounts to 4,400 match-sticks per minute, 264,000 per hour, 2,640,000 per working day of ten hours, and the immense number of 821,040,000 per year. The match-sticks, as they are cut, fall into a trough below, and are thence carried into large bins where they are "gathered," as it is called—that is, they are disentangled from the mass in which they are collected—an operation which is performed by boys with great rapidity—and laid out in racks, which are measured to contain a certain number. They are then tied in round bundles and carried into another part of the building, where there are a large number of children at work, some of them not more than five years of age. These children untie the bundles and place, by very quick manipulations, each match-stick in a groove which keeps it isolated in what is called a "slat;' some dozen of these grooved "slats" filled with matches are screwed together and form a "batch." From the sides of this batch the ends of the matches protrude about an inch. The "batches" are then carried by boys to a room where the ends are dipped into a brimstone-vat. This vat is over a hot coal fire, and it requires some considerable experience on the part of the dipper to keep the hot brimstone always of the same depth, because if the brimstone should be too deep in the vat, the stick would receive too much of it, the fumes of which, when the match should be burned, would be extremely disagreeable. He first dips one side of the batch, then the other, when it is carried into another room where it is again dipped into the phosphorus.

The primary coating of sulphur cannot well be dispensed with, for the inflammable compound burns too rapidly to set fire to the wood. The flame produced by it is first transferred to the sulphur and then to the wood. The original matches were made by mixing phosphorus with mucilage, to which chlorate of potash was then added. The sulphured wood was dipped in this. Sometimes the phosphorus was replaced by sulphuret of antimony. The noise of this in flaming was objectionable, and noiseless matches were then made by replacing the detonating action of chlorate of potash for the slower combustion of nitrate and phosphorus. The general principle conceived in the action of all these matches is, that substances (as phosphorus) having a great affinity for oxygen, are mixed with a large amount of it, condensed into a small space (as in nitrate or chlorate of potash), so that the slightest cause is sufficient to effect the combination. The peroxides of lead and manganese, which abound in oxygen, are often mixed with the nitre; they act in the same way when they have reached a red heat.

The preparation, which consists of chalk or Paris White, glue, and other glutinous substances, mixed with phosphorus, is kept hot in a kettle, under which enough heat is maintained to keep it fused. When the matches are to be dipped, the preparation of phosphorus is taken from the kettle and thinly spread over stones which are kept hot by means of steam pipes. The matches already dipped in the brimstone are now dipped into this to the depth of about an eighth of an inch, and are then placed in large racks to dry. The quickness of the drying process depends altogether upon the atmosphere. If it is damp they will not dry at all, and the whole building becomes enveloped in a thin vapour, with an exceedingly unpleasant odour, which comes from the phosphorus. When the atmosphere is not damp they dry in from three to eight hours, sufficiently to admit of their being packed into the boxes. The matches are first taken out of the grooved "slats" by boys, and placed in a little rack of the same size as those in which they were originally placed when gathered from the mass, and taken into another room, where a number of girls stand surrounded by thousands of match-boxes and piles of matches. Before each trio is a knife, which operates perpendicularly, and is used for cutting the matches in two. The girl who stands immediately in front of this knife, with a nicety that long practice could alone give her, takes in her hand a bundle of matches from the rack, which is just sufficient to fill the boxes; this bundle she places under the knife, which, as she puts her foot upon the treddle, descends and cuts the bunch in the middle. Each of the severed ends is taken by the girl on each side of her, and put into the box, on which the cover is placed, and the box of matches is then thrown into a receptacle for them, from which they are taken to be packed in parcels of a gross each. The operation of filling the boxes is performed with great rapidity, and makes one wonder at the flexibility of the muscles and sinews of the human hand.

The process of the manufacture of match-boxes is almost as curious as the manufacture of the matches which they contain. They are made of different materials, and in various ways. Some of the articles used are paper, paste-board, sheet-tin, brass, and wood. The better sort of boxes, even when made of common paper, cost nearly as much, and sometimes more than the matches. The paper boxes are made entirely by hand, by Germans, mostly outside of the factories, and are sold to the manufactories by the gross. When made in the factory, the paper is first cut into long strips, by means of a large knife which is worked by machinery, these strips are again cut into pieces of the required size for the box. A large quantity of the paper is cut by one stroke of the knife, every stroke cutting off 288 strips; each strip is again divided into six parts, so that by seven cuts of the knife the materials for 1,728 or twelve gross of boxes is furnished. The packs are then put into a machine in which a number of very sharp little knives are made to work vertically, and are "scored,"—that is the knives cut through the entire depth of the pack two incisions about a quarter of an inch in length. These incisions are made at each end of the paper, to enable those who put them together to form the sides and ends of the boxes. The tops are cut in the same way. The boxes which are of thin pine wood, are made of the same material as the matches. The blocks of wood are put into a box of the same appearance as those which make the splints or match-sticks, and a knife, which works horizontally, slices the wood into thin pieces with great rapidity. The thin slips are then gathered and put into packs, which are grooved by machinery, and after being glued together by hand, are pasted over with paper. The covers are made in the same way.

The round wooden boxes are made by machinery, in Connecticut and New Hampshire. The material is furnished by the pine saplings which are the second growth of oak lands. A vast quantity of these saplings are used for this purpose, and the country in some places for miles is entirely cleared of them in this way. It is found that this material is not only cheaper, but better than full grown timber. These boxes are sent to New York in packing-cases containing thirty-six gross each. The covers and boxes are packed separately.

The boxes are all labelled by women and girls. This is very rapidly done ; a good practiced hand being able in a day to label about thirty-six gross, besides putting the sand on the bottom of the boxes. The sand is put on very quickly. The bottom of the box first receives a smearing of glue, and is then dipped into a pile of sand, which of course adheres to the box sufficiently to form a rough surface to produce the necessary friction on the match.

The manufacture of matches gives employment to a large number of persons, principally children, who make from twenty-five to seventy-five cents per day, working generally about ten hours. They work by the piece, and, of course, the amount they receive depends upon their industry and aptness for the business. The average amount received by all persons may be pretty nearly arrived at, from the fact that Mr Charles Partridge, who is, perhaps, more extensively engaged in the match business than anyone in the United States, pays out to the hands employed in his factory, six hundred dollars every Saturday night, on an average nearly five and a-half dollars (23s.) to each person employed.

Besides the persons who work regularly in the factories, there are a large number of persons engaged in the manufacture of boxes and splints, who perform their work at their own houses. These persons are all Germans, who live in the suburbs of the city. The splints they make are the round ones, which they manufacture principally out of old masts and other spars, and such timber as they can buy cheaply or obtain in another way at less cost ; but lumber merchants having yards up-town, know too well that a good many feet of their lumber are burned in matches for which their cash books show no account. These round splints are cut by those who make them with an instrument shaped like a long stave plane, only the knife, instead of being smooth like that used in the plane, is cut into a number of very sharp small cylinders, across which the wood is forced, and, instead of shavings, match-splints are the result. These splints, as originally made, vary in length from twelve inches to three feet, according to the length of clear stuff between the knots in the timber from which they are cut.

The amount of timber used in making matches is really enormous, considering the very small amount of wood composing a single match. The manufactories in New York pay monthly for lumber alone, to be made into matches, from 500 dol. to 1,000 dol. each ; while the lumber used in the construction of the packing cases, in which they are shipped, and the boxes, in which they are packed in grosses, is almost as great. The boxes containing a gross are made of butts of large logs, because the parts thus cut off are generally refuse timber, and clearer of knots than other lumber.

The number of persons, of all ages, engaged in the making of matches in the United States is not less than two thousand—about one-fourth of whom work in New York ; the rest in Boston, Connecticut, Ohio, and Pennsylvania. Of course, the majority of them are children, from four years to sixteen years of age.

Matches are sent from this city to all parts of the world. The principal foreign markets are Canada, the West India Islands, Mexico, Central and South America, both the Atlantic and Pacific coasts, Sandwich Islands, California, Oregon, Australia, the various parts of the Mediterranean, and the Chinese Empire. The matches are packed for shipping in tin cases, which not only keeps them from the water, but also protects them from the moisture of the sea atmosphere, which would soften and destroy the tips.

Certain kinds of matches are sent exclusively to particular markets, and persons not acquainted with these peculiarities, have experienced heavy losses by sending the wrong sort.

In California, none but the round splint match, put up in the round wooden boxes, meet with a ready sale. The reasons for this are found in the fact that matches put up in this way are much more convenient to carry in the pocket and on journeys. The bottom of the box presents a rough surface, always at hand, against which to rub the match ; and when the box is exhausted, it forms a convenient receptacle for the traveller or miner, in which to carry his little odds and ends, such as pins and needles, and, in many cases, the dearly-procured object of all his toils, his precious gold-dust. The large square splints are sent to the West Indies ; the small round matches, in thin paper boxes, to Central and South America ; while the same matches that find a ready sale in Cincinnati and other western cities, will not bring half their cost in Boston or New Orleans.

The number of matches made and sold in the course of the year amounts, in the aggregate, to about 4,733,501,760 matches, or 505,716 gross of boxes, or 72,823,104 boxes of matches, which is nearly three boxes of matches a year for every man, woman and child—white, red and black—in the United States.

There are a great many matches, besides, imported into this country from Germany, which, owing to the light duty and the cheapness of labour where they are made, are sold in New York at prices which enable the foreign manufacturers to compete profitably with the American makers. Manufacturers in the United States are obliged to pay as high a duty on the phosphorus used in the composition as the foreign matches pay, including phosphorus, brimstone, timber, manufactured boxes and all.

Matches are sold at various prices, which generally yield the retail dealer a profit of about ten per cent. But a good many of the matches which are sold at retail do not come into possession of the consumer as they leave the purchaser, and this occurs in this wise. A large number of boys are engaged in New York and other cities in peddling matches about the streets. The matches which they sell are not put up in the small boxes in which they are usually sold, but in large paper boxes which hold a much greater number. These boxes have no labels upon them, but the matches are generally of a good kind, and, of course, there must be some secret about it, which is this ; the matches are for the most part stolen out of the boxes which are honestly filled in the factories. For instance, these peddling boys buy several gross of matches ; the boxes contain from fifty to eighty matches, from which these little rascals take about one fourth and thus make up the boxes which they sell so cheaply. In this way they commit a fraud upon those who purchase the matches in the small boxes, and do an injury to the honest manufacturer, who loses his reputation for fairly filling his boxes, when, though he really does so, the fault lies entirely with the boys. All the manufacturers complain loudly of this fraud, but we know of no way to prevent it, except to make it public, and warn all honest people against aiding and abetting in it, by purchasing the matches sold by boys in large boxes without labels.

It would be supposed that owing to the combustible properties of matches, and the ease with which they are ignited, fires would frequently occur in the factories in which they are made ; such, however, is not the fact. The matches do sometimes accidentally ignite in the hands of the persons engaged in cutting them in two, or in putting them into boxes, but they are immediately extinguished before they can do any damage by throwing them into a bucket or cask containing water, and which stands in the near neighbourhood of the table where they work. People would also make a mistake in supposing the match-making business to be an unhealthy one. While going through several of the factories, we watched carefully for indications of disease among the many operatives, but could find none of any consequence. They all appeared to be in the enjoyment of good health and spirits, and worked away singing and laughing, and seemingly as happy as they could wish to be. We learn, however, that there is a decaying of the jaw-bone which is peculiar to persons working at this business. It has very rarely manifested itself, however, and only when the bone has been exposed by some accident to the jaw, or the loss of a tooth. Phosphorus is used medicinally, as a tonic, and is useful in many cases of constitutional weakness. We saw several persons who had been constantly employed in the business for seventeen years, who showed no symptoms of disease ; on the contrary, they seemed remarkably healthy.

By a process discovered a few years ago by an Austrian chemist, phosphorus is now reduced to a condition perfectly innocuous; it may be handled, and even reduced to a fine powder, in which state it is equally serviceable for the purposes of the manufacturer.

There are in this city (New York) altogether about half-a-dozen factories engaged in making matches. The principal ones are those of Mr Charles Partridge and Mr Le Cure.

Mr Partridge's factory is situated in Thirty-sixth street, between Seventh and Eighth avenues. The building is of stone, 125 feet by 32, and four stories high. He employs, here and elsewhere, nearly 300 men, women, and children. The building is heated all over by steam-pipes, and is well lighted and ventilated, and everything furnished that can facilitate the labour of the operatives or render them more comfortable. The first story of the building is used for making packing-cases and boxes to hold a single gross. The second story is used for packing, the third for cutting and putting into boxes, and the fourth for dipping and drying. There is no machinery of any consequence used by Mr Partridge in the manufacture of his matches, because he is of the opinion that he has no right to deprive any of the opportunity of working with their hands, and is loth to introduce more machinery than he can possibly do without. All his splints are made by hand, cut by hand, and dipped in the same way. He is adding to the already very large building a wing equally large, fronting on 37th street, and will, when the building is finished, increase the number of persons in his employ to nearly double. It is also his intention, at the same time, to confine the work to females as much as possible, believing as he does, that it is his duty and the duty of all, to do everything in their power to enlarge the sphere of woman's labour. He intends that the nailing together of boxes for holding grosses of matches shall all be put together by women, the work being light, and in all respects more healthful than the terrible slavery of the needle. As he will pay women for doing this work the same price that he now pays his men, it is apparent that selfish motives have no part in this new arrangement.

Mr Partridge manufactured, in 1853, 84,286 gross of matches, containing 144 boxes each, amounting to 12,137,184 boxes, at an average of 65 matches each box, giving 788,916,960 as the aggregate number of matches, which amounts to 2,629,723 daily, making 262,972 per hour, 4,382 per minute, and 73 per second. With his increased facilities he now manufactures at least 200,000 gross.

Besides the wooden matches, Mr Partridge is largely engaged in the manufacture of wax tapers, which burn from one minute to five, and are very useful for various purposes, for which the wooden matches are impracticable, such as sealing letters, lighting one up-stairs, &c. &c. They are very neatly made and put up, and though they can never, from their greater expense, supersede the wooden ones, yet they are gradually getting into very general use; and it is rare that we find an *escritoire* or merchant's desk without these useful things.

Their retention of flame in the wind is another quality which will commend them to the use of travellers who like to enjoy "a weed" while *en route* in pursuit of business or pleasure. Mr Partridge also does a large business in what he calls 'Diamond Cigar Lights,' which are very useful little things for smokers. They are made of the same material as the old "Lucifers," and are diamond-shaped ; one end of them is inserted into the cigar, and the other, which is tipped with a composition, is rubbed like a match. The burning composition being entirely free from odour, does not in the least destroy the flavour of the cigar.

One of the most remarkable peculiarities of Mr Partridge's establishment is the plan of its organisation. Mr Partridge believes that unity of interest can alone produce and preserve harmony between labour and capital, and this end he proposes to carry out in the following manner :

Let capital, or the employer, continue to pay the same prices for labour that they now do, or may hereafter, under any advance in the cost of living, and, in addition to this, divide a liberal percentage of the net profits of the business among the operatives, annually, in the ratio of services each has rendered.

In following out this principle, Mr Partridge divides among his employees, in the ratio of their services rendered, ten per cent. of the profits of his match factory. The number among whom this money was divided was 102, some receiving more and some less, in proportion to the services each one had rendered, to the whole amount of work done. After the distribution, the hands sit down to a splendid banquet. The occasion is one of great interest, and his plan has attracted much attention among the community generally and the manufacturers in particular. Mr Partridge is daily receiving letters from persons employing a large number of operatives, seeking information as to his plan and its workings, and he feels sanguine that in the course of a few years it will be quite generally adopted.

Another extensive match factory is that of Mr Le Cure, in the Second avenue, between Twenty-ninth and Thirtieth street. Mr Le Cure has been in the business for a number of years, and has, as he deserves, been exceedingly successful. His factory occupies nearly an acre of ground, and employs a very large number of men, women, and children. He has adopted all the improvements that have been made in the manufacture of matches, and all the ingenious machinery which we have described may be found in his establishment. His matches are eagerly sought for wherever they have been introduced, although they contain at least twenty times as many matches as the ordinary boxes, and are sold for about one-half the price ; as they sell them at a profit, it is with difficulty that, with all his advantages, he is able to supply the demand.

The spill, or match-making machines, each make 900 round spills, 15 inches long, $\frac{1}{8}$ inch diameter, per minute ; so that, if each spill were cut into five matches, each 3 inches long, 4,500 would be produced every minute. The spills are cut from pieces of straight-grained timber, made of such a length as to pass between two grooved feeding-rollers, which hold the timber so that its under surface is level with the lowest parts of a row of tubular cutting-tools, or long, sharp-edged punches. The cutting-tools are thus arranged: five pieces of steel are fixed side by side in a horizontal bar. Each piece of steel is perforated with three long holes, lying close together, and having their ends sharpened like the cutting edges of a hollow punch. A line of 15 tubular cutters is thus formed, and motion is given to the horizontal bar, in which they are fixed, by a crank which impels them against the timber; this is depressed at each stroke sufficiently to allow each cutter to cut out its spill, which passes through and falls out behind. The cost of this machine does not exceed 20*l.*; and when the number of matches, all nicely rounded, which it is capable of producing, is contrasted with the number which could be produced by a hand-instrument in the same time, it will serve as a simple and striking illustration of the advantages of the employment of matter in the form of machinery to do the work of man. S.

New York.

NUTMEG CULTURE IN THE STRAITS SETTLEMENTS.

BY T. BRADDELL, F.R.G.S.

About the close of the last century, the cultivation of the nutmeg and clove were introduced into the Straits Settlements by the Local Governments. These spices were confined to the narrow limits of the Banda and Amboyna groups, where the Dutch Government had long enforced strict rules for preserving the monopoly, destroying the germinating principle of the fruit before exportation, to prevent the growth elsewhere, and burning all produce beyond the quantity considered necessary to supply the market, so as to keep up prices. During the British occupation of the Dutch Islands, commencing in 1795, advantage was taken of the opportunity to introduce large numbers of nutmeg and clove plantations into British possessions. Bencoolen, Pinang, Bourbon, Mauritius, and some of the West India Island, were pointed out, but Dr Roxburgh, the eminent botanist, at that time curator of the Calcutta Botanical Gardens, reported strongly in favour of Pinang, as being better suited for spice cultivation than any other place within the British territories.

Pinang was, in consequence, fixed on as the locality for experiment, on a large scale, while other places received plants to a lesser extent. From March, 1800, till September, 1801, 24,820 nutmegs, and 15,985 clove-plants and seedlings were introduced into Pinang, and in a report of the Honourable Company's botanist in the next year, it is stated that no less than 71,262 nutmegs, and 55,264 clove-plants and seedlings had been introduced. The greater portion, however, of the plants appear to have died off, and although the Company went to considerable expense in the garden, it does not appear that much progress was made; for in 1805, when the plants were sold off, and the cultivation abandoned by Government, there were only 5,100 nutmegs, and 1,615 clove trees, with 1,050 seedlings. These were sold among the European residents, many of whom commenced to plant round their houses ; but one of them, Mr D. Brown, entered into the speculation on a larger scale. After many trials, and great expense, he succeeded in establishing both cultivations, and after his death, his descendants reaped the benefit of his enterprise, in the valuable estate named Glugore, so well known to travellers. Many of the officers of Government were encouraged to enter into spice cultivation, and in later years, the Chinese also engaged largely in the speculation. In 1833, there were eleven spice-gardens in the settlement, two only belonging to private individuals, the other nine to Government officers. In the municipal assessment accounts for that year, the value of the produce for assessment purposes, was estimated as follows:

Mr Brown's estate - - - -	38,000	dollars
Another estate - - - - -	1,000	„
Government officers' estates - -	18,400	„
Total - - - -	57,400	

From this time the cultivation rapidly extended, as may be seen by the following return of exports from Pinang, in piculs of 133⅓ lbs.

	Nutmegs.	Mace.	Cloves.
1840	598	159	——
1850	2,086	653	1,292
1860	6,421	2,094	139

The annual returns of cloves exported show great irregularities, which are to be attributed to the quantities of that spice imported from Bourbon and the coast of India being included.

Within the last few years a fatal blight has fallen on the trees. In some districts whole gardens are abandoned, the trees having died off from some cause as yet unaccounted for. The great numbers, however, of young plantations coming into bearing have, so far, kept up the produce for exportation; but it is feared that in a few years these young trees may in turn be affected. Accordingly, many owners of nutmeg plantations are turning their attention to the culture of cocoa-nuts and betel-nuts, planting these palms wherever the nutmeg-trees have perished. An effort is also being made to cultivate Cinchona. The 'Pinang Argus' asks why Tea should not flourish upon the hills, and evidently thinks it worth while that some experiment should be made for turning them to some profitable account. The same paper also points out that cotton might be cultivated with advantage in Pinang. By returns for which I am indebted to the courtesy of the Surveyor-General, it appears that there are now in Pinang 13,153 acres; in Province Wellesley, 1,349 acres: total, 14,502 in spice cultivation, though of this quantity much has been abandoned, and some part is not yet in bearing.

Sir Stamford Raffles had a supply of nutmeg- and clove-plants sent from Bencoolen in August, 1819. They were planted out in the Botanical Gardens, on the side of Government hill, Singapore; but, although plants were then easily procurable from Pinang, as well as Bencoolen, there was no great progress made, as is shown by the fact, that in 1843 there were only 5,317 bearing trees in the island. About that time, however, commenced the move towards the country among the European residents, and spice-trees were largely planted round houses; in some instances as ornaments, but in most cases for profit. Even with this great additional impetus, the cultivation never reached the extent it did in Pinang. By a statement of the surveyor published in the 'Journal of the Indian Archipelago' (vol. iii., p. 219), it appears there were 1,190 acres in nutmeg, and 28 acres in clove cultivation at Singapore in 1848, with 71,400 nutmeg-trees and plants, producing 624 cwt. of nutmegs, and 156 cwt. of mace, and 5,488 clove-trees and plants, producing less than 6 cwt. of cloves. Since that time it is doubtful whether the cultivation of spices has increased. Some of the large estates near the town, where vast sums had been expended in cultivation, have within the past few years been sold for building purposes; and numbers of European dwelling-houses now fill the space formerly occupied by spice-trees. The nutmeg disease has been at work at Singapore for the past five years. In the island of Batu Kawan 15,000 trees, producing about four millions of nutmegs, have nearly all been killed. The cultivation was originally introduced from the Moluccas in the beginning of the century. Government deputed Dr Oxley to those islands, to procure seedlings and nuts of the true stock. Upwards of 400,000 were introduced into Pinang and Singapore in 1856, but the disease is still spreading to such an extent that the large plantations belonging to Dr Oxley and Mr Prinsep have been laid out for building purposes.

Singapore.

THE COLLECTION AND MANUFACTURE OF LAC IN THE NAGPORE TERRITORY.*

BY RAMASAWMY MOODLIAR.

The koosumb-tree (*Schleichera trijuga*), from which stick-lac is procurable, is generally found located on hills; but it flourishes also along the banks and in the neighbourhood of nullahs (ravines), and in itself presents the appearance of a jungle. It attains both a great height and diameter, the first varying from thirty to seventy feet, and the latter from one to four feet; its branches are wide-spreading, and the wood is strong and pliable. The tree blossoms in February, and the fruit is ripe in April and May; from the seeds of which an oil is procured and used for the lamp, and

* Articles on the Natural History of the Lac-Insect, and Remarks upon the Commerce in Shellac, will be found at pages 196 and 204 of vol. i. of TECHNOLOGIST.

considered a good cure for poora. In the Nagpore territory, the tree (called by the natives, koosumbia) is found in the districts of Lanjee, Comtah, Roypore, Joucknudee, Chandah, Bundara, Buster, and Ranjem, but most abundant in the last-named district.

The lac-insect is produced inside the bark of the tree, and may be observed in removing a portion of it early in the month of August, and during the prevalence of heavy fogs the insect perforates the bark and forms the lac, the insect itself forming the colouring matter. The first crop is picked in November, December, and January. If allowed to remain on the tree for a month or so longer, a whitish maggot is generated, which consumes the lac-insect. Should fogs not prevail in August, as is usual, there would be a failure in the lac-crop. There is a second crop of lac, procurable in July, but its quality is very inferior to the first.

The Goands collect the crude stick-lac and bring it to the village bazars, where it is sold for tobacco and salt, and sometimes for cash ; but merchants generally make a contract with the Goands for it, and an advance is made by purchasers to them. They furnish it at the rate of four to six coodoos, equal to from 32 lb. to 48 lb. weight per rupee. When the lac is kept for a few months after it is collected, it is reduced to half its original weight.

After the lac is brought from the jungle, it is converted into dye in this country for leather, Tusser, or common silk, and good silk at Nagpore ; but the Nagpore country people do not understand the use of it for dyeing cotton cloth, and thread, and it is only used in a rough way. The process of making lac-dye is as follows :—The lac having been carefully picked from the branches, is reduced to powder in a stone hand-mill, and then thrown into a cistern, covered with two inches of water, and allowed to soak for sixteen hours, or say from four p.m. to six a.m. It is then trampled by men for four hours or so, until the water appears well coloured, each person having a portion of about ten pounds weight of lac to operate upon. The whole is then strained through a cloth, boiling alum-water being poured on it during the process, and the coloured water run off into another cistern, where it remains for one day to settle. The water is then run into a second cistern, and the day following into a third. The water is then allowed to run off as waste. The colouring matter is now taken up in tin vessels from the three cisterns, and placed in a canvas strainer, where it is allowed to remain from two to three days, or until such time as all the water has been strained off. It is then placed in a pressing-machine, and all remaining moisture squeezed out. The square cakes of dye are then impressed with the letters or mark of the manufacturer. The shell-lac is made from the lac which remains in the cloth after the first straining.

The branches contain, as mentioned, the insects under the bark, a removal of which would exhibit them to the naked eye (red). To promote their increase, all that is necessary is to attach or bind a branch containing the insect to the ordinary berry fruit, or Ellenda, tree ; but the koosumba-tree yields the best lac. The Moorka-tree yields lac largely, but very inferior in quality.

ON THE PRODUCTS OF THE HEMP PLANT (*CANNABIS SATIVA*.)

BY JOHN R. JACKSON.

The hemp plant is known chiefly in this country on account of the valuable fibre it affords, which is in such constant use in the manufacture of cord, ropes, &c. Although its fibre is of the greatest value to us, still its other products are equally valuable to the natives of tropical climates. For example, in the East it is cultivated entirely on account of its narcotic resin, which is spontaneously secreted in all warm climates. In cooler temperatures it is grown exclusively for the sake of its fibre, as in Russia, Prussia, Spain, Italy, &c. It grows wild in temperate Asia and in Northern India.

Hemp appears to have been known from a very remote period, the first mention of it being made in the first book of Herodotus (C. 202), where he says :—" The Scythians never washed any part of their bodies excepting their heads, and accordingly purified themselves with an intoxicating kind of smoke, which seems to be somewhat analogous to the smoke of tobacco. Having first washed and thoroughly cleansed their heads, they made a tent by stretching thick woollen cloths over three sticks fixed in the ground and inclining towards each other. They next placed a vessel full of red hot stones in the centre of the tent, and crept round it, whilst the tent covering was kept very close and almost air-tight. They then threw hemp seed on the hot stones, and a smoke and steam soon arose, which was denser than the hottest vapour bath, and the intoxicated Scythians would cry and shout at the top of their voices, from the excitement and exhilaration produced by this overpowering process." It is mentioned again in another book of the same author, where he speaks of the Scythians having " a sort of hemp very like flax," growing " both spontaneously and from cultivation," and of garments being made from it by the Heracians " very like linen." It is also spoken of by Pliny, who says the plant was well known to the Romans. Mention is also made by the writer of some medicinal properties reputed to belong to it. Thus, we see that the plant was well known to the Greeks and Romans ; but the Hebrews and Egyptians seem to have been unacquainted with it. At the present time, it is grown to a great extent in Russia, wholly on account of its fibre, from which country alone we received, in 1860, 597,610 cwts. We also find it cultivated in some parts of India, Africa, and China, and also to a small extent in the United States and Canada. It grows well in England, and is cultivated largely in some counties, as Suffolk, Yorkshire, Lincolnshire, &c. The finest kind is obtained from Italy, though in small quantities ; it is known as " Italian Garden Hemp," being raised by spade culture. This is sometimes eight or nine feet long, and is used for sail-cloth as well as for the finer kinds of cordage. The mode of preparing hemp much resembles that employed in the preparation of flax. Its value and uses are so well known that it is needless to mention them here. For its narcotic and resinous properties, it is exclusively cultivated in some parts of Africa and

India. The value of the fibre of hemp grown in those counties seems greatly diminished, while the resin-producing properties of the plant appear much enhanced by growth in tropical climes. This resin, called in India, "Churrus," is collected in the following curious manner :—Men are clad in leather dresses, and sent into the hemp field, where they brush about amongst the plants in a furious manner ; the soft resin, by this means, adheres to their dresses, and is afterwards scraped off and made into balls. The leathern costume is said to be dispensed with in Nepal and the resin collected on the bare skins of the coolies. In Persia it is collected by submitting the plants to pressure between coarse cloths, which are subsequently scraped, and the resin melted in pots with the aid of warm water. A finer kind of this resin, called waxen churrus, or "momeca," is collected by hand, this fetches a high price, nearly double that of the ordinary kind, which usually sells at from five to six rupees the seer. Churrus is of a dull greyish brown colour, with little or no smell, and is usually met with in cakes from two to three inches long, somewhat in the shape of a lemon. It is used in medicine in India, and is reported to have been successfully employed in tetanus, though its application in this country, for the same purpose, has failed to give satisfactory results. Its intoxicating effects, as stated by Dr O'Shaughnessy, are most remarkable.

Hemp enters into Indian commerce in other forms besides Churrus. Gunjah, or Ganjah, is found in the Calcutta Bazaars, and is used chiefly for smoking. It consists of the plants themselves, with the leaves and inflorescence attached, and upon which the resin is left adhering. It is made up into bundles of from three to four feet long, containing about twenty plants, these are flattened by pressure, and their colour is of a greenish brown, while there is present a heavy aromatic odour. It is smoked in a similar manner to tobacco, and it is said that its continued use brings on severe asthma. In Africa it is known as "Djamba," and is found in the markets packed in strips of palm leaf or husks of maize, generally about two feet long, tied at top and bottom, and at intervals of about an inch, or an inch and a half, throughout the whole length of the case. When required for use one of these divisions is cut through, which is sufficient for one pipe ; the packages are sometimes smaller and the "charges" not much larger than a marble. The "Hasheesh," or "Hasshisch," of the Arabs, appears to differ from Gunjah in this peculiarity, that it is composed of the tops and other tender parts of the plant after the lowering period. They use it in a variety of ways other than smoking, for which purpose alone they have many modes of preparing it. They make it into an electuary, with the addition of dates, or figs and honey, and sometimes cloves, cinnamon, or musk, boiled in butter, or oil and water ; the filtered product is used in pastry. "Bhang," "Sidhee," or Subjee," is composed of the larger leaves and capsules with a very small quantity of resin. This like Gunjah is sold in the Indian Bazaars, its intoxicating properties are not so great ; indeed, it is not applied to the same use, but being mixed with water and other additions, is formed into a drink called "Subzee," which is reported to be highly conducive to health. A stimulating infusion is prepared from the plant in Scinde, which is said to promote appetite, and is in great repute among the upper classes. The fruits of the hemp plant, which are usually known as hemp seed, are oleaginous and demulcent, but appear to be devoid of any narcotic principle. Their chief use is for feeding cage birds. A serviceable oil is, however, expressed from them, which is used for mixing paints, burning in lamps, and also in the manufacture of soft soap.

Kew.

KERMES, OR THE SCARLET GRAIN OF COMMERCE.

BY THE EDITOR.

Although cochineal and lac dye have now quite superseded the use of kermes as a tinctorial substance in England, yet a short notice of this dye-stuff is worth placing on record, for the information of those who may not have facilities for referring to it, and are never, perhaps, likely to see the insect product. There are several varieties of the insect (*Coccus ilicis*, Linn.) named after the plant which they frequent. The insects were long taken for the seeds of the tree on which they lived, and hence called grains of kermes. The Coccus occurs as a parasitic insect, having all the appearance of a berry or seed, exhibiting not the slightest indication of its insect nature, being immovably affixed, in clusters, to the branches of the oak (*Quercus Coccifera*) upon which it subsists, by introducing into the substance of the stem a long and delicate haustellum. The oak is a low, bushy evergreen shrub, much resembling a holly in miniature. It is only at the close of its existence, however, that the coccus assumes the form of a seed. Although the insect is provided with two legs, and when young, possesses locomotive powers, yet after impregnation, it greatly increases in size, and the eggs are deposited beneath the body; so that, by degrees, as the eggs are excluded, the two surfaces of the body come together, and form a covering for the eggs; hence it will be observed, that it is only the females which are collected for traffic; the males, in the perfect state, being minute, active, two-winged flies, totally unlike their insect-partners.

In the natural state, the kermes are of a shining appearance, and of the colour of a plum covered with a whitish bloom. In the condition in which they are brought to market, they appear of a dull, reddish brown, which is not, of course, the natural colour of good kermes, but is imparted to them by steeping in vinegar. The inhabitants of the countries where these insects are obtained, distinguish three stages in their existence. In the Provençal language, the term "*Le ver*" is applied to them, when they are in the earliest stage of activity; "*Le ver couvée*," subsequently in the month of April, when they become stationary; and "*Le ver commence d'éclore*" in the last stage, about the middle or towards the end of May, when each female insect is found reduced to a skin, covering its brood of eggs to the number of 1,800 or 2,000.

The crop of kermes is more or less abundant, according to the mildness or severity of the preceding winter; when, therefore, there has been little or no frost, and the weather has been generally mild, a good yield is expected, which is not obtained every year, and, as there is no trouble in planting or otherwise attending to the management of the trees, after they are once established, and as no other instruments are required for collecting the kermes than the finger-nails, it may be reasonably supposed that the harvest is an inexpensive one. The kermes are usually collected in the morning, before the dew is off the oaks, as at that time their leaves and prickles inflict less injury to the hands. An experienced person will thus pick two pounds each day. It is stated that the price of the kermes decreases considerably, according to the period in which they are gathered. Those earliest collected are the most valued, and the later ones less, in consequence of being lighter than those first obtained, owing to the young ones having escaped. The merchants who purchase the kermes, immediately steep them in vinegar, and then expose them to the action of heat sufficient to destroy any remaining vitality in the young. This process changes their colour to a bright, red hue, for which they have so long been celebrated. This production was known to the Phœnicians before the time of Moses, under the name of *thola*, to the Greeks by the appellation of *coccus*, and to the Romans by that of *Coccus baphica*; hence, the origin of the word "Coccinati," the persons who wore robes that were dyed with the kermes. Previous to the discovery of America, it was employed to a great extent in dyeing a very rich blood-red, which is of so permanent a nature, that the old tapestries of Brussels and other parts of Flanders, although manufactured more than two centuries ago, have lost none of their richness of tint. Since the settlement of America, it has been supplanted, in a great degree, even in Europe, by the *Coccus cacti*, or cochineal. The kermes, nevertheless, is still extensively prepared in some parts of Spain, as well as in the East. Bancroft states in his 'Permanent Colours,' that with a solution of tin, which is used with the cochineal, the kermes is capable of imparting a scarlet quite as brilliant as that dye, and perhaps more permanent. At the same time, however, as ten or twelve pounds contain only as much colouring matter as one pound of cochineal, the latter, at its ordinary price, is more economical. At present, it is chiefly used at Tunis, and other parts of the Barbary coast, for dyeing the scarlet skull-caps (fezes) so much used in the Levant. In the department of the Bouches-du-Rhone, one half of the kermes crop is dried. It amounts annually to about sixty quintals or cwts., and is warehoused at Avignon. From the middle of May to the middle of June, the egg cases are collected, and exposed to the vapour of vinegar to prevent incubation. A portion of the eggs is left upon the tree for the maintenance of the brood. The Spanish kermes is preferred to the French. In Seville, they dry the gall-shaped nests of this insect's eggs on mats in the sun; the dust which arises from stirring it about, is considered the most valuable part, and when mixed with vinegar is called pastel or carmine. The species of oak on which the kermes insect is found abounds in Algeria, principally in the provinces of Algiers and Oran; but neither the tree nor the insect are an object of any careful attention. The Arabs, however, collect the insect in June, and the price at which they dispose of it has ranged of late years from five to ten francs the kilogramme. The exports of kermes from Algiers are about 2,000 kilogrammes annually, which, at the official price of nine francs per kilogramme, represents a total value of 18,000 francs; but the greater part of the production is used in the province to dye stuffs red instead of cochineal. That shipped is principally in demand for colouring cosmetics, distilled waters, and pharmaceutical preparations. France imports annually about 3,000 kilogrammes of kermes.

Coccus polonicus makes similar nests for its eggs on the roots of *Polygonum cocciferum*, *Schleanthus perennis*, and other plants, in sandy soils in that country and the Ukraine. This species has the same properties as the preceding; one pound of it, according to Wolfe, being capable of dyeing ten pounds of wool; but Hermstadt could not obtain a fine colour, although he employed five times as much of it as of cochineal. The colour does not take well on silk. The Turks, Armenians, and Cossacks, dye with kermes their morocco leather and cloth, as well as the manes and tails of their horses, and the females the nails of their fingers.

The kermes called *Coccus fragariœl* is found principally in Siberia upon the root of the common strawberry. The *Coccus uva-ursi* is twice the size of the Polish kermes, and dyes with alum a fine red. It occurs in Russia. Kermes is found not only upon the *Lycopodium complanatum*, in the Ukraine, but upon a great many other plants.

Good kermes is plump, of a deep, red colour, of an agreeable smell, and a rough and pungent taste. Its colouring matter is soluble in water and alcohol; it becomes yellowish or brownish with acids, and violet or crimson with alkalies. Sulphate of iron blackens it. With alum it dyes a blood-red; with copperas and tartar, a lively grey; with sulphate of copper and tartar, an olive green; with tartar and salt of tin, a lively cinnamon yellow; with more alum and tartar, a lilac; with sulphate of zinc and tartar, a violet. Scarlet and crimson, dyed with kermes, were called grain colours, and they are reckoned to be more durable than those of cochineal. Hellot says, that previous to dyeing in the kermes bath, he threw a handful of wool into it, in order to extract a blackish matter, which would have tarnished the colour.

Black Varnish.—A fine black varnish, from the fruit of *Holigarna longifolia*, is imported into Cachar from Munnipore, as is another made from *Sevuvium Anacardium* (marking nut), and a remarkable black pigment resembling that from *Melanorhœa usitatissima*, which is white when fresh, and requires to be kept under water. This turns of a beautiful black colour when applied to a surface, owing, according to Sir D. Brewster, to the fresh varnish consisting of a series of congeries of minute organised particles, which disperse the rays of light in all directions; the organic structure is destroyed when the varnish dries, and the rays of light are consequently transmitted.—'Hooker's Himalayan Journals.'

INTRODUCTION OF THE CINCHONA TREE INTO INDIA AND THE COLONIES.

The genus Cinchona affording by several of its species one of the best and most important of all known febrifuges—quinine—is now absorbing the attention of every European nation having colonies in the Tropics. The introduction of the plant, in a pecuniary point of view, will be of great importance, and we are glad to find that it has been attended with complete success in both the East and West Indies. Mr Nathaniel Wilson, the curator of the Botanic Gardens, Bath, Jamaica, in his report to the Board of Directors, dated Oct. 8th, just received, states :—

"Soon after this time last year, I was liberally supplied with seeds of three species of this plant—namely, *Cinchona nitida*, *C. micrantha*, and *C. succirubra*, direct from Peru and Guayuquil, sent by desire and at the expense of the English Government and recommendation of Sir W. J. Hooker, Director of the Royal Botanic gardens at Kew, to whom this island is largely indebted for many valuable plants. These seeds were sent with a view of rearing plants to carry out an experiment of establishing its cultivation here on a large scale, and I have now the satisfaction of stating that I have succeeded, beyond expectation, in rearing the plants; and have several hundreds of them on hand in a healthy condition, many of them ready for planting out. The two first-named species produce the finest grey bark of English commerce, so named from the prevailing colour of the epidermis. The alkaloid contains from 2 to 2·22 per cent. of the weight of the bark, almost entirely consisting of cinchonine. The *Cinchona succirubra*, or "Cascarilla colorada" of the Spaniards, produces the red bark of commerce, and by far the most valuable of all marketable barks; the current prices being 6s. per pound for very ordinary quality. The alkaloid of this contains from 3 to 4 per cent. of quinine, being nearly twice the quantity produced by other species, and fortunately the plant has also the advantage of a stronger constitution than the two former, and found in localities several thousand feet elevation less than them; in moist ravines where palms and other plants requiring a rather higher temperature are abundant. The climate where cinchona plants are found to arrive at greatest maturity is naturally moist, and at an elevation above the sea varying from 2,000 to 6,000 feet. Those producing grey bark are indigenous to the forests of Huanaco, in Peru, and the red bark from near the foot of the Chimborazo in Guayuquil, at a temperature during the months of June, August, and September, of mean minimum 68½ degrees, and mean maximum 73½ degrees; the lowest temperature in July was 57 degrees, and the highest during the same month 80½ degrees, with much moisture in the atmosphere. Nothing can more exactly correspond with the climate of our mountains and hilly land in the interior, at similar elevations or less when moisture prevails, and I have known the thermometer stand as low as 55 degrees at an elevation of 4,000 feet. It must be observed that as moisture reduces the temperature of the earth and atmosphere, it is in a great measure equivalent to altitude, in like manner as a high and dry climate is to that of moisture, and which influences the growth of plants accordingly. These cinchona trees grow to a lofty size in their native forest attaining a height of 50 feet, and in some instances 70 feet and 30 inches diameter, producing 253 lbs. of dry bark, which will give some idea of the value of an acre of land with these trees arrived at maturity ;—planted at distances of 25 feet apart, an acre will contain about 70 plants, each producing 253 lbs. of bark, at 6s. per lb., would amount to the surprising sum of 5,313*l.** The native forests of Cinchona are fast giving way before the axe of the "barkers," and it is firmly believed by the best judges and eye-witnesses, that the supply of these barks will soon become too small for commercial purposes ; and the price is fast on the increase, on account of the scarcity of bark and the general and increasing interest of the tree producing it to meet future demands. The English, Indian, and other Governments are sparing neither pains or expense to establish extensive plantations of Cinchona, wherever the plant is likely to thrive. In 1854, the Dutch Government commenced its cultivation in Java with half-a-dozen of plants, which reproduced themselves by seeds, in 1857, and, by the end of 1859, the plants numbered 100,133—some of them over 20 feet in height. This rapid progress was certainly not made under more favourable circumstances than this island presents ; and I mention it to prove how much can be done by an industrious nation, by well-directed energy to add to the wealth of a community at a very trifling expenditure of money, labour, or time. I have no hesitation in saying, from my knowledge of this climate, and experience with the treatment of the plants, that the Cinchona plant can be grown here to any extent, and to as great perfection as it is in Java, or elsewhere, more particularly by skilled labour placed under proper management. And I therefore hope that the successful issue of this experiment in my hands may not be lost sight of by either the English or this Government, but meet with approbation. And as a desire to cultivate the plant here, which is not a question, like many others, involving a great expenditure of labour and money ; but one which requires to be assiduously conducted on practical principles, when cultivation might rapidly extend to many parts of the island, clothing the mountains to their summits, ultimately proving as remunerative as our richest vales, and thereby improve the social condition of the country."

Mr Thwaites, the Director of the Royal Botanic gardens, Peradenia, Ceylon, in his report, dated Sept. 21, also speaks of the success of his labours as follows :

"It gives me great pleasure to report very satisfactorily upon the

* Mr Wilson assumes a selling price of 6s. per lb. ; but this is the highest current rate here for the very best red bark, the range having been, in the last two years, from 2s. to 6s. per lb. The present quotations (Dec. 1861), for other descriptions of Peruvian bark, are, Crown and grey, 1s. 2d. to 2s. 6d ; Calisaya flat, 3s. 6d. to 3s. 9d.; ditto quill, 3s. 4d. to 3s. 6d. ; Carthagena, 10d. to 2s. ; Pitayo, 1s. 6d. to 2s. 2d.—EDITOR.

progress of the important experiment now being made in the island, in the cultivation of species of the valuable quinine-producing Cinchonas now under the charge of Mr Mc'Nicoll, at the Hakgalle garden, near Newera Ellia. The plants of cinchona, which in my last report I mentioned as being expected from Bombay, arrived at the latter place in so unpromising a condition, that it was thought best to have them all despatched at once to the Neilgherries, instead of sending a portion, as was at first intended, for trial on our hills. Nearly all of these plants subsequently died. Another consignment of cinchona plants, collected by Mr Spence in South America, arrived some months afterwards at Bombay in very good condition ; but these were also conveyed to Ootacamund, not any being reserved for Ceylon, as I was given to understand would be the case. As far, therefore, as regards Mr Markham's mission to South America, we have received here no growing plants of Cinchonas ; but a parcel containing seeds of *Cinchona micrantha* and *C. nitida*, collected by Mr Pritchett, was sent to me in February last from Mr MacIvor, through the chief Secretary to the Government, Fort St George, Madras ; and a parcel was received by me shortly afterwards from the Secretary of State's Office, which contained seeds of *Cinchona succirubra*, collected by Mr Spence. From these seeds more than 800 plants have been raised (*C. succirubra*, 530 ; *C. micrantha*, 180 ; *C. peruviana*, 25 ; *C. nitida*, 45 ; uncertain, 60), which, although at present necessarily of small size, are nevertheless progressing very satisfactorily in the locality which has been selected for them. To Sir William Hooker we have been indebted for the transmission to us at different times, from the collection at Kew, of six plants of the very valuable *Cinchona Calisaya*. The greater number of these, however, suffered so much in their transit, that two only of those kindly taken charge of for me by Dr Anderson, of the Calcutta Botanic gardens, arrived here in a healthy state. They are now planted out in the Hakgalle Garden, and are growing vigorously. Mr MacNicoll has, without risk of delaying the period of flowering, succeeded in obtaining from one of them eight cuttings, two of which have produced roots, and he has every reason to anticipate success with the remainder.

During the present month, I have received from Dr Anderson a portion of a supply of Cinchona seeds, communicated by the Government of Java to that of India, but from what species they have been collected has not been stated. These have been sown at the Hakgalle Garden, and a very few of them here ; they have, however, not yet been in the ground sufficiently long a time to germinate.

From the experience we have had of the species of Cinchona now growing in the Island, I think it might be considered that *C. Calisaya* would not be likely to succeed at an elevation much below that of Hakgalle, and that it should be planted above 5,000 feet. *C. succirubra* grows extremely well at Hakgalle ; but as it also grows tolerably well at Peradenia, with the appearance only of being a little too much forced by the heat, I think it might succeed, probably, at any elevation above 3,500 or 4,000 feet.

C. micrantha, judging from one little plant we have retained at Peradenia, appears to thrive quite as well as at Hakgalle ; it will, however, have to be ascertained, by and by, at what elevations respectively this and the other species will produce the largest relative quantity of quinine.

As I have reason to believe that many gentlemen engaged in coffee planting, would be glad to co-operate in trying experiments in the cultivation of the Cinchonas at different elevations upon their estates, it may possibly be considered desirable to distribute, some time hence, under conditions to be determined upon, a few plants of those raised at Hakgalle. This course of action might probably lead to a more extensive cultivation of Cinchona in this Island than the Government would feel disposed itself to undertake, though it would be, no doubt, desirable for the present experiment to be carried on with every possible activity and carefulness, until the cultivation should be well understood, and it could be fairly given over to private speculation.

THE MYROBALANS OF COMMERCE.

BY P. L. SIMMONDS.

Under the trade name of Myrobalans,* are imported from India the dried fruit (a drupe) of several species of *Terminalia*, chiefly *T. Bellerica* and *T. Chebula*, which are used by tanners, and in calico-printing for producing a durable black dye.

The drupe of *T. Bellerica*, Roxb., is obovate, obscurely five-angled, fleshy, covered with greyish silky down. The fruit of the Belleric Myrobalan, in its dried state, is larger than an ordinary oak gall-nut, but not so regular in shape. The taste is astringent, and it is sometimes used medicinally by the natives. The kernel of the nut is said to intoxicate, if eaten in great quantity. These Myrobalans have been occasionally imported here under the name of Bedda nuts. They are likely, from this name, to be mistaken for the Badam nuts, the fruit of *Terminalia Catapa*, Linn., the drupe of which, however, is compressed, oval, with elevated margins, convex on both sides. The various vernacular names of the Belleric Myrobalan are Tamkai, *Tamil; Tani*, *Malay ;* Bahura, *Bengal;* Toandee, Tadi, *Teloogoo.*

The Belleric Myrobalan is much used in the arts as an astringent and as the basis of several colours. The tree is found in the mountainous parts of India, and is common in Mysore. The kernel of the fruit yieds an oil which is said to promote the growth of the hair.

* [The mode of spelling this word is very various. O'Shaughnessy (Bengal Dispensary), spells it Myrobalon ; Poole (Statistics of British Commerce), Myrabolam. I agree with M'Culloch (Com. Dict.), that Myrobalan is the correct spelling.]

The Chebulic Myrobalans (*T. Chebula*) have oval glabrous drupes, with the nut irregularly and obscurely five-furrowed. The outer coat of the fruit, mixed with sulphate of iron, makes a very durable ink. The fruit is very astringent, and on that account much used by the Hindoos in their arts and manufactures. The unripe dried fruit, which is the Indian or black Myrobalan (Kooroovillah-cadookai, Tamsihal) of old writers, and sold in the Northern Provinces of Bengal, are recommended as purgative by the natives. The native names of the Chebulic Myrobalan are Kadu-kai-marum, *Tam.;* Kodorka-marum, *Mal.;* Karakai, *Tel.;* Huldah, *Duk.;* Hor, or Hara, *Hind.;* Haree-tukee, *Beng.* Myrobalans should be chosen fleshy and plump, the least wrinkled and black that is possible, such as are resinous within, of a brownish colour, an astringent taste, with a little bitterness, are to be preferred. There are several other species of *Terminalia*, and the fruit of these come occasionally mixed in the imports. Under the name of Kirritochee, probably intended for Kara-tukee, imports have been made into London of the small drupes of *T. angustifolia*, which are compressed, two-winged, and gibbous on one side.

The drupes of *Terminalia Citrina* are about half an inch longer than those of the Chebulic. They are obtained chiefly about Goa and the Malabar coast. These are the Hara nuts of the Hindoos. The fruit, which is a gentle purgative, is often made into a pickle.

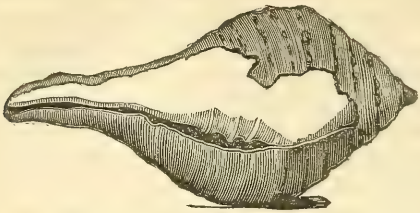
Emblic Myrobalans are the fruit of the *Emblica officinalis*, belonging to the Euphorbiaceæ. When fresh, they are about the size of a gall-nut, rough, and ridged on the outside. The plumpest and blackest of these are most esteemed for tanning and ink-making. When dry, they become very wrinkled, have a slightly aromatic odour, and an astringent taste.

Myrobalans are imported in bags from 1 to 1½ cwt. each ; the annual import into the kingdom often reaches 9,000 tons, and the prices have ranged from 7*l.* to 14*l.* per ton in the last ten years.

ON THE MANUFACTURE OF BANGLES, OR BRACELETS, FROM THE CHANK-SHELL IN INDIA.

BY THE EDITOR.

Under the commercial name of Chanks, the large, white, concave shells of *Turbinella pyrum*, Lam, the *Voluta gravis*, Linn., are much prized and extensively used in Bengal. The shell is ventricose above, pear-shaped, fulvous white, with reddish spots in young individuals ; spine small mucronate ; apex mamillated ; beak long, striated ; columella, with four folds ; attains a length of about six to nine inches.



Chank Shell (*Turbinella pyrum*).

The fishery for these shells is principally carried on in the Gulf of Manaar, in the vicinity of Ceylon, and on the coast of Coromandel, at Travancore, Tuticorin, and other places, the shells being fished up by Divers in about two or three fathoms of water. Those taken with the fish, and called green chanks, from having the epidermis on, are most in demand. The white chank, or the dead shell thrown upon the beach by strong tides, having lost its enamel, is scarcely worth the freight to Calcutta.

The number obtained varies considerably, according to the weather, and the success attending the fishing. In 1854, 1,875,053 were imported into Madras from Ceylon ; in 1857, only 173,200 shells ; in 1858, 1,268,892 ; and in 1859, 1,910,050 shells. A few hundreds are occasionally imported into Calcutta, from the Arabian and Persian Gulfs. The Chank fishery off Ceylon, at one time employed 600 divers, and yielded a revenue to the island government of 4,000*l.* per annum for licenses. The fishery is now free. Sometimes four and a half million of Chank shells are obtained in a year, in the Gulf of Manaar, valued at upwards of 10,000*l.*

The following figures gives the exports from Ceylon for six years ; Chank shells are not specified in later official returns.

	Number	Declared value £
1850	591,616	1,073
1851	2,016,290	3,053
1852	2,762,445	4,793
1853	4,343,411 and 8½ cwt.	9,961
1854	2,164,683 and 7 packages	4,271
1855	843,220 and 1 bag	1,667

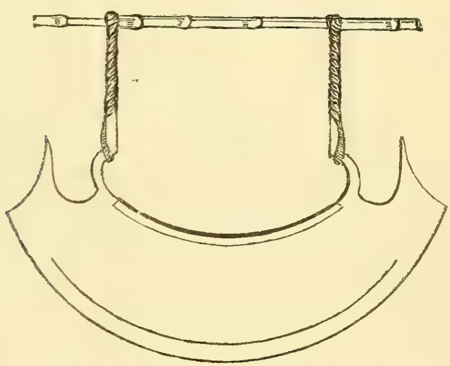
These shells are often used as oil vessels in Indian temples, for which purpose they are carved and otherwise ornamented. When the volute turns to the right, the shell is held in peculiar estimation, a right-handed chank being so highly prized from its rarity, as sometimes to sell in Calcutta for its weight in gold, or at from 40*l.* to 50*l.* In Ceylon, also, the reversed variety is held sacred by the priests, who administer medicine from it. This shell, from its weight and smoothness is used in Dacca, for calendering or glazing, and in Nepal for giving a polished surface to paper.

The following figures will show the importance of the trade in this shell, even in its rough state, before it has passed into the hands of the manufacturer.

Value of the Chank shells imported into the two Presidencies of Bengal and Madras, in the years ending 30th April.

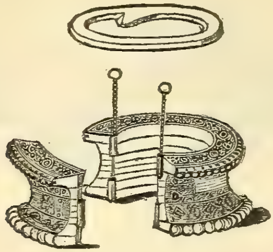
	Madras.	Calcutta.		Madras.	Calcutta.
1851	£3,649	£1,360	1855	£1,198	£5,998
1852	2,844	574	1857	6,321	4,765
1853	4,565	3,263	1858	3,954	——
1854	5,521	9,769	1859	6,132	4,256

The principal demand for these shells is for making bangles, or armlets and anklets, and the manufacture is still almost confined to Dacca. The solid porcellanous shell is sliced into segments of circles, or narrow rings of various sizes, by a rude semi-circular saw, the hands and toes being both actively employed in the operation.



Saw employed for Cutting the Shell.

The introduction of circular saws has been attempted by some European gentlemen, but steadily resisted by the natives, despite their obvious advantages. Some of these bangles, worn by the Hindoo women, are beautifully coloured, gilded, and ornamented with gems. The shell rings are coated inside with plaster to take off the roughness. Filagree bordered edges of plaster are also added; patterns and devices of red, blue, and gold, are figured on them, and they are further ornamented with silver or gold tinsel, spangles, small coloured glass beads &c. The larger bracelets, formed of many segments, are made to open, to admit the hand, by two spiral pins, which unscrew, and let out the piece. These bangles are not removed at death, and hence there is a continual demand for them, many wearing several, both on the legs and arms.



Segment of Shell, and Bangle, or Ornamented Bracelet of United Segments of Shell.

PETROLEUM, KEROSINE, PHOTOGENE, OR ROCK AND WELL OIL.—The introduction of this article is taking tremendous strides. If the rocks and wells of Pennsylvania, Canada, and other districts continue their exudation at the present rate of supply, the value of the trade in this oil may even approach that of American cotton. Montreal (internally and perhaps externally by this time) is lighted with the white refined. The oil gas distilled from the raw petroleum is immensely superior, and much more brilliant than our own coal gas. For years we have sent coals to America for her gas works, and it will be a singular freak of events if she and Canada should now supply us with a better expedient. The merits of the petroleum will be better understood when importers are informed that, besides the uses already named, lubricating oils of every colour and specific gravity can be obtained from it ; wax also, for the manufacture of paraffin candles ; naphtha, and consequently benzole (from which the fashionable dyes Magenta, rosenine, analine, &c., are obtained) ; pitch, &c., all of them having several other applications. It is reported, on the very best authority, that they have discovered from it now an available substitute for spirits of turpentine for paints, and also a solvent for india-rubber—results, I understand that they have not effected in America or Canada, and the importance of which cannot be over-estimated. In my first circular it was stated that some 7,000 barrels of crude and refined were on the way to this country, and the *Times* of the 13th Dec. mentions 8,000 barrels on the way to London. There are 10,000 barrels coming to Liverpool, and 2,000 barrels to Glasgow, in all about 20,000 barrels. American hostilities and the ice in the St Lawrence (although we have still St John, New Brunswick open) may stop supplies to some extent, but that the future will vindicate the best expectation requires little prescience to affirm.—'Circular of Mr A. S. Macrae, of Liverpool.'

THE LATE PRINCE CONSORT.

Amidst the universal manifestation of grief at the death of our Sovereign's Royal Consort, it would ill become the Technologist to remain silent on so mournful an occasion. England has indeed lost "a Prince and a great man," for his was a princely nature, and the greatness of his mind is too widely acknowledged to be questioned. Art and Science were the amusements of his leisure, the play-toys of his existence; and especially did he interest himself in that particular branch of science which it is the purpose of this periodical to encourage.

Technology was a favourite pursuit with the late, and lamented Prince, by reason, doubtless, of its useful tendencies. The Animal and Food collections at the South Kensington Museum, testify to this preference for practical science,—and often, when developing, arranging, and cataloguing those collections, have we seen the Prince Consort carefully inspecting and examining the products and their applications, either alone, or explaining them to his children. It seems but as yesterday that we received from him a kindly acknowledgment of a copy of our Dictionary of Trade Products and Technical Terms*—and now he is taken from this scene of his useful labours.

For seventeen years the Prince Consort was President of the Society of Arts, Manufactures, and Commerce, and his patronage, presence, and influence, has been widely felt in the rapid progress of that Society and the extension of its field of operations.

The very last public act of His Royal Highness was the laying of the foundation stone of an Industrial Museum, in the capital of Scotland. Of International Exhibitions, also, he may be considered the founder, and, did space permit, it would be very easy to enlarge the list of practical benefits thus conferred upon us.

In the death of the Prince, therefore, we have to mourn the loss of the leading Technologist of the country; and, as the coming months and years roll slowly by, we, in common with many others, whose pursuits the late Prince loved to patronize, shall awake gradually to a real sense of the affliction which has befallen us.

The Prince was also a good man, and his goodness had a far higher and purer origin than mere natural amiability of soul. To this fact,

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"Osborne, March 6, 1858.

"Sir,—I have the honour to acknowledge the receipt of your note and the accompanying Copy of your Trade Dictionary; I have lost no time in bringing them under the notice of His Royal Highness the Prince Consort, and am now commanded to request that you will accept the expression of his Royal Highness's best thanks for your kindness in sending him a Copy of this very useful Work.—I have the honour to be, Sir, your most obedient Servant, "C. Grey.

"P. L. Simmonds, Esq."

doubtless, we may attribute the sterling quality of his ideas, as well as the remarkable success which invariably attended their practical embodiment. That eminently useful life, too soon, alas ! brought to its termination, was prompted by no common motives ; for the Prince had no paltry ambition or mercenary desire to satisfy—neither did stern necessity spur on his unwearied efforts in every good and noble cause ; but, his coveted reward, though less obtrusive, was far more worthy of his regulated mind—it was

"To hear the still small voice of conscience speak
Its whisp'ring plaudits to the silent soul."

To this singleness of purpose, likewise, we may trace the unanimity of sentiment with regard to the late Prince's worth. His plans were too expansive to excite enmity, and too generally diffusive of good to be mistrusted. But he is gone from this busy scene of mortal labour, and we can only cherish his memory, and derive comfort from the inspired statement respecting those who die in the Lord, that "THEY REST FROM THEIR LABOURS AND THEIR WORKS DO FOLLOW THEM."

Reviews.

THE CIRCLE OF KNOWLEDGE : A SCIENTIFIC CLASS-BOOK. By CHARLES BAKER. Illustrated with 300 Woodcuts. Varty.

This is the fourth volume of a graduated series of reading-books by the Head-master of the Yorkshire Institution for the Deaf and Dumb, a gentleman who, from the research manifested in this volume, must himself have pursued a most extensive course of reading. The plan adopted appears to us to be an excellent one for fastening the attention of the student upon the subjects discussed. Extracts are given under each sub-division from the best authors upon each of the topics treated ; hence, we have a cyclopædia of information furnished, as it were, by the most eminent men in their several departments. We have gone over the work carefully, and it may be confidently recommended for its completeness and authenticity. The numerous woodcuts are good, and, what is more to the purpose, are truthful, which is not always to be said of illustrations of plants and animals, &c.

Mr Baker deserves great credit for the labour he has bestowed in condensing and arranging so large an amount of useful information in a systematic and classified form ; and we can only hope that he will be well repaid by an extensive sale.

A MANUAL OF BRITISH AND FOREIGN PLANTS, WITH THEIR LATIN AND ENGLISH NAMES, &c. By LEO. H. GRINDON, Lecturer on Botany at the Royal School of Medicine, Manchester, &c. William Pamplin.

This is a most useful little work for ready reference, to ascertain the Latin name of a plant when the English one is known, or the English one when the Latin is known. The names are classified scientifically in the body of the work, and a well-arranged and full index of twenty-seven pages gives them alphabetically. The names of 5,500 plants are given, including every flowering plant and fern indigenous to the British Islands, all the favourite and useful ones ordinarily cultivated here, and all plants yielding substances of importance, either for human food, or for the purposes of art and medicine, whether produced in Great Britain or in foreign countries. The numberless uses of this little manual it is scarcely possible to specify; and its correctness, a careful examination enables us to testify to. In the words of the preface, "There is no other small and compendious work in which the scientific names, the families, and the native countries of plants yielding such substances as gutta-percha, arrowroot, divi-divi, castor-oil, &c., can be learned in an instant."

Dictionary of Mineralogy, Geology, and Metallurgy. By M. Landrin, C.E.—Dictionary of Chemistry and Physics. By Dr Ferdinand Hoefer. Paris: Didot Brothers.

These useful works of reference, belonging to the valuable series of cheap, scientific hand-books issued by Messrs Didot, are too well known to need special reference at our hands. In them is condensed all the practical knowledge and most recent discoveries, and their applications announced in the scientific works of the day, in Great Britain and the Continent. Supplements are added from time to time to keep pace with the progress ot science.

Tahiti par G. Cuzant. Paris: Victor Masson.

This is an interesting work on an interesting field of observation—the Society Islands, one of the French Colonial Possessions in the Pacific. Within the compass of under 300 pages, we are furnished with much authentic and recent information, acquired during a residence of more than three years in the islands, illustrated, too, by several maps. The natural history, geology, and principal commercial products of the islands are fully described, and a large amount of analytical detail is furnished by M. Cuzant, who is a Practical Chemist, on the oils, gums and resins, dye-stuffs, and starches, to which we shall endeavour to direct special attention more fully hereafter. Fibres, woods, sugar, coffee, oranges, and other staple products are treated of very fully, and there is a conspectus of the flora of Tahiti catalogueing, 532 plants, of which 248 appear to have been introduced and naturalised; the materials to this store have been furnished by the French government botanist, M. Pancher.

The West India Quarterly Magazine, No. 2. Kingston, Jamaica: De Cordova and Nephew.

This is an excellent number of this periodical, which comes to us much improved and enlarged. It contains some well-written articles. The Hon. R. Hill discourses pleasantly on his favourite topic in "Notes on Natural History." Taking as his text the chapter devoted to the subject in our work on "The Commercial Products of the Vegetable Kingdom," Mr Hoffman, Island chemist, treats "On the Manufacture of Muscovado Sugar, and its Relation to Science." He shows that while a good deal has already been effected, much remains to be done yet, before the colonial sugar planters can enjoy equal scientific advantages to the beet-sugar manufacturers of the Continent. A model plantation, directed by competent, scientific, and practical men, will he says, never fail to return an intelligent answer to every intelligible question, and to furnish advice, based upon true science and true unimpeachable practice. 'Coal and Its Products,' by Mr Toase, is a condensed account of the most recent chemical discoveries and useful applications of carboniferous products. In a paper "On Determination of Purpose," the valuable indigenous resources of Jamaica, and the profitable field of enterprise for industrious small settlers, is well pointed out. The practical articles in this periodical are far superior to the lighter papers with which it is interspersed. The number is illustrated by a lithographed portrait of His Excellency Governor Darling.

Publications Received.—Hoefer's Dictionary of Practical Botany. Dictionary of Theoretical and Practical Horticulture. Beraud's Dictionary of Geography. Barre's Biographical Dictionary. Dictionary of the French Academy, abridged;—all from Messrs Didot and Son, Paris.—On the Cohesion-Figures of Liquids, by Charles Tomlinson, reprinted from the 'Philosophical Magazine' for October. In the 'Pharmaceutical Journal' for December, Mr Hanbury continues his learned notes on Chinese Materia Medica, and Dr Crace Calvert enumerates some of the uses to which carbolic acid has been successfully applied in Medicine. There is an extracted paper from the Proceedings of the Royal Society "On some varieties of Tannin," by Dr Stenhouse. In the 'Chemist and Druggist' Dr Noad brings his articles on the Analyses of Manures to a close by a paper "on Bones," and Mr Quin also with the volume concludes his valuable Essays on Photographic Chemicals. Mr Tegitmeier still gives practical attention to all the striking novelties of the day. "Prince's Descriptive Catalogues of Foreign and Native Grape-vines, and Strawberries"; Flushing near New York. [We wish our foreign correspondents would pay their postages].

Polytechnic Institution.—Mr Pepper is indefatigable in providing the frequenters of this popular institution with a constant succession of novelties, which his skill in seizing the topics of greatest interest at the moment renders additionally attractive. He now lectures on the "Iron Age," embracing the science of the Armstrong, Whitworth, and other rifled guns, illustrated with experiments, and also with pictures, photographs, and diagrams shown by the oxy-hydrogen light on the largest scale. The audience are initiated with the peculiar lucidity of explanation, that renders Mr Pepper's scientific lectures so deservedly popular, into all the mysteries of iron-making, and opportunity is taken to supplement the description given by the lecturer, three or four years ago, of the Bessemer process by an account of the improvements therein since effected. A model of Bessemer's monster breech-loading gun, and one of the ringshaped steel plates of which it is proposed to be constructed, are exhibited and explained. The lecture is followed by a new series of Dissolving Views illustrating the navies and naval dock-yards of England and France, copied from the drawings of Mr J. Pickering, whose delineations of shipping are so well known. The great interest felt in this subject at the present time can nowhere be better gratified than at this institution, where the public may compare Cherbourg with Portsmouth and Plymouth, and learn what are the points of difference between the Warrior and La Gloire. On the evening of the 24th Dec. we attended a private view of the entertainment provided for the Christmas holidays, and here amusement has been pleasantly mingled with instruction. The beautiful experiments on spectrum analysis as shown by the apparatus of Mr Ladd, will attract great attention. The exquisite series of photographs of American scenery by Mr England, enlarged by the lime light on the great disc in the lecture theatre are beautifully developed.

THE TECHNOLOGIST.

THE STARCH-PRODUCING PLANTS OF CEYLON.

BY W. C. ONDAATJE, COLONIAL ASSISTANT-SURGEON.

Starch is found in a vast number of vegetable products, as grains, peas, tubers, stems of many monocotyledonous plants, and in lichens. The granules of starch are contained in the cellular tissue of plants, and form a nutritive article of diet, besides being used in the arts. In this island, we have a number of plants from which starch may be obtained, and which we shall enumerate. But before doing so, it may be as well to describe a simple method by which it may be extracted with much purity. It consists in enclosing flour in a muslin bag, and squeezing it with the fingers while submerged in clean water, by which process the starch passes out in a state of white powder and subsides. Two essential constituents of flour are thus separated from each other; a viscid substance remains in the bag, which is called *gluten*, and the white powder deposited is *starch*. Under the microscope, starch presents the form of a rounded grain, the size and shape of which differ in different plants, and in the same plant at different times, and from different parts of the same plant. Of plants yielding starch we have—

1. The Indian Arrow-root, which is the fecula in the rhizomata of several species of the Marantaceæ. In the West Indies it is obtained from the *Maranta arundinacea;* also from *Canna glauca*, called "Tous les mois"; and in the East Indies from *Curcuma angustifolia;* also from *Maranta ramossissima* in Silhet.

2. The Bread-fruit (*Artocarpus incisa*), which yields a large quantity of starch.*

3. The sweet potato (*Batatas edulis*, Choisy.)

4. The pith or farinaceous part of the trunk of the *Caryota urens* (Kittule of the Singhalese), which is almost equal to the finest sago. In Assam, the sago of this palm is much used.

Meal sago, from the Jaggery palm, is deserving of attention as an article of diet, being found in the districts of Badulla and Colombo. But a better mode than that known to the natives must be resorted to, to render it clean and pure. As prepared by the natives, it is of a brown colour, mixed with pith and the woody fibre of the stem. A superior article can be

* *See* TECHNOLOGIST, vol i, p. 193.

manufactured by pounding the pith when fresh, and straining it through cloth in a large vessel containing water. A good deal of astringent matter will be found in the starch, to which it gives a brown colour. This may be removed by mixing the starch with the white of eggs, which precipitates the tannin, and by straining again, the fine, pure starch may be obtained. It will be found more glutinous than common sago.

In the month of January, during the rainy weather, the kitool abounds with starch, which, however, is not found in every tree.

The natives discover its presence in a tree by the whiteness of its leaves and petiole, also by boring a hole in the stem, and extracting the pith. The Singhalese make use of the flour for food, after boiling it in steam, which changes it to a gum-like mass. To make kitool jelly, dissolve a tea-spoonful of the starch with a little cold water, and pour over it four ounces or two wine-glassfuls of boiling water, and keep stirring till it jellies ; then flavour it with milk and sugar.

From the seeds of the *Nymphœa stellata*, the people at Bintenne prepare starch, which they use during times of scarcity. They also use a decoction of the seed in dysentery. The seeds are collected from tanks from June to September.

5. The Cassava (*Janipha Manihot*). " A shrub, 4 to 6 feet high, root large, tuberous, fleshy and white, with a milky, acrid, poisonous juice ; leaves palmate, 5 to 7 parted, smooth, glaucous beneath, segments lanceolate, quite entire ; flowers axillary, racemose, monœcious ; calyx campanulate, 5 parted ; petals none ; stamen 10 ; filaments unequal, distinct, arranged round a disk ; style 1 ; stigmas 3, consolidated into a rugose mass.—*Andr. de Juss. and Hooker*."—' Bot. Mag.' 3071. There are two varieties of this plant, mamely the *Bitter* and *Sweet* Cassava. Through the root of the latter there runs a tough ligneous fibre, not found in the former, which is one mode of distinguishing between them. These two are also regarded as distinct species ; the sweet, called *Janipha Lœflingii*, the Yuca of the natives, is described with " 5 partite cordate leaves, segments acuminate, very entire, the middle one panduriform ; the other *J. Manihot*, their yuca-dulce, has leaves from 5 to 7 partite, glaucous on the under surface ; segments acuminate, very entire."

The bitter cassava is cultivated for making the tapioca of commerce and cassava bread. The juice is very poisonous, owing to the presence of hydrocyanic acid. By the Kaffirs at Putlam the sweet kind is more largely cultivated and used as food. They also prepare an intoxicating liquor by making the coarsely powdered root ferment with the seed of Corakan (*Eleusine coracana*), macerated in water, till germination commences. It supplies a vast number of the inhabitants of South America, the West Indies, and Mexico, with food, and was introduced into this island, in 1792, through the zealous exertion of the Dutch Governor, Van de Graaf, who, by disseminating information widely in the Singhalese and Tamil languages as to the best mode of cultivating the plant, succeeded in making its merits known.

The plant thrives on even the poorest soil, but it does not appear to be so generally used as one might expect. The mode of planting it is simple. It consists in laying cuttings a foot long in square pits a foot deep, and covering them with mould, leaving the upper ends open. From two to four pieces may be planted in each square. The planting ought to be in the rainy season ; the cuttings must be made from the full grown stem. Eight months after the planting the roots are fit for use. At Putlam, the sweet cassava, after being planted for three or four months, is fit to be dug for use. The plant soon exhausts the soil, and no more than three successive crops can be raised on the same spot. A humid soil causes the root to decay ; a dry soil is, therefore, more adapted for its cultivation.

The name "Jatropha," the original generic name, is derived from two Greek words, signifying "a remedy" and "to eat." The poisonous property in the root may be removed by washing and boiling, and it is owing to the carelessness of persons in not attending to these points that serious consequences have been known to result.

The fecula or starch of the cassava is called *moussache* or *cipipa* ; the grains of which, when prepared in hot plates burst and agglomerate in irregular gum-like masses. This receives the name of tapioca. To prepare tapioca, take 1 oz. of the grains, steeped in soft water for an hour, pour off the superfluous water, and boil with 1 lb. of water for an hour ; a transparent uniform lymph-like fluid is obtained, which jellies on cooling, and has a peculiarly rich and agreeable flavour.

The Cassava affords a very superior arrow-root, which is imported into Europe, under the name of Brazilian arrow-root. The imports into the United Kingdom of this powder and tapioca now reach nearly 3,917 cwts.

I prepared some starch of the sweet Cassava, growing at Putlam, by grating the tuberous root. From a large root weighing 10½ lb., I obtained nearly 1 lb. of pure starch.

Arrow-root, on the score of nutritious properties, is not to be compared to it. The Cassava plant will grow anywhere in Ceylon, and it is cultivated in considerable patches by the natives of Jaffna, for the sake of its yams, which grow freely, and to a large size in the loose sandy soil of the peninsula. The natives do not often take the trouble of reducing the roots to flour. Like a great many other products to which agriculturists are invited to turn their attention, the *Janipha Manihot* is of an exhaustive nature, and patches of deep rich soil are not over-plentiful in Ceylon. Still it might be grown profitably in the neighbourhood of houses. The raw root when immediately out of the ground is poisonous—when exposed to the sun for a short time it is innocuous, and when boiled quite wholesome. The juice forms one of the ingredients in the celebrated pepper-pot of the West Indies. The plant, which bears a considerable resemblance to the tree cotton, is propagated by cuttings, and grows easily if not killed by too much damp. As blossoms are occasionally plucked off potato plants, so the Manihot is deprived of its buds to increase the size of its roots. The Manihot, like so many other tuberous plants, is indigenous to South America. In Madagascar it is the ordinary food of the inhabitants, but it is in Brazil that this substance occupies the most important position. It is largely cultivated, and much of it exported to England in the shape of tapioca. To form the thin cakes on which so many of the people subsist, the roots are ground against the face of a rapidly revolving wheel, the pulp being received into a trough, put into bags, subjected to pressure, baked crisp on hot hearth-stones or iron plates and reserved for use. This bread the Brazilian considers palatable and nutritious, but the more rigorous and discriminating stomach of the Englishman submits to it in but a grumbling way. It is well to multiply forms of human food, but after all, no kind of bread can equal the leavened wheaten loaf of Old England, looking lovingly at its twin brethren of the round and rump steak family.

I have no hesitation in recommending the fecula of the Cassava as an article of diet for young children, and in every respect surpassing arrow-root. The density of Moussache is as 14: 16. The starch prepared like arrow-root with a little milk, imparts a grateful flavour.

6. *Arenga saccharifera* (*Saguerus Rumphii*, Roxb.), which yields sago, sugar, palm wine, and black fibre for cables and cordage. It may be introduced into low situations near the coast.

7. The *Phœnix farinifera,* a dwarf species, which is found on sandy hills, at a short distance from the sea near Coringa, contains farina in its stem, which is used as food by the natives in times of famine. It will grow in the dry and sandy plains of the country.

8. Ceylon moss (*Gracilaria lichenoides*), fronds filiform ; filaments much branched and tufted, and of a light purple colour, so well known for the amylaceous property it possesses. It grows abundantly in the large lake or back water, which extends between Putlam and Calpentyn, and is chiefly found about the small islets near Palleywasel torre and Candacoda. It is collected by the natives principally during the S.W. monsoon, when it becomes separated by the agitation of the water. The moss is spread on mats, and dried in the sun for two or three days. It is then washed three or sometimes seven times in fresh water, and again dried in the sun, which renders it white ; afterwards it is collected in heaps for exportation. Professor O'Shaughnessy has given the best analysis of the moss, which in 100 grains weight yielded the following :—

Vegetable jelly	54.50
True starch	15.
Wax a trace	
Ligneous fibre	18.
Gum	4.
Sulph. and mur. of soda	6.50
Sulp. and phosp. of lime	1.
Iron a trace	
	99.
Assume the traces of wax, iron, and loss at	1.
	100.

The result of his experiment, as it refers to the best mode of preparing it as an article of diet, I give in his own words, as it may be of interest to some.

"In the first place, from the tendency of pectin or vegetable jelly to form insoluble compounds with saline and earthy bases, it is necessary to steep this fucus for a few hours in cold rain-water as the first step in its preparation. This removes a large proportion if not the entire of the sulphate of soda, leaving all the gelatine and starch. It should then be dried by the sun's rays, and ground to a fine powder ; I say ground, for cutting or pounding, however diligently or minutely performed, still leaves the amylaceous globules, so mechanically protected, and so closely involved in an external sheath of tough ligneous fibres, that scarcely a particle of the starch can be extracted by boiling, even though the decoction is prolonged beyond several hours. When ground, on the contary, boiling for twenty-five minutes or half-an-hour dissolves all the starch and gelatine ; the solution, while hot, should be passed through muslin or calico, and thus the ligneous fibre is removed ; lastly, the strained fluid should be boiled down till a drop placed on a cold surface gelatinizes sufficiently."

9. From the nuts of the *Cycas circinalis* the Singhalese in the Ouvah district prepare an inferior kind of starch, called Madupitte. The fresh kernels are cut in slices, and well dried in the sun before they are fit for use, otherwise when eaten, they are intoxicating, and occasion vomiting and purging. The poorer classes generally use the flour prepared by pounding the kernels. They also esteem it highly as a remedy in bowel complaints and hæmorrhoids, for which purpose the flour is boiled in steam and eaten. I have given the flour made into porridge in several cases of chronic dysentery in Malabar coolies, and from the few trials made, I think favourably of its effects in restraining the inordinate purging which is beyond the control of the usual astringent medicines. The tender leaves are also eaten by the natives in curries. The natives of the Moluccas use the flour of the nuts for a similar purpose.

Colombo.

ON A NEW PROCESS OF PHOTOGRAPHY WITHOUT SILVER.

BY DR T. L. PHIPSON,

Member of the Chemical Society of Paris, &c., &c.

This process, which is founded upon the use of oxalate of iron, was discovered by me about a year ago. I gave a slight sketch of it in the 'Moniteur de la Photographie' of Paris, for Oct. 1st, 1861, and I did not intend to say anything more about it until I had made further experiments with a view of testing its value in comparison with the use of salts of silver. But a few weeks ago, to my surprise, I perceived that Mr Reynolds had brought it before the Dublin Chemical Society as a novelty, and, moreover, as a discovery of his own. But this author has had recourse to nitrate of silver to finish his proofs, whereas, in my process no silver is used at all.

It is well known that light has a peculiar action (a reductive action) upon many organic salts of iron, more especially upon the *oxalate of peroxide of iron*, which it reduces to the state of *oxalate of protoxide.* The first of these salts forms beautiful emerald green, prismatic crystals, extremely soluble in water, and decomposable by light; the latter salt is yellow, insoluble in water, and not influenced by light.

The first thing to be done is to prepare a concentrated solution of oxalate of peroxide of iron. For this purpose I take a solution of chloride of iron, and having precipitated the peroxide of iron by ammonia, I collect it upon a filter and wash it with boiling water, after which this oxide is dissolved in a warm concentrated solution of oxalic acid. A beautiful emerald green solution is thus obtained, which must be concentrated a little by evaporation, and then set aside in a dark place for use. If this solution be exposed to the sunlight, microscopic yellow crystals of oxalate of protoxide of iron are deposited, more or less rapidly, until the solution contains no more iron, and has become perfectly colourless. Upon this remarkable decomposition is founded the process of which I speak. The paper, destined to receive the photographic image, is floated for about ten minutes upon the green solution of oxalate of peroxide in a flat dish or capsule, to which a certain quantity of oxalate of ammonia has been added; the whole, of course, being kept away from the day light, and at the expiration of that time, the paper is taken out of the solution and hung up by one of its corners to dry.

Let us suppose, for example, that a positive proof is required: the paper thus prepared is placed behind the negative and exposed to the light for ten or twenty minutes, according to the weather. It is then well washed with distilled water or with rain water (spring water will not answer, on account of the lime it contains which decomposes the image by forming oxalate of lime). All the non-decomposed oxalate of peroxide of iron is thus washed from the proof, and a feeble yellow image of oxalate of protoxide, scarcely visible, is left upon the paper.

This image can be transformed into Prussian blue, or into sulphide of iron, by plunging it into ferricyanide of potassium, acidulated with a few drops of nitric acid, or into sulphide of ammonium. In the first case, the image, though very permanent, is blue, a colour not generally desirable; in the second, it is jet black, but not permanent, for the damp air destroys it, and turns it brown or red.

The best means I have hitherto discovered of developing the image, and obtaining proofs equal in tone, colour, and vigour, to those obtained with salts of silver, is as follows:

The faint yellow proof, obtained as above, is plunged for a little time into a solution of permanganate of potash, to which a few drops of ammonia have been added. In this bath the image soon becomes brown and distinctly visible; it is then withdrawn, washed, and plunged into a solution of pyrogallic acid, where it is allowed to remain for half an hour, after which it is taken out, washed and dried. The image thus developed, is a very dark brown, and can be distinguished with difficulty from proofs obtained with silver; the tones are peculiarly soft and permanent.

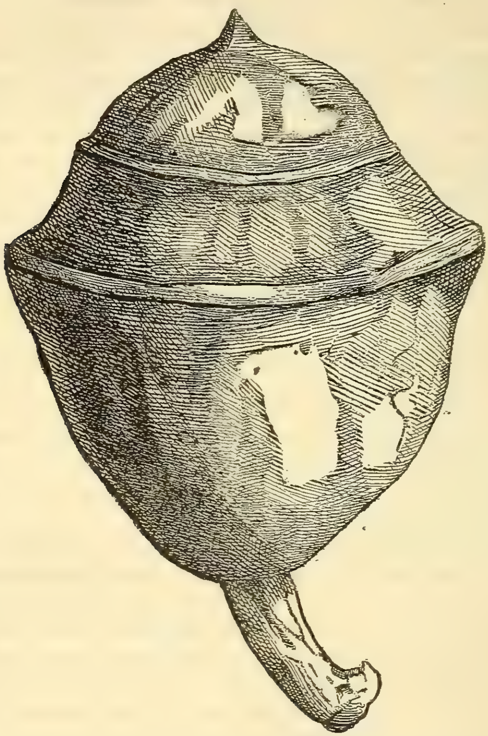
This process is, therefore, extremely simple, and as the use of salts of silver is quite excluded, I imagine it will prove economical. A few experiments I have made without a camera seem to indicate that oxalate of iron may be used in the camera for producing negatives, which must be afterwards developed as above with permanganate of potash, and pyrogallic acid. But I should much like to hear the results it would furnish in the hands of a practised photographer.

THE SAPUCAYA NUTS OF COMMERCE.

BY JOHN LINDLEY, M.D., F.R.S.

So many enquiries are addressed to us concerning the South American "nuts" called Sapucayas, now common in fruiterers' shops, that it seems desirable to give some account of their origin, as well as to explain why they are not nuts in the proper sense of the term.

The name appears for the first time in books of Natural History in 'Piso's Account of the Medicinal and other Plants of Brazil,' published at Leyden in 1648. The author states that the Zabucajo is a very tall tree with a hard, rough, grey bark, like that of the Oak, from which writing-ink is made. The young leaves are brown, the old ones green, &c. This tree produces cups of great size and excessive hardness, with the mouth turned downwards, and closed by a lid, like that of a pyx or soap box. These cups contain nuts of a pleasant flavour, which, when ripe, fall out spontaneously if the cups are struck, and furnish a most grateful food to the natives, as well as animals. They ripen once a year, in mid-winter; and in taste and excellence are equal to Pistachios. A very fat oil is pressed from them, hotter than Almond oil, for the kernels from which it is obtained are understood to be hot in the second degree and dry in the first. They are better eaten roasted than raw, because the latter are apt to affect the head. More than 30 seeds are found in each cup, adhering by a sticky substance to a triangular body. The cups themselves are so hard that the Aborigines (Tapuyeris) use them not only as goblets but as pots and dishes. Hence Linnæus called the plant *Lecythis ollaria.* The timber is extremely useful; it resists decay in a wonderful manner, and on account of its hardness is preferred to all other kinds for the axle trees of sugar-mills. The bark, when beaten, is used by boatmen as oakum. Piso adds that there is another tree called Zabucajo, a good deal like the first, but its cups are not so regularly shaped, and its nuts not so good; for, according to the natives, those who eat them in excess are apt to lose their hair. A rude woodcut accompanies the description, from which it appears that the cups of the first Zabucajo were nearly spherical or roundish-oblong.



This statement was echoed by George Marcgraaf de Liebstad, whose papers were edited by De Laet of Antwerp. Marcgraaf, using Piso's woodcut, speaks of the tree as being called Iapucaya; but it is doubtful whether he has not confounded some other sort with that of Piso; for he says that the cup contains four cells, in each of which is one chesnut as big as a plum, a description that has no application to Sapucaya.

In 1775, the French botanist Aublet, in his 'Histoire des Plantes de la Guiane Française,' describes and figures a tree called in Guiana Canari Macaque, which he also referred to the genus *Lecythis* of Linnæus, naming it *Lecythis grandiflora.* This tree was called in his day *Marmite de Singe,* or Monkey-pot, for a reason to which we shall advert presently. The figure given by him of the cup of this species, and which we reproduce, represents a vessel tapering to the base, and described as being about seven inches high, two and a half inches across the opening into the interior, an four inches or more in diameter. He states that the nuts are sweet and very good to eat, but adds nothing further.

As the figure given by Aublet of the seed of his *Lecythis grandiflora* agrees pretty well with the Sapucayas of our shops, it has been occasionally inferred that they are produced by that species. But Aublet has another *Lecythis*, to which he applies the name *Zabucajo*, which he says bears in Guiana that name, and is also called Quatelé, its fruit like the other, having received from the colonists the appellation of Marmite de Singe, or Monkey-pot. The description given by him of the tree, agrees very well with that of Piso. As for the cup, whose lid naturally falls off when ripe, it does not seem to be the same as that of Piso, as far as can be gathered from description. Portuguese turners make boxes and other small articles out of the cups. In other respects the statements are similar to those of Piso. For this reason, Prof. Oliver, in the 'Official Guide to the Kew Museums,' refers the Sapucayas to both *L. ollaria* and *L. zabucajo*, apparently regarding the two species as the same. We are informed, however, by Messrs. Keeling and Hunt, the great fruit importers, that the Sapucayas on sale in this country, come exclusively from Para; and not from Demerara, which raises a suspicion that there may be differences between the trees of the two countries. We are also informed, on good authority, that no Sapucayas come hither from Demerara, their quality being inferior to that of the Brazilian kind. This, at all events, is certain, that Sapucayas are produced in the interior of great hard goblet-shaped capsules, which open by a circular lid, in the same way, only on a grand scale, as the seed-vessels of our own little Henbane and Anagallis. Hence, Sapucayas are seeds, not nuts ; for all nuts, properly so-called, are seed-vessels forming seeds in their interior.

The name of Monkey-pot is said to have arisen thus : When the cup of a Lecythis falls, its lid drops off, the seeds rolls out, and it then becomes a hard pot with a narrow mouth. These pots are used for catching monkeys. Filled with sugar they are placed on the ground which such animals frequent. The sugar attracts the latter, who pick it out leisurely till they are disturbed, when they insert the paw, grasp as much sugar as it will hold, and endeavour to escape with their prize. But their doubled fist being larger than the mouth of the pot, cannot be withdrawn, and the monkeys, tenaciously holding the sugar, run off with a pot firmly enclosing one paw. This renders it impossible for them to escape from their pursuers by climbing, and they are easily run down. We do not further advert to the Botanical question, which must be studied with reference to Von Martius' Brazilian Flora, and the materials accumulated in Museums.

[Mr T. C. Archer, in his 'Popular Economic Botany' thus speaks of the Sapucaya.] Editor:—

" This curious nut is very superior to the Para or Brazil nut, its flavour is finer, and it is more digestible ; but, unfortunately, these good qualities are as well known to the monkeys, which abound in the Brazilian forests, as to ourselves ; the consequence is that, instead of pelting the castanheiros with them, they eat them, and we get but very few. The trees grow in the same localities as the *Bertholletias*, but the capsule is rather different: instead of being pyriform, or pear-shaped, it is urn-shaped,—hence, its name of Pot-plant—opening by a sort of lid, which falls off, leaving a large opening sufficient for the nuts to fall out. So eager are the monkeys to obtain the nuts, that they will thrust their hand into this opening, which they do with difficulty, and grasp the nuts ; but the orifice which admitted the empty hand will not allow the egress of a full one, and the animal will torment itself a long time rather than relinquish its hold. The Indians avail themselves of this cupidity to entrap the monkeys. They open the lids of several capsules, and then throw them under the trees ; the greedy monkey will not be satisfied with one pot, but will thrust its hands into two, and will not relinquish its hold ; the encumbrance renders its capture easy, and has led to a saying amongst the Brazilians equivalent to our 'old birds are not caught with chaff ;' it is 'he is too old a monkey to be caught by a cabomba,' the capsule being called by them a *cabomba*.

"The Sapucaya nut is long, rather curiously, but slightly curved in the S form, and the surface is deeply wrinkled longitudinally ; the shell is softer than that of most nuts. It is to be regretted that this delicious fruit is not more generally known. The nuts come in small parcels, and are sold cheaply in consequence of the ignorance which prevails respecting their good qualities."

PAPIER-MACHE MANUFACTURE.

BY W. K. SULLIVAN.

Papier-maché goods have of late become of considerable importance as articles of utility and of decorative furniture, from the facility with which that substance can be moulded into any required shape, and the great extent to which it admits of ornamentation. This old form of papier-maché from pulp, whence the name, is but little practised in England at present, except for the cheapest articles. The mass is now formed by pasting a number of sheets of paper together, a process first employed in the year 1740 by Martin of Paris. The advantages of this process are increased solidity, firmness, and elasticity, at the same time that the mass is readily made to assume the full sharpness of the moulds. The article is formed by simply pasting, one on the other, a number of sheets of a fine grey, slightly sized, not very strong packing-paper. The paste is usually made of a mixture of gum and starch. The sheets thus pasted are not pressed, except in particular cases, but are rubbed smooth with a kind of smoothing-iron. Legs of tables and other similar articles are usually formed upon moulds, or rather cores, of well-baked wood, each sheet, as it is pasted upon the form, being carefully rubbed smooth. When a sufficient number of sheets of paper have been pasted together to produce the required thickness, the mass is introduced into an oven, or drying-chamber ; when a core is used, the article with the core still attached is placed in the oven. In twelve hours the drying is completed, and the mass becomes as hard as wood, and of a uniformity of texture seldom found in wood ; it is then cut and turned as required, hollow articles being turned externally while still adhering to this core. In certain cases it is necessary, in order to remove the core, to cut the papier-maché into two symmetrical halves, which are afterwards glued together, again baked, and then turned. The next operation is to rub the articles smooth with pumice and sand-paper, after which they are saturated with a mixture of oil of tar and linseed oil, stoved, lacquered, and ornamented with designs, and are then ready to be gilded or inlaid with mother-of-pearl.

There are two ways of employing the mother-of-pearl : The first is to soften the shell in water, and while in this state to saw out, by hand, the rough form which the ornament is to have, and of a somewhat larger size than it is to appear when subsequently finished. The pieces thus cut are rubbed perfectly even and smooth, and are then imbedded in their proper places on the article, in a thick coat of the tar-varnish, of the consistence of honey, which is employed for the ground upon which the finer varnish is subsequently laid. The article is next placed in the lacquering-stove, and when fully dried is again coated with another coating of the ground varnish, the mother-of-pearl ornaments being also covered, and again stoved. The mother-of-pearl can now be distinguished only by the inequality of surface which it produces. These inequalities are ground off, by which the mother-of-pearl is fully exposed, its surface being even with that of the rest of the article. The whole is then ready for painting and gilding, and receiving the last coat of fine varnish.

The second method of inlaying is that patented by Messrs Jennens and Bettridge of Birmingham, and consists in reserving the ornament or design by sketching it with some kind of varnish, not acted upon by acid, upon a piece of the shell ground and polished upon revolving-wheels, as in the other case, and then etching away the surrounding unprotected portions by means of an acid. This process possesses several advantages, one of which is that it is much cheaper than where the design is cut out by hand.

The process of painting presents nothing peculiar ; but the method of gilding is very ingenious. The part to be gilded is covered with gold-leaf just before the coating of varnish has fully dried, and while it is still adhesive enough to allow of the gold-leaf adhering to it ; upon this gilded surface the ornament, which is to appear in gold, is designed by means of a copal varnish, or of a solution of bitumen, somewhat like Brunswick black, which resists water, but is soluble in oil-of-turpentine. The varnish is then allowed to dry to such a degree as to withstand a slight rubbing, but still to be readily acted upon by a solvent. The superfluous gold is removed with a damp cloth, whilst that protected by the varnish remains attached; the latter is then dissolved off with turpentine, and the gilded ornament exposed. The whole surface is subsequently covered with a coating of fine copal varnish.

The manufacture of articles in papier-maché of the kind described, has become a great branch of trade in England, to which, indeed, it is almost confined. For many purposes it possesses very many valuable properties, which will no doubt recommend a much more extensive use of it, now the duty on paper has been removed. The tediousness of the process joined with this duty, have hitherto rendered the cost of papier-maché articles so very high, that they could only be purchased by the wealthy. Considering the price paid for them, and the class which alone could afford to purchase them, but little taste has been exhibited in the decoration of English papier-maché goods.

MARMALADE.

It is not very many years since marmalade was one of the greatest rarities, and was used only in the houses of the wealthiest classes of society. In some houses of the middle class, thrifty housewives, here and there, would manage to economise a few shillings from the current expenditure, and about the month of May or June, in the country, and perhaps in April in cities, the little hoard would be spent upon a few pounds of bitter oranges, with sugar to match. Bitter oranges were then tenpence or a shilling per pound, and dingy whitey-brown sugar cost from sixteen to eighteen pence per pound. This was in the days before railways, and when the steamboats, conducted by foolhardy servants of rash companies, paddled their dangerous voyage from the Broomielaw to Ayr Harbour in the marvellous short space of fourteen hours!

Times have wonderfully changed since then. Now, few housewives in cities ever dream of making marmalade or other preserves, though bitter oranges can be bought, according to the time of the year, at from twopence-halfpenny to fourpence or sixpence per pound, and good white loaf-sugar at from sixpence to eightpence. Still, though the rich and pungent flavour of boiling oranges does not salute the olfactories of hungry husbands every day for a whole week during spring, nevertheless, there is no lack of marmalade—it is a common appendage to many a breakfast table, or a neatly laid out tea-table on the Sunday evening, and now and then on week days. Moreover, it can be purchased in every grocer's shop throughout the country, and at prices so moderate that it is not an entire stranger to the tables of our hard working, and not over highly-paid working-men.

It may not be amiss to explain to our readers how it is that this refreshing and healthful conserve, which possesses considerable tonic power, can be so easily and cheaply purchased. The great peculiarity of this age is, that everything that can by any possibility be manufactured in portions—which requires to go through a series of distinct operations—is sooner or later systematised, and the several processes are performed simultaneously by a number of different workers, just as cotton is manufactured from the raw wool, and carried through all its stages, until printed, finished, packed, and labelled, it is ready for its ultimate destination, whether that be the home or a foreign market.

We will now endeavour to explain how the factory system of operations has been applied to the manufacture of marmalade. Let us then step down to the establishment of Messrs James Wotherspoon and Co., in Dunlop street, in this city, and we will see this work carried on to an extent and with a regularity which is remarkable even in these days of divided labour. On entering these premises from Dunlop street, we ascend a flight of stairs, and land in a large warehouse filled with bottle-racks, shelves, counters, piles of tin and wood boxes, rows of barrels, &c., &c., almost beyond computation. This hall—the store-room of the establishment—is one hundred feet long by eighty feet wide. But the building contains five stories, consequently there are five such halls like the first, with boilers, revolving and oscillating pans, steam pipes, many series of machine gearings, belts, pullies, mills, with men and women in most orderly disorder, intent upon their several duties. On each floor of this huge establishment, separate branches of the manufacture of confectionery of all kinds is carried on. But the arcanum of marmalade is on the lowest floor of the establishment under the level of the street. Let us go into this *dulcamara* cave, where the bitter oranges of Seville are prepared for the palates of the million-mouthed public. Here, on all sides, we see boxes of oranges and barrels of sugar in endless rows, and, between them and the light, crowds of industrious and tidy young women busily employed in quartering the oranges. These quarters are then divested of their skins, which are thrown into tubs on the one hand, while the pulp is thrown into similar tubs on the other. The skins are, along with a given quantity of water, put into pans, which are kept on the boil by steam carried from the principal boilers, which supply heat and motive power to the manufactory. The pulp is then put into sieves, and rubbed until the entire matter, excepting only the seeds, is reduced to a degree of fineness not unlike rough gruel. This pulp is then boiled. After the skins have been boiled sufficiently, they are carried singly to a revolving knife with eight blades working vertically, where they are reduced to the thinness of joiner's shavings, or the leaves of flowers. The marmalade is usually slightly flavoured with lemon, and in the process of manufacture this fruit is used in large quantities, as well as for other sweetmeats. The lemons are cut and skinned in the same manner as the oranges. The skins are, however, the only part used in making marmalade. These being boiled and cut are, together with the orange pulp and cut skins, put into tubs, and tossed and churned until they are as intimately mixed as possible, after which they are carried in pailfuls to pans which contain about ninety pounds each of mashed oranges and sugar, and there boiled at a high temperature for about twenty minutes, when the mass is converted into admirable marmalade, which is put into stoneware jars containing one pound each, of which piles like haystacks stand on all sides. These are then covered with prepared paper laid close on the surface of the preserved fruit. The jar being covered over with a piece of bladder, and tied fast round the brim, the marmalade is ready for home consumption or for export.

We are afraid to specify the quantity of marmalade manufactured at this large establishment; but our readers may estimate the quantity for themselves, when we tell them that the oranges are used by ship loads, and the sugar by tons upon tons. There are, during the busy marmalade season, always employed no fewer than fifty women; and during the months of spring the quantity manfactured is not less than two thousand five hundred pounds weight per day.

We have got the marmalade potted, but in that state it cannot be carried from the manufactory to the markets where it is to be disposed of to individual consumers. There are boxes and barrels required for its safe transmission, and in the establishment where it is made, a large circular saw is constantly at work, cutting up wood for joiners and coopers, who make such larger packages as are neccessary for the railway and steamboat traffic.

After supplying the home market with as much of this delicacy as the constantly-increasing demand requires, large quantities are shipped to Australia, the West Indies, America, the East Indies, and to the Continent of Europe—for even France, Spain, Portugal, and Italy draw large supplies of their own fruit back in the shape of marmalade; and our readers would be surprised if we were to give only a meagre sketch of the extent of the trade carried on by this firm, through their establishments in London and Jersey, with the southern states of Europe.

We have described as shortly and lucidly as we were able, a little known, but, as our readers will now understand, a most important branch of our local industry. G. H.

Glasgow.

APPLICATION OF ALUMINIUM TO PRACTICAL PURPOSES.

The constant appearance in our jeweller's shops of fancy articles of aluminium is beginning to draw very general attention to that valuable—but not admittedly precious—metal. A few years ago (1855) small specimens were handed about and examined as curiosities from Deville, the French chemist's laboratory, and regarded with great interest. It is true it had been discovered eight and twenty years before (1827), by Professor Woehler, of Gottingen; but people then heard the announcement of the elimination of the metallic base of clay, with little more than that ordinary indifference with which the description of a merely new element is commonly received. Deville, whose name is everywhere familiar for his many valuable labours, however, in his investigations of its characters, found that it possessed peculiar and curious properties, and he unhesitatingly stated his impression that it was a metal destined to occupy an important position in the requirements of mankind, as soon as the means could be found of obtaining it in manufacturable quantities.

In his first statements (1855) he drew attention to its power of resistance to all acids save hydrochloric, to its fusibility, its beautiful whitish-blue colour, and the fact of its undergoing no change of lustre or colour by the action of the atmosphere or of sulphuretted hydrogen. Its density as low as glass, he foresaw would insure for it many special applications, while superior to the common metals in respect to the innocuousness of its compounds with the feebler acids, and intermediate between them and the precious metals it was evidently a fitting material for domestic purposes. "And when it is further remembered," he added, then, "that aluminium exists in considerable proportions in all clays, amounting in some cases, to one-fourth of the weight of a very widely-diffused substance, one cannot do otherwise than hope that sooner or later this metal may find a place in the industrial arts."

This prevision seems to be realising itself every day, and a forcible proof of the rapid strides made in its economic production is afforded by a comparison of its past and present commercial prices. A few years ago it cost 60*l.* per lb., while from the Aluminium Works recently established at Newcastle, in our own country, it is now supplied at less than sixty shillings. Every step taken in the reduction of the prime cost of a raw material widens the range of its adaptability to ornamental purposes in the arts, or useful applications in the manufactures. It is malleable and ductile, being reducible to very thin sheets, or capable of being drawn into very fine threads. In tenacity, it is superior to silver, and in a state of purity it is as hard. It files readily, and is an excellent conductor of electricity, and combinations of it, with other metals, have already been used with advantage. The most important of these compounds is aluminium-bronze, formed of one part of aluminium with nine of copper. This bronze possesses great malleability and strength, Professor Gordon's experiments giving the following relations of wires of the same diameter: iron, 100; aluminium-bronze, 155; copper, 68. This immense tenacity and strength confer on this bronze admirable qualities for the working parts of machinery where great durability is required, and notwithstanding its higher price than that of the ordinary metals, the quantity of aluminium required is so small, that it is said that practically the cost of the bronze does not exceed that of ordinary brass or gun-metal bearings.

Another property of aluminium is its extreme sonorousness, and this has also had very serviceable application in the construction of musical instruments. So highly sonorous is it, that a mere ingot suspended by a fine wire emits, when struck, a clear and ringing sound.

The metal can be beaten out into leaves for gilding, or rolled in the same way as gold or silver, and it can be drawn out into wire fine enough for the manufacture of lace. It is also easily run into metallic moulds, or, for complicated objects, into moulds of sand. It is very finely susceptible of what is technically called "matting," by being plunged into a weak solution of caustic soda, and then exposed to the action of nitric acid. It is also easily polished or burnished by a polishing stone steeped in a mixture of rum and olive oil. When aluminium is soiled by greasy matters it can readily be cleaned with benzine. Soiled by dust only, india-rubber or very weak soap and water may be used.

The process of soldering aluminium also is worthy of note. The solder used is composed of zinc, copper, and aluminium, and the pieces of the article intended to be joined must be "tinned," as in ordinary soldering with tin, with the aluminium-solder itself. The pieces are then exposed to a gas blow-pipe or other flame; but in order to unite the solderings, small tools of the metal itself must be used. Tools of copper or brass, such as are employed in soldering gold and silver, are not permissible, as they would form coloured alloys; moreover, no flux whatever can be used, as all the known substances employed for that purpose attack the metal, and prevent the adhesion of the pieces. The use of the little tools of aluminium is an art which the workman must aquire by practice, as at the moment of fusion the solderings must have friction applied, the melting taking place suddenly and completely.

In comparing the price by weight of this with other metals, its greater bulk must be borne in mind. Thus comparing it with silver, the bulk of a given weight of aluminium is nearly four times that of the same weight of silver, so that if one ounce of silver were required for an article, four similar articles could be made of one ounce of aluminiun. Its lightness is, as we have before observed, one of its principal qualities; the specific gravity of platinum is 21·5, of gold 19·5, tin 7·3, while that of aluminium is only 2·6. The lightness which it communicates to the bronze, whose durability, hardness, and immense strength nearly equal that of the best steel, renders probable its future extensive use in the construction of buildings, the manufacture of ordnance, and other objects where strength and lightness are required to be combined.

Having witnessed how admirably the French have applied this metal to ornamental and fanciful objects, it will be a matter of future interest to watch the development of its applications, as a British manufacture, to more solid and practical objects.*—'London Review.'

* A very interesting paper on Aluminium, by Mr P. Le Neve Foster, will be found in the Society of Arts Journal, vol. vii, p. 162.

TURPENTINE AND ROSIN.

BY THE EDITOR.

The trade in turpentine, and its resulting products, for which we have hitherto been indebted chiefly to the Southern States of America, is a very important one ; and it seems highly desirable in the present disturbed position of the States, that attention should be prominently directed to it, with the view of stimulating residents in those of our Colonial Possessions which contain forests of resinous pines, to address themselves to the collection of this important staple of commerce. In the latest year (1860), for which we have the full official returns, we find that our imports of turpentine were to the extent of 185,474 cwts., of the gross value of 86,020*l.* The average price being 9*l.* 3*s.* per cwt. Of rosin, the imports were 612,705 cwt., valued at 182,328*l.* The average price being taken at 5*l.* 11*s.* per cwt. Here we have an important article of commerce, amounting in value to upwards of a quarter of a million sterling, for which we are almost exclusively dependent on the North American States. Our imports last year were 50 per cent. below those of 1860, and 100 per cent. less than those of 1859. The collection of turpentine centres chiefly in North Carolina, although of late years, some attention has been given to the production in South Carolina, Virginia, and Georgia.

Statistical information, in regard to the product and commerce of this article, is exceedingly difficult to obtain, consequently all attempts at an authentic estimate must be defective. Turpentine, however, we know, forms an important item in the labour and wealth of both the States of Carolina. Few persons unconnected with the commercial transactions carried on in this article, can form an idea of the quantity made in the narrow limits of Carolina, the amount of labour employed in its manufacture, the extent of capital invested, the large numbers supported by it, and the various uses to which it is appropriated. Nor are we prepared to enlighten them fully upon the subject, because of the necessarily limited information which even dealers in the article possess in reference to it.

In conversation and correspondence with intelligent brokers, merchants, and others engaged in the business, we have been enabled to gather some particulars, however, which may be interesting.

Ten years ago, the extracted commercial products of the pine shipped from the Southern States, exceeded in value a quarter of a million sterling, but this was only the export, not the whole production. About 800,000 barrels of turpentine were then annually made in the single State of North Carolina. The estimated value to the makers was about 400,000*l.* From 4,000 to 5,000 labourers were engaged in obtaining it, and, perhaps, three times as many more persons supported mainly by the proceeds of its first sale. The local distillation of turpentine is carried on very extensively in America, and this has greatly reduced the shipments of crude turpentine.

The natural wood of this region is the swamp, or long-leaved pitch-pine (*Pinus australis* or *palustris*), which is much larger than the same kind of tree in the Northern States, attaining a height of 60 feet. This wood affords tar, pitch, turpentine and lumber, which constitute an important export from the State of North Carolina. *Pinus Tæda*, abundant in Virginia, yields common turpentine, but of a less fluid quality than that which flows from *P. australis*. American turpentine contains about 17 per cent. of essential oil. The odour is pleasant, and the taste somewhat bitter.

The principal articles of export from North Carolina are turpentine, pitch, tar, and rosin, comprised under the general name of "naval stores." During the year ending June 30, 1857, the following quantities were exported from the State to Foreign countries :—

	Value.
Tar and pitch, 18,681 brls.	$26,817
Rosin and turpentine, 11,092 brls.	$20,582
Spirits of turpentine, 64,460 galls.	$41,392

This statement, however, gives but a very imperfect idea of the quantities manufactured in the State, as large exportations were made to the Northern ports.

More naval stores are shipped from Wilmington than from all the other ports of the United States, and it is a matter of surprise that there is so little direct foreign trade in these articles. The dealers, however, have been in the habit of sending their orders chiefly to New York, Boston, and New Orleans, whence there is a greater facility of shipment. Some small shipments are made from Beaufort.

The pitch pine yields five different substances, which are included in the resinous sap, and obtained thence by extraction and subsequent distillation. Turpentine is the resin in the liquid state, drawn from the tree while growing, by incision and heat of the sun. Spirit or oil of turpentine is obtained by distillation, and the portion which remains in the retort is rosin. The black rosin, or colophony, is the cooled brittle mass in the state in which it leaves the still ; the amber, or yellow coloured, is the same rosin mixed with about one-eighth part of water, while it is yet fluid. Rosin is used in soap-making, as a varnish, and for plaisters, &c. 250 lbs. of turpentine yield 60 lbs. of oil.

The oil of turpentine, sometimes called essence of turpentine, and familiarly "turps," as found in commerce, contains more or less water, from which it may be freed by re-distillation along with water. It is colourless, limpid, very fluid, and possessed of a very peculiar smell. Its specific gravity, when pure, is 0·780. It always reddens litmus-paper, from containing a small proportion of succinic acid. According to Oppermann, the oil which has been repeatedly rectified over chloride of calcium consists of 84·60 carbon, 11·73 hydrogen, and 3·67 oxygen. When oil of turpentine contains a little alcohol, it burns with a clear flame ; but otherwise it affords a very smoky flame. Chlorine inflames this oil, and muriatic acid converts it into a crystalline substance, like camphor. It is employed extensively in varnishes, paints, &c., and also in medicine.

After the trees have been cut down, split up, and dried, the application of fire-heat produces tar, the solid part of which is separated from the liquid by boiling, and becomes pitch. Turpentine is obtained from boxes cut in the standing green trees, about a foot from the ground, into which the sap descends through slight incisions made into the tree, immediately above, with an instrument especially constructed for this purpose. The process of boxing, chipping, and preparing barrels for shipment, is thus described by an old hand at the business:

"Box the tree after the sap has gone down, and stop before it rises; therefore, it will require more hands to box than it will to work the trees. A good hand will cut from 50 to 60 quart boxes a day; some expert axemen, in practice, may cut 100, but it is very seldom such hands are to be found. Care should be taken to cut the box on the straight side of the tree. Some trees will contain from 1 to 4 boxes, owing to the size of it. Care should be taken to leave from 4 to 6 inches of sap and bark between faces, so as to preserve the life of the tree. Cut the box from 4 to 4½ inches deep, about 8 inches wide. Go down the stump of the tree, so as to cut the heart as little as possible. Clean out the chips and bark from the boxes, that your turpentine may be free of them. The next work, after the box is cut, is to gouge, or corner by a few chops, commencing in the edge of the box, running up the tree, widening it at the same time, so as to make a channel for the turpentine to run into the boxes. If the face is nearly a foot wide, say from ten to eleven inches, then your boxes, or at least a part of them, will fill quickly; and you should have your barrels ready, so as to dip as fast as the boxes fill. The next work after the cornering is to be done with a hatchet, made for the purpose; then comes the round shave—you chip off two or three times with a hatchet, keeping the face smooth, then begin the round shave. Never go into the tree more than two and a half or three grains of the wood, and that should be repeated every eight or nine days, never going up the tree more than one-eighth of an inch at a chipping—that is, with the round shave—the only object is to keep the old cut fresh. You may go over every seven days, as many persons do. A hand can chip over his task in five days; some will in less time. Twenty-five hundred is a task for a good hand; then he has two days to dip. If his trees run well, and are thick, he can dip three barrels a day; if not, from two to two and a half. The timber for barrels should be got in the winter—staves thirty-two inches long, the heading wide, so as to make, when round, seventeen and a half inches across. A common cooper will make from four to six good barrels a day. An average to the hand is 200 barrels per year, which vary in price from two and a half to four dollars per barrel."

Another practical man describes the method of preparation still more fully, as follows:

"A good crop season, with occasional showers, is about the most favourable season for the running of the trees. The trees should be boxed at least eighteen inches from the ground, so as not to be overrun by heavy rains, and for greater convenience in dipping also. The boxes, moreover, should be cut, when the form of the tree will permit, on the north side of the tree. They are not so much exposed then to the action of the sun. The turpentine, when running to the box protected in this way, will retain more of the spirits. Besides the advantage of saving more spirits from evaporation by having the boxes on the north side of the tree, you have the boxes protected from the dust and leaves that fly about with the south winds, which prevail most constantly during the summer.

"When the boxes are cut, they should be well cleansed of the chips; and in chipping the tree afterward, care should always be taken to keep the chips of wood and bark from falling into the boxes. It is important, in boxing the trees, to see that the hands perform their task properly. The experiment, I learn, has been made successfully, in chipping over the same spot twice. The object of doing this is to have the running exposed on less of the face of the tree, and to make the trees produce for a greater number of years, before the chipping gets so high as to be very inconveniently managed. As the chipping goes on from year to year, you have a longer face of the tree for the turpentine to pass over before it reaches the box. The value of the turpentine then is very much diminished, and you have to gather it from the face of the tree for scrape, which is worth only half as much as what is dipped from the boxes.

"To guard the trees from the worm and from fire, rake away the leaves and chips every season. The turpentine should be gathered clean as possible from the boxes, and put up in neat barrels of uniform size and about the standard weight, which at present is 320 pounds gross weight. In dipping turpentine, the virgin or yield of the first year should not be mixed with the dippings from trees of older running. It should be carefully barreled by itself, and sent to market. This quality of turpentine, most valuable just after it is gathered, diminishes in value when kept, by the rapid loss of the spirits. It is not unusual in North Carolina to continue to chip trees until you run up from 12 to 15 feet high. Any good axeman that can cut twice in one place, may be taught in a week to cut 50 boxes per day, and then up to 75, and will soon learn to chip well. The most important part of the labour is to have the trees properly boxed and chipped, so as to insure you constant gain. Green hands to commence cutting boxes, say the 1st of November, would cut by the middle of February from five to six thousand boxes, which are about as many as they could tend well the first year. From the number of trees that would run well and work steadily, the hand will make the number of barrels of turpentine herein stated. There are many hands in North Carolina who tend 7,500 to 9,000 boxes for their tasks, making 300 barrels and upwards of turpentine; but they are the crack hands of the country.

"Ordinary hands will chip from 8 to 10 hundred boxes per day, and when getting out the turpentine dip 3 barrels per day; while tip-top hands will chip from 12 to 15 hundred per day, and dip from 4 to 6 barrels of turpentine, where their trees stand thick, and their boxes are well filled.

"After tending your trees six or eight years from your first boxing, according to the procedure in Carolina, you back box the same trees, leaving some two inches of the sap on each side of the tree, between the old and the new box, thereby preserving the life of the tree. Then, after tending these boxes as many years as the first, you can cut the face out 10 or 12 feet, by the axeman having a bench to stand on, which affords an immense quantity of the rich kind of wood, such as tar is run from in North Carolina."

Distillation.—The cost of distilling is very great, and it is a business requiring no small capital and energy. In North Carolina there were in operation, a few years ago, about 150 stills, which, at an average cost of about $1,500, with fixtures, demand an expenditure of $225,000 (45,000*l.*). There are three or four also in South Carolina.

Estimate of Profits.—From an American pamphlet on the production of turpentine, we extract the following calculation showing the probable profits of making the article, estimating the yield per hand at 200 barrels :

Average price of dip turpentine . . .	$2½	
„ „ scrape „ . . .	1¼	
150 barrels dipping, @ $2½	$375	
50 „ scrape @ $1¼	62½	
		437½
Deduct expenses for making 200 barrels @ 30 cents	60	
Conveyance to market, @ $¼	50	
Commissions, &c.	27½	
		137½
Making clear to the hand of each labourer . .		$300, or 60*l*,

The average yield here assumed appears very large. We find this estimate, however, amply supported by other published reports and observations, derived from the best authorities. One of these is from an experienced North Carolina manufacturer, who spent several months in an examination of the pine-lands of South Carolina and Georgia. He gives, as his opinion, that no region of the world offers greater inducements to embark in the business than the pine-lands of those two States. The trees in many sections are so numerous as to be almost inexhaustible, and the yield, both in respect to quantity and quality, equal to any he had ever found in the best regions of North Carolina. The location of these lands in the immediate vicinity of railroads, navigable steamers, and seaport-markets, offers the best facilities of transportation and ready sales. An average crop to the hand he estimates at 200 barrels per annum, prices varying from $2½ to $4, and expresses his conviction that from $300 to $400 can be made clear to every hand employed.

A gentleman engaged in the business, near Ridgeville, thirty-one miles from Charleston, states that, with forty hands, he succeeded in making

125 barrels to the hand, or 5,000 barrels, which, at $2 per barrel (a low average), for the crop, is equal to $10,000. The expenses deducted, say $6,000, leaves a net profit of $4,000 (800*l.*) But, with the recent high range of prices, a much greater profit has been realised.

Rosin is used chiefly for soap-making (all kinds), the more common by paper manufacturers, and very fine and common for sealing-wax and varnishes. The commercial classifications consist chiefly of the following descriptions :—Common amber, medium (which includes opaque), fine, and extra pale, or virgin.

Within the last few years, rosin has ranged in price from 3s. 9d. to 5s. per cwt. for common ; 4s. to 10s. for medium ; and 6s. 6d. to 21s. for fine. But latterly, since the disunion of the United States, the former has gone from 4s. 2d. to 14s. 6d. ; the second, from 4s. 6d. to 17s. 6d. ; and the latter from 6s. 6d. to 25s.

Crude, or rough turpentine, is still distilled in this country to some extent, but the trade has very much decreased since the duty was taken off American spirits of turpentine.

Crude turpentine has ruled, in ordinary years, from 6s. 6d. to 12s. per cwt., but this year it has ranged from 10s. to 20s. American spirits of turpentine have ranged, in ordinary years, from 29s. to 46s. per cwt., but this year it has realized 30s. to 75s. (with casks). English distilled spirits generally range about 2s. lower than American make, and French 3s. to 4s. per cwt. less. Reshipments have been made this year to New York, and the Continent is even drawing upon our supplies.

Rosin and spirits are made in France, and shipped from Bayonne and Bordeaux. The turpentine is harder, and not so much liked, nor is French rosin in such good repute as American; hence, save when prices are high, not much is received here. It is the produce of *Pinus maritima*, *P. sylvestris*, and other species. It flows from May to September.

The essence, or volatile oil of turpentine, is obtained by distilling turpentine with water, with the vapour of which it readily passes over at 212,° though its boiling point exceeds 314°. It is one of the most important of the volatile oils in consequence of its numerous applications in the arts, especially in the preparation of paints and varnishes. The highly rectified oil, or distilled spirits, is used under the name of camphine, as a burning fluid, being mixed with alcohol in various proportions. In consequence of the great inflammability of oil of turpentine, it is highly dangerous when kept in quantities. If preserved in wooden vessels, they are very apt to leak ; hence the necessity of placing them in another cask surrounded by water.

Continental spirits of turpentine is frequently imported ; it is much more caustic than the American quality. Rosin and turpentine are both received in barrels, containing from three to three and a half cwt. each.

Gum Thus, or Flake Turpentine, is the solidified turpentine picked from the trees, having hardened and become bleached, after the sap has ceased running from the incisions made. Nearly all the spirit has evaporated from it. It is used in paper-making, like rosin, but is chiefly employed by chemists for plaisters, and also for incense.

Rosin-oil used to be imported from America, the common dark fetching 6s. to 7s. per cwt., and the fine pale 12s. to 14s. It is used for burning, lubricating machinery, &c., but the new American earth-oils have materially interfered with its sale.

FOSSIL HYDRO-CARBONS—THE SOURCE OF LIGHT, HEAT, COLOUR, ETC.

BY THOMAS D. ROCK.

PART III.

Having already given, to readers of the TECHNOLOGIST, an outline description of those industries connected with the subject before us, as well as a brief account of the raw material in its distinctive varieties, I propose in this third, and concluding paper, to consider the hydro-carbons collectively in respect of their practical utility to man ; and in enumerating some of the various applications of these interesting substances, I shall preserve the order above mentioned, and notice their value consecutively as sources of Light, Heat, Colour, &c.

LIGHT.

Artificial light is an important element of comfort in modern civilization, and the nearer it approaches in brilliancy and effect to the genuine light of day, the greater its value and efficacy. Our ancestors, as well as the forefathers of all the present European nations, contented themselves with very dim substitutes for the glorious orb. Lamps for burning limpid oil, and those not constructed upon *Moderator* principles, furnished the chief supply of artificial light ; or solid fats and waxes were formed into candles, with wicks that would be reckoned abominable in these days of useful progress. But now all is changed ; and without, in any measure, commending the altered and nocturnal habits of the people, induced, or encouraged, it may be, by the increased brilliancy and superior character of our illuminating agents, it is, nevertheless, impossible to deny, that, so far as the light itself is concerned, the improvement contributes much to our physical, as well as mental, enjoyment. Contrast the dingy and melancholy aspect of the thoroughfares as they appeared in the early days of many who will peruse these lines, with the cheerful gas-illumined street of recent times ; or the sombre interior of our public institutions and churches of the past with those of the present, as they appear radiate with brightness streaming from innumerable jets of flame, as it were mysteriously inexhaustible ; and the gain is obvious. The social and family hearths likewise share in these great improvements in artificial light, and even the cottager may now take a last farewell of the farthing rushlight, which only helped to intensify the squalid misery of his wretchedness, and substitute in its place a lamp that will, by its vigorous and inspiriting flame, impart an air of cheerfulness around, and, at the same time, prove equally, if not more, economical than its unfortunate predecessor.

To the fossil hydro-carbons, Society is indebted for most of the very important and beneficial changes in the character of our artificial lights to which I have referred ; and it is quite possible, if not probable, that all our supplies of light, whether in the form of gas, oil, spirit, or candles, may eventually be obtained from this source, to the exclusion of all others. Petroleum, or rock oil, has been burnt in lamps in its crude state in various parts of the world, and by various peoples. The Seneca Indians are reputed to have used the oil in this way, whence we have the synonym "Seneca oil." In Greece also this mineral oil was consumed, as well as by the inhabitants of the Caspian Sea, and its neighbourhood. Cannel coal is another of the fossil hydro-carbons that is immediately available for purposes of light, since, if it be turned into sticks about three-quarters of an inch in diameter, it will burn gradually away like a candle, with a fair flame, from the abundance of volatile matter it contains ; and this, in the absence of any other source of light, would not be without its value.

Gas, however, was the first illuminating agent ever derived by manufacture from the fossil hydro-carbons, and its production is now most extensive, and carried to a high pitch of perfection, and it will be improved in quality still further, in consequence of recent legislation on the subject. Gas is too well known to require much notice, and I shall simply describe it as an elastic fluid, highly inflammable, lighter than air, and producing, when ignited, a brilliant flame. Gas can be obtained with facility from either of the fossil hydro-carbons, but at present, coal is the raw material generally employed in its production, although in Ireland peat has been made available for the same end, and might be thus employed to a much greater extent.

The next important illuminating agents derived from the hydro-carbons, are those kinds of spirituous oil burnt in lamps, which are becoming so popular, and obtained from coal, peat, bituminous shale, and bitumen. These lamp oils are distinguished by a variety of names rather confusing to the general public, each producer, emulous of notoriety, selecting a distinctive by which his own especial production shall be known in the market ; thus we have,—

From American Rock Oils :—

- Photogene oil—or literally, earth light oil, from φως, light, and γη, the earth.
- Kerosene oil—literally wax oil, from κηρος—wax, in allusion to the solid wax-like Paraffine, these oils contain in them.
- Crystal oil, in allusion to its clearness and purity.
- Petrolene—or rock oil—from πετρος—a rock.

FROM RANGOON TAR :—

Belmontine ; after Belmont, the name of Price's Candle Factory.

FROM BOGHEAD MINERAL :—

Saxoline, or stone oil—from *Saxum*, a stone.

Paraffine oil.

And besides these, there is the German oil from bituminous shales —sold as "Mineral oil." These all vary in colour and purity ; the sp. gr. ranging from about ·800 to ·830, upon which the illuminating power, doubtless, mainly depends, and it would be interesting to test, by actual experiment, the relative value of oils having diffe- rent weights, all other things being equal. The character of the light yielded by these oils is all that can be desired ; and when burnt in properly constructed lamps, their light is superior to gas. Floating rumours of danger, and difficulty in the management of Paraffine lamps alone prevent their more general adoption, whilst there is also great objection manifested to the odour which almost invariably attends their use. As regards the first-mentioned complaint, that appears to be a complete misapprehension ; for all Paraffine oils having a sp. gr. higher than ·800 are non-inflammable without the aid of a wick, and any oil lower in the scale of weights is not sold for lamp use, except by ignorant or incompetent tradesmen. Some of the American oils—Kerosene, &c.—are certainly inflammable without a wick, but I cannot say that is the case with them all, not having sufficient experience to make such an assertion. Professor Herapath's advice, published in the 'Times' of the 13th January, will, at any rate, enable the public to protect themselves to a considerable extent from any danger—and I copy the pith of it here. He writes : "Let two or three drops of oil be allowed to fall upon a plate or saucer, and apply to them a lighted match ; if the flame spreads over the surface of the drops, the oil should on no account be used, as it will, under many circumstances prove explosive. The genuine paraffine, or petroline, will not burn except upon a wick." The difficulty of management, supposed to be inseparably connected with the paraffine lamps is also another delusion ; the only precaution and care necessary to insure success being a *perfectly even* wick, free from all carbonized matter. As regards the odour of the paraffine, that is an evil immensely aggravated by spilling the oil in filling up the reservoirs, and which, with greater care in the operation, can be easily avoided. Still a strong and unpleasant perfume appears to be almost inherent in these oils, although at an additional expense, much of it may be removed. Price's Belmontine is about the best specimen of paraffine oil at present offered to the public, having no perceptible colour, and comparatively little smell. I do not know if it burns without the intervention of a wick. Saxoline, and some of the German oils, are next in order of merit, and lower in price ; and there are some oils of a very inferior type, high coloured, abominable in odour, and proportionately cheap.

Before leaving this part of my subject, I would allude to the great necessity there is for care and precision in the distillation of these oils, that the sp. gr. may be sufficiently high to preclude the possibility of danger. Sometimes makers mix together light oils and heavy oils, so as to average the weight, but this course appears fraught with mischief, for I am informed that a perfect homogeneity of the two fluids does not take place, and that the lighter portion will readily separate by a very slight application of heat, or even with a warm temperature, and is easily fired. This may possibly explain those few accidents which have occurred with paraffine, and it is a danger which the hydrometer cannot detect. It must, therefore, rest with the makers, thus far, to protect the public; and inasmuch as the light spirit is now becoming valuable in itself, instead of being a waste product as heretofore, there will be less inducement to practise the evil. When distilled over at the same time, these light and heavy fluids, even if they be not absolutely homogeneous, are notwithstanding so well commingled as to be practically safe.

Another, and a very beautiful source of light derived from coals, peat, and bitumens, is paraffine, the solid substance from which the oils derive their name. It is separated from the heaviest products of distillation, and in its rough condition has a most offensive smell and dirty color, but when purified it is brilliantly white, and crystalline, not unlike spermaceti, sp. gr. ·87, and having a formula $C._{20}$, $H._{21}$. In combination with a small proportion of animal or vegetable stearine, paraffine forms admirable candles of a semi-transparent nature, and more attractive to the eye than the best wax lights. It has been clearly demonstrated that all paraffines, although possessing exactly the same composition and chemical formula, are not alike in their fusing point, the range being from 108° to 140° Fahrenheit, a most important fact in the application of this beautiful substance to the manufacture of candles, since it becomes apparent that whereas some paraffine candles would be suitable for the high temperature prevailing at the tropics, others would be melting and softening in such a way as to produce complete condemnation of paraffine for warm climates.

Paraffine candles are sometimes greatly adulterated with chalk and other substances, especially those received from abroad.

Heat.

To the denizens of a cold and moist climate, a warm fireside is a necessity and a luxury of no little value. The wood-fire on the hearth, around which our ancestors gathered, has been necessarily superseded by the iron stove and fossil fuel, and the cheerful aspect of our open grates, with their bright and glowing piles of burning coal, is as great a comfort to our own people as it is a subject of admiration to foreigners accustomed to the closed and half-suffocating stoves of Continental houses. But a very small proportion, however, of the fossil hydro-carbons consumed in this country for the production of heat, are expended in cheering the family hearth, or cooking the family provender. It is the furnaces of England's busy factories and smelting yards, of her locomotives and steam-vessels, that absorb the great bulk of fuel raised from our practically inexhaustible stores. Millions of wheels are set in motion by steam, generated by the heat which is derived from the fossil fuels, both coals and peats; for the latter substance is largely employed in the sister Isle, and, as many think, might be profitably adopted as a fuel in England, when converted into charcoal and compressed.

Volumes have been written, from time to time, on the fossil fuels—coals and peats—and it certainly is a subject of the greatest importance to a manufacturing people, although too vast and extensive for a short paper in a magazine. I shall, therefore, pass by this portion of the hydro-carbon history, and notice briefly the application of gas as a heat producer. Gas-stoves for heating rooms, baths, or for culinary purposes, are pretty generally known; and from the great facility with which this gaseous fuel is obtained, and ever ready to do its kindly work, they are coming more into favour. Attempts have been made to use gas in some of our metallurgical operations, but I believe with no success; although in Prussia and Austria this fluid is used for furnace and refinery purposes with complete success. The furnaces in question are said to be built expressly for the use of a compost fuel or inflammable gas. The gas so used is mostly prepared from wood, and there may be something in the nature of this gas to render it as superior to coal-gas, as charcoal is to coke for smelting purposes amongst ourselves. Those who are supposed to be practically acquaintedwith the merits of all plans for the reduction of metals, speak of gas furnaces as impracticable in this country, from their greater expense in the item of fuel.

It is very probable that the bitumens may yet form another important source of heat for mannfacturing and general steam purposes, an idea originating in the immense discoveries of rock oil in America. Our trans-Atlantic kinsmen, eagerly anxious to turn their oil-springs to the best possible account, and fully recognising the importance of cheap and available fuel in these days of manufacturing progress, have already directed their attention to the application of rock-oil as a heat producer. In the 'Chemical News' for May, 1861, I find the following description of an apparatus with which certain experiments have already been made in Pennsylvania. "A series of iron pipes are laid in the fire arch of the boiler, which pipes are perforated in their upper surface with minute holes; the oil is supplied to those pipes by means of a force pump, aided by an air-receiver, to preserve a constant pressure. A spray, so to speak, of oil is thus made to fill the space usually filled by the flame of wood or coal used to raise steam; this, once ignited, fills the fire-arch and flues of the boiler, and maintains the desirable amount of heat in the boiler. If this fuel is not found to be too expensive, it will prove a good thing for the use of steamers on sea voyages."

It is even contemplated to utilise the numerous oil and bitumen springs in Asia Minor, by working the projected railway across the Euphrates valley with them, in conjunction with wood. These bitumens, mixed with wood, have been found to equal, if not surpass, coal as a fuel for the generation of steam, and when Col. Chesney explored the route for the first time, they were selling at about 3d. per cwt.

Colour.

The production of colour from coal-tar bases, is a branch of the great hydro-carbon industry still in its infancy : Yet so encouraging are present practical results that it is hardly predicting too much to say that eventually we shall be supplied with every requisite dye from the same source, and if the brilliant, though limited, number of colours of coal-tar origin, at present existing, are a fair sample of what is to follow, I feel sure the public will very readily bid a lasting farewell to most of the dyes obtained from plants and animals.

Amongst the various residuary products of the coal-gas manufacture already enumerated, and which are mainly included in coal-tar, is a basic oil termed "*aniline*" from "*anil*," the Hindostanee for indigo, and from which dye it was formerly obtained, although only in small quantities, and for purely chemical and experimental purposes. The quantity of aniline existing as a distinct and separate body in coal-tar, is, however, extremely small, and this invaluable source of so many shades of colour is now obtained from Benzole, another ingredient in the bundle of hydro-carbon treasures, just now exciting so much attention. Of coal-tar naphtha about 25 per cent., or one quarter part, is benzole, which, on being dissolved in nitric acid, yields the well-known product nitro-benzole, presently to be noticed as an artificial oil of almonds. From nitro-benzole, aniline is now produced in large quantities, and of the numerous processes by which that result can be obtained, Mr. Perkins stated in his admirable paper read before the Chemical Society, that Bechamp's plan was the one most generally adopted, by which the nitro-benzole is submitted to the action of acetate of lime, the product being aniline.

From aniline, many colours have already been elaborated; but as I have not space sufficient to describe at length the chemical treatment of this basic oil in their production, I will simply mention the principal coal-tar dyes, that the reader may be enabled to identify the source whence they are obtained.

"Mauve" is as familiar to us as a household word, and the remembrance of its introduction into the gay world will be long retained ; for it came to the rescue at a time when the connoisseurs of colour were positively languishing for something novel wherewith to attract the votaries of fashion, and enjoyed no ordinary measure of success and popularity. The name is derived from the terminal syllable of the French for the mallow *guimauve*, to the flower of which plant this new colour bears a striking resemblance. Aniline purple, phenamine, indisine, &c., are synonyms of this same dye.

Violine and roseine are other shades of purple, thought by Mr. Perkins, who is a chief authority in such matters, to be closely allied to the mauve, and the names indicate a resemblance more or less complete to the tints of the violet and rose.

Magenta is another dye product of aniline, and equally popular with the mauve. Its association with the blood-stained field of Italy betrays its resemblance to some gory tint, sad and sorrowful to mortal eye. It is, nevertheless, a beautiful colour, and one that promises to outlive the fickleness of fashions' fancy. Fuschine is the synonym of this dye.

A blue colour known as bleu de Paris, discovered by a French chemist, and a green, aniline green or emeraldine, have also been produced from aniline ; but I cannot learn that any success has yet attended their manufacture, or that they have really passed from the theoretical into the practical world.

A beautiful orange colour very recently (and previous to that sad bereavement which has filled the nations heart with sorrow) was enlivening the shops of our metropolis under the designation of capucine, the French name of the common garden nasturtium, *Tropæolum majus*, as bearing some resemblance to its flower. This dye, I have every reason to believe, is prepared from another coal-tar base, carbolic acid, as this substance when treated with an excess of nitric acid yields picric acid, which is of itself a beautiful orange yellow colour, and, as I suppose, the very dye in question "Capucine." The gum resin of the Australian grass trees, *Xanthorrhœa sp.*, has been the chief source of picric acid hitherto, but carbolic acid must, I should suppose, furnish a cheaper supply of raw material. It is obtained from that portion of coal oils distilling over at a temperature of from 300° to 400°. Carbolic acid has likewise another application, to which I shall allude presently.

Naphthaline is a further basic substance from coal-tar which promises us eventually a supply of useful colours. Popularly known in the gas trade as the gas-makers' nuisance, from its corroding the pipes in large quantities, and injuriously affecting the quality of the gas ; it possesses, in the crude state, a most intolerable odour, and has the appearance of a mass of mud ; but when sublimed, it occurs in beautifully white crystalline flakes or scales, and the disagreeable odour, although not removed, is sensibly diminished. Efforts have been made, as yet unsuccessfully, to elaborate a blue from this base. There are also other hydro-carbon bases which yield colour, and may yet be employed.

The coal-tar colours, from their great brilliancy, are plainly discernible, and readily distinguished from all other dyes, and yet withal they are not coarse, but soft in effect, and if our chemists can but elaborate other shades, and more decided colours, the ordinary dye-stuffs of commerce will at last become curiosities and relics of the past.

A few pigments are also obtained from the fossil hydro-carbons Cologne earth is a species of brown coal. From certain kinds of peat a brown pigment is prepared, termed peat umber, or humic acid ; and from coal-tar a very good lamp black is produced.

Miscellaneous Products.

The miscellaneous applications of the fossil hydro-carbons are both numerous and important, every day, almost, adding to the long and interesting category. Hundreds—yea, possibly thousands—of busy brains are bestowing patient thought upon these fossil productions of Nature, which, in their rich, and varying results, are the nearest possible approach to the philosopher's stone yet discovered; and, ever and anon, some fresh novelty—still hydro-carbon, a chip of the old block—is set before an approving public.

Jet and cannel coal are largely turned into useful and ornamental articles of *vertu*, the former especially having been prized for personal adornment for many ages. On the shores and in the neighbourhood of the Dead Sea, a species of bituminous limestone, termed fetid limestone, is found. It is externally white, being coated with sand, or mud; but, on being broken, exhibits a jet black interior, with rather a glossy fracture, and connected with this material is quite a little industry—charms and amulets being carved from it, in various parts of Palestine, by the natives, especially at Bethlehem and Jerusalem. These charms are supposed to be specifics against plague, and have been so regarded by the Asiatics for many ages. The smell arises from the combination of sulphur and hydrogen, and friction intensifies it. Compressed peat is another variety of hydro-carbon that is sometimes formed into a variety of useful and ornamental objects.

Many of the fossil hydro-carbons and their products are valuable antiseptics, and a much greater development will probably be given to their practical employment in the arts. The ancient Egyptians, I believe, used petroleum, or asphaltum, in the embalming of their dead. Barbados tar has long been reckoned a valuable remedy for putrid sores. Peat is possessed of such virtue in arresting putrefaction, that it is recorded of the body of a female found buried in a bog, having been there for several centuries, that it was tolerably perfect, with the skin, nails, and hair in a good state of preservation. Peat charcoal is an excellent deodoriser, and has been employed in hospitals to absorb the fetid smell connected with putrid wounds, and in other similar ways. Rangoon tar is employed by the Burmese as a preservative for timber; and carbolic acid, analogous to creosote, is invaluable for similar purposes at home. This latter substance, either in its raw state, or somewhat manufactured, is, I believe, sold as artificial smoke for flavouring and preserving hams, &c. A new sheep-wash, patented by a firm at Manchester, is also based upon this valuable acid, which, possessing properties analogous to creosote, may likewise be employed in the treatment of toothache. In the English and continental pharmacopœias will be found several of the hydro-carbons and their products, as petroleum, tar, naphtha, &c., mostly valued for their antiseptic properties, and administered both externally and internally. Naphtha has even been given in cases of phthisis, but I cannot hear that the plan has proved successful.

The fossil hydro-carbons promise also to yield us an unlimited supply of delicious odours, similar to those now extracted from various plants with great patience, and at considerable expense. Already one important perfume, derived from this source, is established as an article of commerce, and sold extensively for scenting soaps—also, very probably, in the flavouring of pastry and sweetmeats. This perfume, or essence, is nitro-benzole, which possesses the exact odour of oil of bitter almonds, and is sometimes sold under that distinctive. Its formula approximates very closely to the genuine oil of almonds, which is, in fact, a hydride of benzole :

Oil of Almonds, $C_{12}\ H_5\ O_2$.

Nitro-benzole, $C_{12}\ H_5\ N.O_4$.

Nearly all the essential oils are simple compounds of hydrogen and carbon ; and, in order to produce them artificially from the products of the fossil hydro-carbons, there must be the necessary re-arrangement of the particles. To induce this result in the most facile and inexpensive manner, is a work in which our chemists will not fail eventually to excel.

Some attention has been bestowed upon the fossil hydro-carbons, as being useful solvents for varnish-making, and in the treatment of elastic gums, &c. Naphtha has long been employed in the preparation of cheap polish, and a common varnish is produced with Rangoon tar and gum dammar, but it is the light paraffine spirit which promises the most important results in this direction. The oils having a lighter specific gravity than ·750, were not long since regarded as waste products, and, in some branches of manufacture, were either allowed to run away, or were employed in the processes connected with the preparation of the burning fluids. Found, however, to be available for more useful purposes, there was at first a demand, suddenly, rather in excess of the supply. This light spirit is an excellent solvent for resins of all kinds, and is a good substitute for turpentine in the mixing of paints, and will doubtless be employed in this way to a considerable extent. To fit it for use, it has to undergo some manufacturing process, by which it is altogether purified and separated from any of the paraffine oil it may contain, if not chemically changed. These fluids are highly inflammable, and the gaseous vapour which continually rises from them readily ignites if the flame of a candle be brought within its reach. One variety of this light spirit, purified, is in the market, under the distinctive of Turpentole.

The cementing and concretionary properties of the bitumen have also attracted much notice of late, and the application of asphalte in combination with sand for pavements, and in conjunction with hair-felt for roofing is very considerable, several public companies for developing these branches of fossil hydro-carbon industry having started into existence. With the example before us of the bricks in Babel's tower cemented with bitumen, I wonder no attempt has yet been made to utilise these same products in this way amongst ourselves. Many of the asphaltes are both cheap and abundant, and there is also a large amount of coal-tar produced in the country, which, although not natural bitumen, is a good artificial one, and I should suppose must possess identical properties. Surely for the foundation work of bridges, or of buildings in general, bituminous cement would be preferable, and more durable than those kinds commonly in use. The little coffin of rushes plastered with pitch (bitumen) in which the infant Moses was hidden at his mock funeral, furnishes another indication of the value of the hydro-carbons as a preservative from the ill-effects of damp and moisture.

Some of the hydro-carbons are also conspicuous for their detergent and cleansing properties. Benzole, under its French synonym, of Benzine, has been for many years in favour with the French and English public—and since Price's Candle Company have carried on their interesting manufacture from Rangoon Petroleum, another detergent of great value, under the name of Sherwoodole, has been upon the market, and earned golden reputations. I may just mention, for the benefit of those who are not acquainted with these substances, that grease spots can be easily removed from dresses of all kinds, especially silks, by their agency ; gloves can also be cleaned in the same manner. That great bane of the hydro-carbons,—an unpleasant odour—clings also to these detergents, but does not remain on the garments treated with them after drying.

Excellent oils and grease for lubricating purposes are to be found among the miscellaneous products of hydro-carbon industry. The grease, which contains a large quantity of solid paraffine in combination, and to which its consistency is attributable, is excellent for railway purposes, also for carts, &c. The oils, especially those made at Belmont works, as a substitute for sperm, are also admirably adapted for their purpose ; they are not exclusively from the fossil hydro-carbons, but contain an admixture of some recent vegetable or animal oils. The oil that was made from peat by the Irish Peat Company, now defunct, was a pure oil, without any admixture, of a dark colour, and very limpid, not unlike some of the thinner kinds of rock oil received from the United States.

A large quantity of ammonia is produced in the manufacture of coal-tar, and peat, and forms, with other ingredients, invaluable manures. Peat, in combination with sea-weed, undergoes some chemical change, that fits it, in like manner, for agricultural purposes, as shewn at page 268 of the first volume of this publication. Peat has also been recommended as a useful material for paper-making.

Although I have, for the present, finished my *sketch* of the fossil hydro-carbons, their history, origin, manufacture, and application, I seem but just to have approached the threshold of this great subject, and on future occasions I hope to consider, in detail, many of its most prominent features, and to do greater justice to a theme so absorbing, and of such vast practical importance. If readers of the TECHNOLOGIST will kindly point out to me any errors they may observe in my statements, they will confer a favour on me personally, and aid in the rescue of a deeply-interesting subject from the darkness of ignorance and indifference.

THE TECHNOLOGIST.

THE IVORY TRADE OF ZANZIBAR.

BY CAPTAIN R. F. BURTON.

Zanzibar is the principal mart for perhaps the finest and largest ivory in the world. It collects the produce of the lands lying between the parallels of 2° N. lat., and 10° S. lat., and the area extends from the coast to the regions lying westward of the Tanganyik Laki. It is almost this only legitimate article of traffic for which caravans now visit the interior. The elephant has not wholly disappeared from the maritime regions of Zanzibar. It is found especially during the rainy monsoon, a few miles behind Pangani town; it exists also amongst the Wazegura, as far as their southern limit, the Gana river. The Wadoe hunt the animal in the vicinity of Shakini, a peak within sight of Zanzibar. Though killed out of Uzaramo, and K'hutu, it is found upon the banks of the Kingani and the Rufiji rivers. The coast people now sell their tusks for thirty to thirty-five dollars' worth of cloth, beads, and wire, per frasilah. In Western Usagara the elephant extends from Maroro to Ugogi. The people, however, being rarely professional hunters, content themselves with keeping a look out for the bodies of animals that have died of thirst, or wounds received elsewhere.

As the chiefs are acquainted with the luxuries of the coast, their demands are fantastic. They will ask, for instance, for a large tusk—the frasilah is not used in inland sales—a copper caldron worth fifteen dollars; a khesi, or fine cloth, costing twenty dollars; and a variable quantity of blue and white cottons: thus, an ivory, weighing perhaps three frasilah, may be obtained for fifty dollars. Ugogo, and its encircling deserts, are peculiarly rich in elephants. The people are eminently hunters, and, as has been remarked, they trap the animals, and in droughty seasons, they find many dead in the jungles. Ivory is somewhat dearer in Ugogo than in Unyamwezi, as caravans rarely visit the coasts. It is generally bartered to return caravans for slaves brought from the interior; of these, five or six represent the value of a large tusk. The ivory of Unyamwezi is collected from the districts of Mgunda Mk'hali, Usukuona, Umanda, Usagozi, and other adjacent regions. When the "Land of the Moon" was first visited by the Arabs, they purchased, it is said, ten frasilah of ivory with one frasilah of the cheap white or blue porcelains. The price is now between thirty and thirty-five dollars per frasilah in cloth, beads, and wire. The Africans, ignoring the frasilah, estimate the value of the tusk by its size and quality; and the Arabs ascertain its exact weight by steelyards. Moreover, they raise the weight of what they purchase to 48lbs., and diminish that which they sell to 23½lbs., calling both by the same name, frasilah. When the Arab wishes to raise an outfit, at Unyanyembe he can always command three gorahs of domestics (locally worth thirty dollars) per frasilah of ivory. Merchants visiting Karagwah, where the ivory is of superior quality, lay in a stock of white, pink, blue, green, and coral beads, and brass armlets, which must be made up at Unyanyembe, to suit the tastes of the people. Cloth is little in demand, for one frasilah of beads and brass wire they purchase about one and a half of ivory. At Khokoro, the price of tusks has greatly risen; a large specimen can scarcely be procured under forty doti of domestics, one frasilah of brass wire, and 100 fundo of coloured beads. The tusks collected in this country are firm, white, and soft, sometimes running six frasilah (210 lbs.) The small quantity collected in Ubena, Urori, and the regions east of the Tanganyika Lake, resembles that of Khokoro. The ivory of Ujiji is collected from the provinces lying around the northern end of the lake, especially from Urundi and Uvira. These tusks have one great defect: though white and smooth, when freshly taken from the animal, they put forth, after a time, a sepid-coloured or dark brown spot, extending like a ring over the surface, which gradually spreads and injures the texture. Such is the "jendai" or "gendai" ivory, well known at Zanzibar; it is apt to flake off outside, and is little prized on account of its lightness. At Ujiji, tusks were cheap but a few years ago, now they fetch an equal weight of porcelain or glass beads, in addition to which the owners—they are generally many—demand from four to eight cloths.

Competition, which amongst the Arabs is usually somewhat unscrupulous, has driven the ivory merchant to regions far west of the Tanganyika, and geography will thrive upon the losses of commerce.

The process of elephant-hunting, the complicated divisions of the spoils, and the mode of transporting tusks to the coast, have freqently been described. A quantity of ivory, as has appeared, is wasted in bracelets, armlets, and other ornaments. This would not be the case were the imports better calculated to suit the tastes of the people. At present the cloth-stuffs are little prized, and the beads are not sufficiently varied for barbarians who, eminently fickle, require change by way of stimulants. The Arabs seek in ivory six qualities; it must be white, heavy, soft, thick—especially at the point gently curved—when too much curved it looses from ten to fourteen per cent., and it must be marked with dark surface-lines, like cracks, running longitudinally towards the point. It is evident from the preceding details that the Arab merchants gain but little beyond a livelihood in plenty and dignity by their expeditions to the interior. An investment of 1,000 dollars rarely yields more than seventy frasilah (2,450 lbs.) Assuming the high price of Zanzibar at an average of fifty dollars per frasilah, the stock would be worth 3,500 dollars, a net profit of 1,050 dollars. Against this, however, must be set off the price of porterage and rations—equal to, at least, five dollars per frasilah—the enormous interest upon the capital, the wastage of outfit, and the risk of loss, which, upon the whole, is excessive. Though time, toil, and sickness, not being matters of money, are rarely taken into consideration, by the Eastern man, they must be set down on the loss side of the account. It is therefore plain that commercial operations on such a scale can be remunerative only to a poor people, and that they can be rendered lucrative to capitalists only by an extension and a developement which, depending solely upon improved conveyance, must be brought about by the energy of Europeans. For long centuries past, and for centuries to come, the Semite and the Hamite have been, and will be, contented with human labour. The first thought which suggests itself to the sons of Japhet is a tramroad from the coast to the lake regions. The subject of ivory, as sold at Zanzibar, is as complicated as that of sugar in Great Britain, or of cotton in America. A detailed treatise would here be out of place, but the following notice may serve to convey an idea of the trade. The merchants at Zanzibar recognise in ivory, the produce of these regions, three several qualities. The best, a white, soft, and large variety, with small "bamboo," is that from the Banadir, Brava, Makdishu, and Marka. A somewhat inferior kind, on account of its hardness, is brought from the countries of Chaga, Umasac, and Nguru. The Wamasai often spoil their tusks by cutting them; for the facility of transport, and like the people of Nguru, and other tribes, they stain the exterior by sticking the tooth in the sooty rafters of their chimneyless huts, with the idea that so treated it will not crack or split in the sun. This red colour, erroneously attributed at Zanzibar to the use of ghee, is removed by the people with blood, or cowdung, mixed with water. Of these varieties, the smaller tusks fetch from forty to fifty dollars; and, when they attain a length of 6½ feet long, fetch 60*l*.

A lot of 47 tusks was seen to fetch 1,500*l*.; the average weight of each was 95 lbs., 80 being considered moderate, and from 70 to 75 lbs. poor. The second quality is that imported from the regions about the Nyasoa Lake, and carried to Kilwa by the Wabisa, the Wahido, the Wangindo, the Wamakua, and other clans. The "Bisha ivory" formerly found its way to theMozambique, but the barbarians have now learned to prefer Zanzibar; and the citizens welcome them, as they sell their stores more cheaply than the Wabisa; though white and soft it is generally small, the full length of a tusk being 7 feet. The price of the "bab kalasi"—scrivelloes or small tusks, under 20 lbs—is from twenty-four to twenty-five dollars, and the value increases at the rate of somewhat less than one dollar per pound. The "bab gugrati, or kashshi," the bab kashi is that intended for the Cutch market.

The tusks must be of middle size, little bent, very bluff at the point, as it is intended for rings and armlets ; the girth must be a short span and three fingers, the bamboo shallow, and not longer than a hand. Ivory fulfilling all these conditions will sell as high as seventy dollars per frasilah,—medium size of 20 to 25 lbs., fetches fifty-six to sixty dollars. The "bab wilaiti," or "foreign sort," is that purchased in European and American markets. The largest size is preferred, which, ranging from 45 to 100 lbs., may be purchased for fifty-two dollars per frasilah. The third and least valued quality is the western ivory, the Gendai, and other varieties imported from Usagara, Uhehe, Urori, Unyamwezi, and its neighbourhood ; the price varies according to size, form, and weight, from forty-five to fifty-six dollars per frasilah. The transport of ivory to the coast, and the profits derived by the maritime settlers, Arab and Indian, have been described. When all fees have been paid, the tusk, guarded against smuggling by the Custom House stamp, is sent to Zanzibar. On the island scrivelloes under 6 lbs. weight, are not registered. According to the late Lieutenant-Colonel Hamerton, the annual average of large tusks is not less than 20,000. The people of the country make the weight range between 17,000 and 25,000 frasilah. The tusk is larger at Zanzibar than elsewhere. At Mozambique, for instance, 60 lbs. would be considered a good average for a lot. Monster tusks are spoken of. Specimens of 5 frasilah are not very rare, and the people have traditions that these wonderful armatures have extended to 227 lbs., and even to 280 lbs. each.

ON THE AMOUNT OF TANNINE IN SOME ASTRINGENT SUBSTANCES, AND THE COMPARATIVE RAPIDITY WITH WHICH THE TANNINE IN SEVERAL OF THESE SUBSTANCES UNDERGOES DECOMPOSITION.

BY WM. J. WONFOR AND S. R. PONTIFEX,

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We have examined the following substances in order to determine their value as tanning materials ; we are indebted to the kindness of Mr. Simmonds, the Editor of this Journal, for the specimens. The tannine was estimated in a manner similar to that pursued by our late fellow-students, Messrs. Mulligan and Dowling ; the process is a modification of that first proposed by Mr. Warrington, and as many persons to whom it is of interest may probably be unacquainted with the details of the operation, we will proceed to describe it.

In the manufacture of leather, the hides, after being softened, are, as is well known, steeped in a decoction of bark, by which means the gelatine and fibrine become chemically united with tannic acid, and the peculiar properties of leather are conferred on the hide,—advantage is taken of this fact in Warrington's process,—an aqueous solution of gelatine being used as the precipitant of the tannic acid extracted from the bark by water.

The method is volumetric, and very easy of execution. To prepare the test solution, 30 grs. of gelatine (the long fibrous isinglass is found to be very pure and pretty uniform) are dissolved in about 8,000 grs. of hot water, boiled for ten minutes, and allowed to cool ; 10 grs. of powdered alum are added, the solution is agitated and allowed to stand until it has become clear, and then made up to 10,000 grs. This solution cannot be used with advantage if kept longer than two days, as the gelatine is very liable to decompose.

The solution is standardized by ascertaining the quantity required to precipitate a known weight of pure tannic acid ; we have found about 5 grs to be the most convenient quantity of the tannine to employ.

The addition of alum to the gelatine solution was proposed by Müller ; it insures a more speedy and perfect separation of the precipitated tannate of gelatine, and without the use of this precaution, Mulligan and Dowling found it impossible to obtain even an approximate estimate of the amount of tannine in the bark solutions of the tan-yards.

The point at which all the tannic acid was completely precipitated was ascertained in the following manner, which is a modification of that proposed by Warrington :—A glass tube, about 10 inches in length and $\frac{3}{8}$ in internal diameter, is selected (a piece of combustion tube is very convenient) and closed at one end with a firm plug of fine washed sponge ; the solution is allowed to stand for a few moments in order to give the precipitate time to settle down, a portion of the comparatively clear supernatant liquid is then poured into the glass tube, and filtered into a test-tube, to this a drop or two of the gelatine solution is added to see whether there be any precipitate or not ; and great accuracy can be obtained by comparing this with a similar tube containing an equal quantity of distilled water, to which a similar quantity of gelatine solution is added (of course if there be still a precipitate, the solution removed, and the water must be returned to the vessel, which may be a Phillips, or any other tall glass). This comparison will be found very convenient in the examination of the solutions obtained from substances rich in tannine, where only a small quantity of the material has been employed, and the solution becomes, from the difficulty of extraction, necessarily dilute, any little inaccuracy becoming then much magnified from the high multiplication required in calculating out the percentages. We have adopted this down-ward method of filtration in preference to the upward, as a clear filtrate is more easily obtained, and the sponge does not require such frequent washing; in the latter case, the pores becoming soon choked up with particles of the precipitate.

We have noted the colour of the precipitates with sesqui-chloride of iron; this test has been found by Dr. Stenhouse (Proc. R. Soc. London, No. 46, vol. ii.) to be a pretty accurate indication of the variety of tannic acid which may be present—*i.e.*, whether it belongs to the class of conjugate sugar compounds (glucosides) or not. We had originally intended, and, indeed, commenced a further investigation into the nature of the tannic acid present, but as we considered this would have no practical advantage, we relinquished this part of the investigation.

It is a well-known fact that pure tannine cannot be kept unchanged in a state of solution if exposed to the atmosphere; it attracts oxygen from the air, and is decomposed into gallic and carbonic acids. As the researches of Stenhouse, and other chemists, have rendered it probable that there are several varieties of tannine, it is not unlikely that some of these will be less stable than others, and that even the decomposition of the same tannine may be accelerated or retarded by some principles existing along with it in the particular substance from which it is derived.

We are not aware that any experiments have been made as to the comparative rapidity with which the tannine in different substances decomposes when in a state of solution, and the determination of this point appears to us to be scarcely inferior in point of practical importance to the estimation of the quantity of tannine itself. We have, therefore, determined the total quantity of tannine in the different astringent substances we examined, and also the comparative rapidity with which the tannine contained in them undergoes decomposition. In order to render the investigation on this latter point as complete as possible, we have determined not only the amount of tannine which decomposes in the infusion of the substances, but we thought it important to ascertain whether the decomposition was influenced in any way by the insoluble substances which remained behind in the exhausted residue. Our experiments, which were necessarily made on the small scale, were conducted in the following manner:—

We took two portions of several of the solutions, as prepared for analysis, and left them in beakers covered with blotting paper, for a week, exposed to the action of the air, in a room having a mean temperature of about 60° Fah. One portion was placed on the bark residue remaining undissolved, the other was left by itself. At the end of a week the solution became slightly ropy; the amount of alteration in the quantity of tannine will be seen below; if the temperature was lower than 50° Fah., the liquid became much more ropy and mildewed, and in a much shorter time to such an extent, indeed, that we were unable to precipitate the tannine. The annexed experiments show that the difference in the amount of tannine left in the two solutions at the end of a week, is very small, and in one case only, that of Myrobalans, has the solution digested on the residue lost most. Our experiments prove that there *are* substances present in the solutions which influence the decomposition of the tannine, and that in different solutions it decomposes with very different degrees of rapidity. As an example, *Terminalia angustifolia* lost 17·46 parts of tannine out of 40·66; now if the action was due merely to atmospheric influence, we should naturally expect that, supposing no other principle was at work, the quantity lost under similar circumstances by different solutions, would be in direct proportion to this, but we do not find this to be the case; for in order to agree with it, Valonia should lose 16·31 parts of tannine out of 37·98, but it only lost 5·28. Japan galls, again, containing 76·59 per cent. of tannine, only lost 9·1 per cent, or a little more than a quarter of that lost by *T. angustifolia.* It is evident that this principle, whatever it is, is soluble, for the difference in the loss between the solution standing by itself and that on the residue is so small as, in a case like this, to be unimportant.

To extract the tannine, the barks were cut into small pieces, and were treated in the following manner:—

About 2,000 grs. of cold water were poured on the weighed quantity, and allowed to digest for about two hours, frequently stirring; in the meantime, the clear solution was poured off, and the residue treated with a similar quantity of water for about three hours; this solution was decanted, and 3,000 grs. of water poured on the bark and left all night; this solution was taken off in the morning, and 2,000 grains more of water poured on, at the end of an hour this was mixed with the solution already obtained, and made up to 10,000 grs. To make sure of extracting all the tannine, 5,000 grs. of water were allowed to remain on the residue for twenty-four hours, and then about half an ounce of the liquid was tested with the gelatine solution; if no precipitate occurred, it was thrown away, but if there was any, it was estimated, and the product added to the first quantity.

In the gall nuts, which contain a very large quantity of tannic acid, much difficulty was experienced in exhausting them; the ether process, as recommended for the preparation of pure tannic acid, was tried, but not found to answer. We consider the following to be the best plan:—Take about 10 grs. of the finely pulverised galls, treat them with warm water, allow the infusion to stand for some time, filter off through linen, carefully wash the residue back into the beaker; continue these successive digestions until a few drops of the filtrate leave a very slight residue on evaporation; lastly, boil the residue with water to make sure of extracting the last traces of tannine, and make up the solution to any convenient standard.

We shall now proceed, in the following pages, to give in detail the results of our various experiments:

TOWAI BARK, FROM NEW ZEALAND.

100 *grains, exhausted with cold water, and the solution made up to* 10,000 *grains.*

I.—2,000 grains of the solution required 180° gel. sol. (1,255° = 5 grains Tannine) = ·717 grains Tannine = 3·585 per cent.
II.—2,000 " " " 200° " " " = ·796 " = 3·980 "

Tannine in 100 *parts of Bark, mean* - - - 3·78 "

LUGAR BARK, FROM BORNEO.

100 *grains, exhausted as before, and the solution made up to* 10,000 *grains.*

I.—2,000 grains of the solution required 108° gel. sol. (1,255° = 5 grains Tannine) = } 430 grains Tannine = 2·15 per cent.
II.—2,000 " " " 110° " " "

Tannine in 100 *parts, mean* - - - - - 2·15 "

Chloroxylum excelsum BARK FROM CAPE COLONY.

100 *grains treated as before, and the solution made up to* 10,000 *grains.*

I.—2,000 grains of the solution required 330° gel. sol. (1,255° = 5 grains Tannine) = 1·315 grains Tannine = 6·573 per cent.
II.—2,000 " " " 335° " " " = 1·334 " = 6·670 "

Tannine in 100 *parts, mean* - - - - - - 6·621 "

MANGROVE BARK OF BORNEO (*Rhizophora sp.*)

100 *grains of Bark, treated as before, and the solution made up to* 10,000 *grains.*

I.—2,000 grains of the solution required 90° gel. sol (1,315° = 5 grains Tannine) = ·3422 grains Tannine = 1·711 per cent.
II.—4,000 " " " 190° " " " = 0·722 " = 1·805 "

Tannine in 100 *parts, mean* - - - - - 1·758 "

KIRRITOCHEE, OR DRUPES OF *Terminalia angustifolia*, FROM INDIA.

50 *grains, infused in cold water, and the solution made up to* 15,000 *grains.*

I.—2,000 grains required 750° gel. sol. (1,540 = 5 grains Tannine) = 2·435 grains Tannine = 36·524 per cent.
II.—2,000 " " 740° " " " = 2·405 " = 36·037 "

On testing the residue, it was found still to contain a little tannine. This was extracted by water, and the solution so obtained made up to 10,000 grains.

I.—2,000 grains of this solution required 140° gel. sol. (1,540° = 5 grains Tannine) = ·454 = 4·54 per cent.
II.—2,000 „ „ „ 130° „ „ „ = ·422 = 4·22 „

TOTAL - - - - { I.—36·524 + 4·54 = 41·064
II.—36·037 + 4·22 = 40·257 }

Tannine in 100 *parts Bark, mean* - - - 40·660 „

VALONIA, THE ACORN CUPS OF THE *Quercus Ægilops.*

50 *grains, treated as before, and the solution made up to* 15,000 *grains.*

I.—2,000 grains of the solution required 780° gel. sol. (1,540° = 5 grains Tannine) = } 2·532 grains Tannine = 37·98 per cent.
II.—2,000 „ „ „ 780° „ „ „ = }

Tannine in 100 *parts, mean* - - - - - - - - 37·98 „

MYROBALANS (*Terminalia Chebula*). For description of these, see TECHNOLOGIST, vol. ii., p. 185.

50 *grains, exhausted with cold water, and the solution made up to* 20,000 *grains.*

I.—3,000 grains of the solution required 480° gel. sol. (1,742° = 5 grains Tannine) = 1·372 grains Tannine = 18·294 per cent.
II.—3,000 „ „ 475° „ „ , = 1·362 „ = 18·166 „

Tannine in 100 *parts, mean* - - - - - - - 18·230 „

BEDDA NUTS (*Terminalia Bellerica*).

100 *grains, treated with warm water, and made up to* 20,000 *grains.*

I.—3,000 grains of the solution required 470° gel. sol. (1,742° = 5 grains Tannine) = 1·349 grains Tannine = 8·993 per cent.
II.—3,000 „ „ „ 480° „ „ „ = 1·377 „ = 9·179 „

Tannine in 100 *parts, mean* - - - - - - - 9·086 „

CHINA GALLS, OR WOO-PEI-TZE, formed on the *Rhus semialata* of Murray, and *Distylium racemosum* of Zuccarini.
(For Description of these and the succeeding Galls, see TECHNOLOGIST, vol. i. p. 186.)

10 grains were treated as before stated, and the solution made up to 20,000 grains.

I.—4,000 grains of the solution required 440° gel. sol. (1,980° = 5 grains Tannine) = 1·1 grains Tannine = 55·055 per cent.
II.—3,000 „ „ „ 330° „ „ „ = 0·834 „ = 55·586 „

Tannine in 100 parts, mean - - - - - - - 55·568 „

JAPAN GALLS.

10 grains treated similarly to the Chinese, and the solution made up to 20,000 grains.

I.—3,000 grains of the solution required 460° gel. sol. (1,980° = 5 grains Tannine) = 1·16 grains Tannine = 77·440 per cent.
II.—3,000 „ „ „ 450° „ „ „ = 1·136 „ = 75·750 „

Tannine in 100 parts, mean - - - - - - - 76·590 „

TAMARISK GALLS.

10 grains treated like the two preceding, and the solution made up to 20,000 grains.

I.—3,000 grains of the solution required 190° gel. sol. (2,435° = 5 grains Tannine } = ·39 grains Tannine = 26·00 per cent.
II.—3,000 „ „ „ 190° „ „ „ }

Tannine in 100 parts, mean - - - - - - - 26·00 „

The following are the solutions that were allowed to rest for a week, the one marked A. standing by itself, that marked B on the residue.

Terminalia angustifolia.

6,000 grains, containing { 4,000 of the 15,000 grain solution / 2,000 „ 10,000 „ „ } were employed.

A.—2,000 grains of the solution required
I.—220° gel. sol. (1,110° 5 grains Tannine) = 1·00 } grains Tannine = 3·00 grains Tannine in 6,000 grains solution.
II.—220° „ „ „ = 1·00 }

B.—2,000 grains of the solution required
I.—230° gel. sol. (1,110° = 5 grains Tannine) 1·03 } grains Tannine = 3·09 in 6,000 grains solution.
II.—230° „ „ „ = 1·03 }

6,000 grains, before standing, contained - - 5·258 grains Tannine.

6,000 „ after „ „ - - { A.—3·000 „ „ / B.—3·090 „ „ }

Showing a loss of in { A.—2·258 grains Tannine / B.—2·168 „ „ } = { A.—17·46 / B.—16·80 } on 100 parts Bark.

VALONIA (*Cupules of Quercus Ægilops*).

4,000 *grains of the solution were put aside for a week.*

A.—2,000 grains of the solution required

I.—480° gel. sol. (1,110° = 5 grains Tannine) = 2·18 grains Tannine.

II.—480° „ „ „ = 2·18 „

B.—2,000 grains of the solution required

I.—500° gel. sol. (1,110° = 5 grains Tannine) = 2·254 grains Tannine.

II.—500° „ „ „ = 2·254 „

2,000 grains, before standing, contained - - - - - 2·532 grains Tannine.

2,000 „ after „ „ - - - - - - - { A.—2·280 „ „ / B.—2·254 „ „ }

Showing a loss of in { A.—·352 / B.—·278 } = { A.—5·28 / B.—4.17 } on 100 parts Valonia.

BEDDA NUTS.

6,000 *grains of the* 20,000 *solution were put aside.*

A.—2,000 grains of the solution at the end of a week required 300 grains gel. sol. (1,740° = 5 grains Tannine) = ·862 grains Tannine.
B.—2,000 „ „ „ 310 „ „ „ „ = ·89 „ „

2,000 grains, before standing, contained - - ·900 grains Tannine.

2,000 „ after „ „ - - { A.—·862 „ „ / B.—·890 „ „ }

Showing loss of in { A.—·038 / B.—·010 } = { A.—·384 / B.—·100 } on 100 parts of the Nuts.

MYROBALANS.

6,000 *grains of the* 20,000 *solution were put to stand.*

A.—2,000 grains required 310° gel. sol (1,740° = 5 grains Tannine) = ·89
B.—2,000 „ „ 300° „ „ „ - - = ·862

2,000 grains, before standing, contained - - ·912 grains Tannine.
2,000 „ after „ „ - - { A.—·890 „ „ / B.—·862 „ „ }
Showing a loss of in { A.—·022 / B.—·050 } = { A.—0·44 / B.—1·00 } on 100 parts of Myrobalans.

CHINA GALLS.

The quantity originally used being so small in these, also in the Japan and Tamarisk, no solution was put on the residue.

A.—4,000 grains of the solution required 500° gel. sol. (2,435° = 5 grains Tannine) = 1·027 grains Tannine.
2,000 grains, before standing, contained - - - 1·100 „ „
Loss - - - - 084 = 4·2 on 100 parts of Galls.

JAPAN GALLS.

A.—3,000 grains of the solution required 500° gel. sol. (2,435° = grains Tannine) = 1·027 grains Tannine.
3,000 grains, before standing, contained - - 1·166 „ „
Loss - - - - ·139 = 9·1 on 100 parts of Galls.

TAMARISK GALLS.

A.—3,000 grains required 180° gel. sol. (1,474 = 5 grains Tannine) = ·372 grains Tannine.
3,000 grains, before standing, contained ·390 „
Loss - - - - „ ·018 „ = 1·25 on 100 parts of Galls.

We shall now state the colours of the precipitates with sesquichloride of iron :

Bark and Galls, &c., which give Bluish Black Precipitates.	Barks which give Green Precipitates.
Lugar Bark.	Mangrove Bark.
Myrobalans.	Chloroxylum excelsum.
Terminalia angustifolia.	Towai.
China Galls.	
Japan Galls.	

We may remark that when a large amount of colouring matter is present, it will be found difficult to distinguish the colour of the precipitate, we find it advisable to have the solution pretty dilute, and partly precipitate the tannine with ordinary gelatine solution, the precipitate in falling will act as a decolorizer, and render the experiment quite easy to perform.

We append our results, arranged in a tabular form, for convenience of reference :—

Name.	Quantity of Tannine in 100 parts.	Loss on the amount of Tannine in 100 pts. after standing a week.	
		In Solution standing by itself.	In Solution digesting on undissolved Residue.
Towai Bark	3.780	...	...
Lugar Bark	2.150	...	...
Chloroxylum excelsum Bark	6.621	...	...
Mangrove Bark	1.758	..	...
Terminalia angustifolia .	40.660	17.460	16.80
Myrobalans	18.230	.440	1.00
Valonia	37.980	5.280	4.17
Bedda Nuts	9.086	.384	.10
China Galls	55.568	4.200	...
Japan Galls	76.590	9.100	...
Tamarisk Galls	26.000	1.250	...

The investigation was conducted in the Laboratory of the Museum of Irish Industry, under the direction of Mr. Galloway.

QUANTITY OF OIL FURNISHED BY THE SEEDS OF VARIOUS FOREST-TREES.

BY M. R. WAGNER.

I have conducted a series of experiments to ascertain the quantity of oil contained in the seeds of various forest-trees. These seeds were passed through an oil-press, mixed with sand or powdered quartz, dried to 100°, and drained of a little of the bi-sulphide of carbon; afterwards, the remaining sulphide of carbon was separated by exposure to the air, and elevating the temperature in a water-bath. The following were the results obtained :—

Beech-nuts, or mast, yielded the following percentages of oil :—

Seeds collected in 1857	23.2
„ „ 1858	25.0
„ „ 1859 Specimen *a*	19.3
„ *b*	22.6
„ *c*	18.9

Hazel-nuts or filberts (*Corylus avellana*) carefully divested of their shells—nuts of 1858 . .	55.0
„ „ 1859 Spec. *a*	52.2
„ *b*	54.0
Seeds of the small-leaved lime-tree (*Tilia parviflora*)	41.8
„ „	30.2
Seeds of the Scotch fir (*Pinus sylvestris*) . .	20.3
„ „ . . .	23.4
„ Common Silver fir (*Picea pectinata*, or *Pinus picea*)	17.8
Seeds of the Swiss Stone pine (*Pinus Cembra*) not shelled	29.2
„ shelled	36.5
Seeds of the Weymouth Pine (*Pinus Strobus*) shelled	29.8
Seeds of the Norway spruce-fir (*Abies excelsa*, or *Pinus Abies*)	20.6
Seeds of the *Pinus Larix*	17.8
„ Dwarf or Mountain Pine (*Pinus pumilio*)	17.5
Seeds of the Hemlock Spruce (*Abies Canadensis*) Specimen *a*	11.4
„ *b*	12.9
Seeds of the *Pinus maritima* „ *a*	22.5
„ *b*	25.0

THE FRUIT TREES OF BRAZIL.

BY DR. HEUSSER AND G. CLARAZ.

In Brazil all tropical fruits succeed very well, but, in general, this culture is not sufficiently attended to. Among those seldom met with are the Mammee Apple, or Wild Apricot of South America (*Mammea americana*), the Carambola (a species of Oxalid) the fruit of which has an acid taste somewhat resembling that of an apple, the Genipap (*Genipa braziliensis*), and the cocoa-nut. Of more frequent occurrence are the Caja (*Anacardium occidentale*), the Mango (*Mangifera indica*), Tamarind (*Tamarindus indica*), and Papaw (*Carica papaya*).

Some varieties of Mango have fruits as big as an infant's head, ovate, with a golden skin, speckled with carmine, and a greengage flavour. It must, however, be admitted, that on tasting this delicious fruit for the first time, a slight turpentine flavour is experienced. Cambuca (*Eugenia Cambuca*), Pitanga (*Eugenia Michelli*), an acidulated fruit resembling a small tomato, Grumixama (*Eugenia Grumixama*), Jambos (*Jambos vulgaris*), Jabuticaba (*Eugenia cauliflora*), Avocado pear (*Persea gratissima*), Ameixas da India (*Mespilus japonica*), Ameixas da Terra (*Ximenia americana*), and the Jack (*Artocarpus integrifolia*) ; the true Bread-Fruit tree (*Artocarpus incisa*), is more rare, owing to its being difficult of propagation. Its fruit is usually cooked by roasting in the ashes. Among the fruits which are found in the greatest abundance, are the varieties and sub-varieties of the *Citrus aurantium* ; the principal are the Laranjas da terra or Bitter Oranges ; the Selatas which are the largest ; the Laranjas da China, China oranges ; and the small and large Tanjerines, the dry and the Embigudas oranges. Of the varieties of *Citrus medica*, the most generally met with are the Sour Lemon, the Cidreiro or Cidra, the Zamboeiro, and the Lime. The Pine-apple is also very common ; but the most abundant of all is the Banana, from the two species, *Musa paradisiaca*, or Banana St. Thomas and *Musa sapientum*, or Banana da terra. There exists a vast number of varieties and sub-varieties of both, differing in size and form, colour and odour. The Banana is, probably, the most valuable of all plants to the inhabitants of the tropics. Its fruit, when ripe, scarcely reddens litmus paper ; it is sugary, and contains a tolerable amount of starch, as may easily be seen by the use of iodine and the microscope. The Banana has the advantage of bearing throughout the year, even if the climate is not very favourable. When once planted, it propagates itself for many years, and requires no further care. On the contrary, it can hardly be extirpated. In confirmation of this we have heard a remarkable anecdote. A Swiss, M. Colin Schuler, bought a house at Rio Janeiro about 15 years ago with the purpose of re-building it. In the court yard grew some Bananas, which were grubbed up, and the soil having been levelled, rooms were built over it which had asphalte floors. Three months afterwards the asphalte began to swell up ; the swelling increased every day, till at last the asphalte rent in several places, and a young and vigorous banana made its appearance. The banana is also cultivated by the wild tribes, who have made some of the banana plantations found in the midst of the forests and wild places. Others have been made by the Maroons, or fugitive slaves, who lived on the borders of the forest, in order to escape the persecution of their masters. The opossums, and likewise the bats, are very fond of this fruit ; the former get it on the trees as they do on the oranges. If only a few bananas are in a room, vast numbers of bats come there in the evening. The leaves are considered very injurious to animals.

It is generally admitted, that where the culture of the vine ceases that of the date commences. Both are found, however, at Rio de Janeiro, and elsewhere throughout the province in the gardens of foreign residents. Firm thick-skinned grapes are the sorts cultivated, as they better withstand the influence of the climate, which is apt to cause the berries to rot ; their flavour, however, is pretty good. The date suffers from the same cause as the grape, the fruit often rotting on the trees before ripening. Dr. Teuscher attributes this to the dampness of the climate. The berries which rot in a bunch of grapes are always those on which condensed moisture has lodged.

If the excess of moisture is the principal obstacle to the culture of the vine in the forest regions, this drawback does not exist in the *campos* or open country, where a much dried climate prevails. With zeal and perseverance the province of Minas would certainly furnish a supply of better wines than those of Lisbon, which are generally adulterated. The general opinion that the trials of wine-making have not been successful proves nothing; for the Brazilians, accustomed to drink wines that have been doctored, and containing a large proportion of brandy, are bad judges of the quality and bouquet of a good pure wine. We have often seen them prefer a bad Portuguese wine to good Constantia, Sauterne, or Madeira.

In the meantime, till the culture of the vine improves and extends (which may not take place during this generation, perhaps never by the present race), the manufacture of wines from other fruits is of the greatest importance. In this also the initiative has been taken by strangers, and but few Brazilians have followed their example. It was only on the appearance of the vine disease that chemists seriously studied wine-making, and the manufacture of artificial wines; the latter branch is still in its infancy. If the use of strong or heady wines is suitable to a northern constitution, it is certain that light, aromatic, or sparkling wines are salutary to the inhabitant of the tropics. The carbonic acid facilitates digestion, and the volatile oils and compound ethers act as stimulants, which explains the preference given to drinks of this description, If it is true that the skin of quinces contains œnanthic ether, the quince, from its growing here, would afford the means of imitating in artificial wines the flavour of the natural grape wine. We have tasted at the French Vice Consul's at Ouro-Preto, wine made from the pine-apple, from the jabuticaba (*Eugenia cauliflora*), and from the *Passiflora quadrangularis*, which many have taken for Spanish wines. He also made wines from the jambos, and from the pichiricas or pingiricas (a black fruit of some dwarf Melastomaceous plant) oranges, aracas, &c. He ferments the bruised fruits with a little water, and when the brisk fermentation is over, he strains the liquid through a cloth, and adds 8 lbs. of sugar per barrel, and a fresh fermentation commences; when this ceases, he adds eight bottles of brandy or spirit per barrel; the barrel contains from 26 to 28 bottles. [According to this proportion the wine contains more than one-third part of brandy.] The liquid having settled, it is strained, and when clear it is decanted and bottled. As all the fruits employed yield likewise spirit on being fermented and distilled, the corresponding spirit is preferred for each kind of wine. Coffee berries and bananas likewise afford an excellent spirit. M. Dietrich, of Cantagallo, makes an effervescent or sparkling drink, which he flavours with different fruits, especially the pine-apple. By fermenting tamarinds with a portion of sugar, a good wine, rich in tannin, may be obtained. The caja (*Anacardium occidentale*), owing to the quantity of tannin which it contains, likewise furnishes an excellent wine. Dr. Teuscher is trying to make a light wine similar to Sauterne. The juice of oranges is usually 7° to 7½° Beaumé; by adding 2 ounces of sugar per bottle, we get 10° Beaumé; and by adding

4 ounces, 13°. It is well to add some powdered gall-nut. The first fermentation lasts for about 6 weeks ; at the end of this time it is strained and kept in large jars for about 6 months. Fermentation having then ceased the liquor is bottled off. In this way Dr. Teuscher has obtained very satisfactory results.

MANUFACTURE OF INK.

In the West Indies common black ink is easily made. In the place of galls, many substances abounding in tannin are used, such as the bark of the guava *(Psidium)*, the Mangrove plant, the sap of the cocoa-nut palm, and plantain, and the seed of the avocado pear *(Persea gratissima)*. The mode of proceeding with all these substances is identical ; I shall, therefore, give the recipe as made with guava bark. Take of bark ½ ounce by weight, water, 8 ounces by measure. Boil to one half, set aside to cool, and filter, then take of sulphate of iron, 1 drachm ; sugar, 1 drachm ; gum arabic, 3 drachms. Dissolve these in a sufficient quantity of water, and add to the former solution, whereupon an ink will be found not inferior in quality to many English-made inks. In the preparation of the plantain fibre, the means adopted for depriving it of its tannin are either fermentation or crushing. Crushing is the best, because it is more economical and profitable. By crushing, the tan liquor can be preserved, and being boiled down with a proper proportion of logwood, and the liquor thus obtained filtered, a very productive article for ink manufacture may be obtained, thus enhancing the value of a plantain walk by 50 or 100 per cent.

A species of palm indigenous to the Colony, and growing in abundance in Berbice, bears a berry that affords a juice, known locally under the name of "Croatie ink," which is stated by Dr. H. A. Koch to be in every respect superior to any ink now in use. A species of Mimosa, which is found in Chili, called Espino, furnishes black seeds in pods, which make excellent writing ink by steeping in water, bruised and mixed with copperas, and exposed to the sun. The same shrub grows abundantly in the Mahrattas (Graham's Chili, appendix, p. 502). In Chili there is also a sort of resinous bean produced by a plant called Alagoroba or Tara, which, when dried, pounded, and infused with copperas, makes a good drying ink.

Red ink is usually obtained from a strong decoction of Brazil-wood (*Cæsalpinia Braziliensis*), with as much alum as it can dissolve and a little gum. The alum precipitates the colouring in the form of lake, while the gum holds the so-formed lake in suspension. A very good substitute is found for the Brazil-wood in the colouring matter of the fruit of the prickly pear (*Opuntia vulgaris* or *Cactus opuntia*). When ripe, the fruit contains a beautiful carmine colouring matter, which is easily obtained by expression, and which is frequently used by West India cooks as a colouring for various tarts. In order to convert this into a permanent red ink, nothing more is necessary than the addition of a little gum and a weak infusion of logwood, in order to enrich and deepen the colour. A beautiful red ink may be obtained from the berry of the spinach.

An ink perfectly black, limpid, and indelible, has yet to be discovered. Nut-galls are the only really valuable ingredient in modern inks. The permanence of the ink depends upon the proper quantity of gallic acid extracted from the galls being used in its preparation. But galls are expensive, and ink-makers are apt to increase their profits by substituting logwood, which gives a large amount of colouring matter at a small cost.

Much of the ink now used fast fades away, and this matter of permanent ink is attracting general attention in Europe and America, especially in the government offices and courts, so as to preserve legible records for future generations.

ON THE CULTIVATION OF COTTON IN BRITISH GUIANA.

BY SIR W. H. HOLMES,

Special Commissioner to the Exhibitions of 1855 and 1862.

I need not trouble the reader with any attempt at a scientific disquisition on the "Gossypium," as botanists call the cotton plant. Its varieties are many, differing from each other in the length of the wool or staple, and in the appearance of the seed. My opinion is, that much, if not everything, in the production of good cotton, depends on suitable soil and climate. You may plant the finest long staple black seed Sea Island cotton, but if the soil and climate are not favourable, it will gradually degenerate into a short-woolled green-seed variety. So that, although cotton grows all over the globe, along that very extensive belt which reaches from forty degrees north to forty degrees south of the equator, it by no means follows that every place within those latitudes will produce a good article. Sea air, salt lands, and a combination of heat and moisture, seem absolutely requisite to form a good cotton-growing country. All these qualifications Demerara possesses in a remarkable degree, and her cotton formerly ranked only second to the Sea-island variety, and was of so rare and valuable a description that it was scarcely ever spun alone, but was mixed up with the inferior short staple cottons of India and other countries, to give them body or length of fibre.

As a practical account of the operations on a cotton estate may be useful, and not altogether uninteresting, I will tell you how we grew it in Demerara, five-and-twenty years ago. Our lands, like those of most other estates in the Colony, are perfectly flat, and about a couple of feet below high water-mark of the Atlantic, by which they are bordered, and against which they are of course embanked. When a new field of cotton was to be planted, it was customary "to warp," or to sink the land under sea-water, which could be done in a few minutes, by making a small cut in the sea-dam, or by opening the sluices as the tide rose. After a time, as soon as the rich alluvial deposit with which our sea-water is charged, had settled down on the land, the water was allowed to run off, and another supply taken in. This was repeated occasionally ; so that, at the end of three or four months, when the water was finally drawn off, not only were all the weeds and underwood destroyed, but there was a fine rich loam left on the land to the depth of two or three inches, and fit to grow anything.

The drains and water-courses having been cleared out, the next thing was to sow the seed. This was usually done early in April, so as to get the showers of that month on the young plants, and to have them sufficiently strong to bear the rains in June. The way we planted was this: a piece of rope, about one hundred feet long was laid down at one end of the field ; along this rope, at regular distances of six feet, small bits of coloured rag were tied, and at each piece of rag stood a woman with her apron full of cotton seed and armed with a hoe. Two men then each took an end of the rope, and stretching it across the field, marched forward exactly six feet, and then stopped, when the women, each opposite her own rag, made one dig at the ground with her hoe, dropped in about a dozen seeds, and lightly covered them over. The two men went on with their line six feet further, the women followed—and so they planted away till the field was completed—the result being, that when the plants came up, they were six feet apart from each other either way, and as regularly and beautifully set as if they had been put in by rule and square. They grew very fast, and in about three weeks or a month were five or six inches high, and thickly clustered together, as nearly every seed had come up.

The women then went back again and "singled" the young plants—that is they pulled up and threw away all except two or three of the strongest-looking. In another month these were twelve to eighteen inches high, when the singling process was repeated ; but this time only one plant was allowed to remain in the spot where it was first planted. They were carefully moulded up and kept clear of weeds, and all bottom shoots or "water sprouts" were broken off till the end of July, when the shrubs, being about five feet high, became covered with bright yellow blossoms, not unlike those of the hollyhock. After this, it was not allowable to go through the fields for any purpose, as the buds and blossoms might be broken off. The cotton flower soon faded, and was succeeded by the pod or fruit, about the size of a small apricot, and somewhat pointed in shape. By the middle of September, the fine dry weather had ripened these, and the shell burst into three parts, from which hung the white wool. This it was necessary to gather at once, before even a shower had wet it, or before the wind had blown it out, and scattered it over the ground. This "blow of cotton," which was called the first crop, continued in succession till Christmas—the harvest time—when everybody turned out to gather the crop. You might ride up to the manager's house and call long and loud, without receiving an answer, or seeing a single soul. The groom was picking cotton, so was the cook, while the butler, who, on these occasions only, condescended to go into the field, picked in company with the housemaid, and helped her to bring home a well-filled bag. A little before sunset, the people came into the logies or store-houses, where each person's cotton was weighed. The men were generally bad and clumsy pickers, and brought only 30 or 40 lbs., but the more quick fingered women, particularly those who could take two or three children into the field to help them, came bending along under the weight of 100 lbs. or more of cotton.

I may here mention that cotton, as it comes from the tree, is calculated to give one third its weight in merchantable cotton. That is, 100 lbs. of cotton will yield 33⅓ lbs. of clean cotton, after all the seeds have been separated from it. Close to the logies or store-houses, were the droghies or drying-places, formed of tiles laid in the ground, on which the cotton was exposed to the sun. This was done by children ; and it took three or four days thoroughly to dry a batch of cotton, the point of perfection being when the seed was dry enough to crack crisply between the teeth. The cotton might then be safely stowed away to wait the "gin men," but it would heat and spoil, with the chances of spontaneous combustion.

Up to this point, the work of the estate might have been carried on entirely by women and children. But now comes the hard work—viz., the separating the seed from the cotton, or "ginning," as it is called. The "gin-house" was a large shed open at the sides ; and, on entering it, the visitor saw what he would probably imagine to be many knife-grinders working away at their wheels, while they turned them with their feet—for so was the foot-gin worked. Only in place of the grindstone there were two rollers about eighteen inches long, and as thick as an office ruler turning in opposite directions, one above the other, and almost touching,—one being made of brass, and the other of a peculiarly tough wood. In front of these rollers was a small feeding-board, at which the gin-man stood, and from which he fed the rollers with cotton, all the time causing them to turn at a quick, steady rate, by pressing with the foot on the treddle of his gin. The cotton-wool passed through the rollers into a bag, and the seed, which was too large to pass, went its way through a slit in the feeding-board. A good gin-man finished about 50 lbs. of clean cotton a day—that is, 150 lbs. of seed-cotton. But the cotton was not even yet ready for shipping, for a few seeds might have been crushed by the rollers in the process of ginning, and not only mingled little particles of their black husks with the wool, but also stained it with the oil which they contained. A few dry leaves also might have escaped the sharp eyes of the children when drying the cotton, and these crushed by the rollers, sullied the otherwise virgin purity of the wool. It was, therefore, handed over to women, about 60 lbs. to each, who picked out every particle of impurity before giving it over to be "baled." Very much of the market value of the cotton depends on this hand-cleaning. It is light, easy work, and may be done in a drawing-room, and I daresay would give employment to hundreds of women and children, who are now unaccustomed to out-door work.

The cotton was now packed by means of a press and a powerful screw into bales about thirty inches square, each containing 330 lbs., so tight that they might be floated out to boats in the offing without being penetrated by the water. Having got our cotton ready for market, I must now go back to the field, where we kept all hands busy picking the first crop which lasted till Christmas, and sometimes later. In January, showers generally fell and produced a new bloom on the trees; in February and March the second crop was gathered. This second picking, indeed, might have been in some degree continued all the year round; but it was necessary to prune the trees down early in April, so as to prepare them for the crop in the September following. This was very rapidly done, a couple of men to one acre, armed with sharp billhooks or cutlasses, trimmed down everything to about breast height, and left the field as level as a billiard-table. This process of pruning might be continued annually for as many years as you liked, for the trees never died; but after five or six years they got "woody;" and it was then always well to plant anew.

It is not easy to give a very exact information on an important point in cotton-growing—viz., the yield per acre. One year we got 600 lbs. of cleaned merchantable cotton from every acre in cultivation, on an estate of 500 acres; but this was considered something good. I do not think in the worst years the yield ever fell below 200 lbs. an acre; and, perhaps, it would be safe to estimate the average yield of an acre of cotton in Demerara at 900 lbs. of seed cotton, or 300 lbs. of clean cotton. This was the way things were done five-and-twenty years ago; but should cotton cultivation be re-introduced, of course it would be accompanied by steam and hand-gear, and all the other appliances which modern science has devised to save human labour. With the aid of the hand-gin, the fibre might be brought to market without the labour of a single able-bodied man. No crop could be so easily raised and prepared by our cottage farmers, for every member of a household, down to children of eight or nine years of age, might perform some part of the process.

The cultivation of cotton in British Guiana is no novel experiment; for, at the commencement of the present century, the whole cultivated surface of the colony from end to end was a large cotton field. In 1803, the export of Demerara and Essequibo alone (Berbice being then a separate colony) amounted to 46,000 bales, weighing about 350 lbs. each. The quality was celebrated above all others. Considering the advantages of the salt alluvium which composes the soil, the perpetual source of fertility in "warping" which the cotton-planters enjoyed, and that the plant is indigenous and perennial in Guiana; it only requires some care and attention in collecting seed, in order to produce a fibre having the colour, length, evenness, and strength of Sea Island samples.

The colony, at present, does not produce a single bale of cotton. That is easily accounted for. When protection was taken off this material, the labour of the colony, which was very limited, was concentrated and employed on the cultivation of sugar, and was transferred from the unprotected to the protected article. The consequence has been, that more than half of the *empoldered* lands have been thrown out of cultivation, or turned into pastures of little value, or have been purchased by the labouring population. These lands are still capable of being easily reclaimed. The extent of country which was once in cotton, but is now uncultivated, amounts to at least 100 miles of sea-coast. It may be also worthy of remark, that those portions of the land in the immediate vicinity of the sea, most suitable for the cotton-plant, being impregnated with salt and exposed to the saline breezes of the Atlantic, are not adapted for the sugar-cane—and those parts of an estate further from the ocean, in which the cane grows most luxuriantly, are least fitted for cotton; as the shrub, when planted in such rich land, is inclined rather to throw out leaves and sprouts, than the flower and pod on which the crop depends.

Having thus explained how well adapted the soil is for growing cotton, and the climate for bringing it to perfection, the question will naturally be asked, why is it not cultivated? The answer is simple—contracted means and, until lately, want of labour. For years the sugar-planter has been so cramped for want of hands, that he greedily availed himself of all sorts of labour, at extreme prices. Indeed, had it not been for the costly nature of the buildings on the sugar estates, many a plantation would long since have been abandoned in despair. The emancipated classes will not give that constant industry, without which the cultivation of the cane is sure to entail loss; and the tenacity with which they stuck out for the last cent., though perhaps not blameable, is remarkable in a class which otherwise shows little regard for money or the comforts it procures. All this, however, is now changed for the better. The thinking part of the community having always felt that the only means which could save the Colony was immigration, they have for years followed up this object with a pertinacity that would take no denial, and that scorned to succumb to adverse circumstances. First, by voluntary contribution, next by loans, then, at the colonial expense, they tried every field likely to afford relief; at length, having overcome bitter opposition, after many half measures, Her Majesty's Government has taken a statesmanlike view of the West Indian question. India and China, with their overflowing and needy populations, have been opened up to our needs, and the Colony has at last been able to draw sufficient labour to double the sugar-crop between 1841 and 1861. Judicious legislation, ably devised and manfully sustained by the eminent statesman who presides over the Colonial Office, has placed immigration affairs on a sound footing, and the demand for labour is met by the supply. In fact, immigration is now a well organised institution, guaranteed from abuse by a variety of checks, and experience has now amply shewn that it is equally beneficent to the emigrant and to the country which receives him. Under these circumstances, the re-establishment of the cotton cultivation has not only become possible, but offers the prospect of a fair return for capital invested. The most feasible plan for trying the experiment, would be through the medium of a joint-stock association, with limited liability. If successful, as I have no doubt it would be, the cultivation of cotton may be carried on in Guiana to any extent. Abandoned cotton estates are easily reclaimed, and can be purchased for sums much under what it would cost to clear and drain the same quantity of land, if even obtained by free grant from the crown. The plantation might, in the first instance, be resettled by the natives ; and the company taking advantage of the colonial regulations for procuring immigrants, could secure the necessary labour for the undertaking.

So great is the reward of success, that the experiment is worth trial, and if only a small portion of those who are so deeply interested in the cotton question, would take part in the proposed enterprise, it would soon be triumphantly proved what are the capabilities of British Guiana, and the problem of "Free Cotton, how and where to grow it," would receive a favourable solution.

THE WILD COCHINEAL INSECT OF INDIA.

In 1848, Dr. T. E. Dempster was led to make certain observations on the wild cochineal of the North West Provinces and Punjaub, which was that year unusually abundant in the vicinity of Loodianah, and to institute certain experiments to ascertain the quality and quantity of the colouring matter contained in the indigenous insects. After much trouble, and a variety of experiments, he succeeded in producing, with the Indian cochineal, fast dyed tints, the brilliancy of which astonished and interested all who saw them. The existence of a cochineal insect in most parts of Hindoostan, had been long and generally known, but it had been regarded as so inferior in quality, as to be altogether worthless, as an article of commerce.

Dr. Dempster found the female insect to agree in all essential characters with the description given by Cuvier of the true Mexican *Coccus cacti.* The size, however, was smaller. It was distinguished from the female kermes, by preserving in its advanced stage the distinct form of an insect, and never becoming a mere berry or gall. He discovered a very small proportion of young perfect male insects. In comparing them with the drawings of the male of the Mexican species, and of the male kermes, he found that the indigenous insect was not identical with either, although in general appearance, it most resembled the male kermes. The Indian *coccus* is found only on the common cactus or prickly pear of those Indian provinces, and is surrounded by a quantity of fine cottony matter, into which the female deposits her young. It is beyond all doubt a *Coccus cacti,* and although it will probably turn out to be of a distinct and separate species, it agrees very closely with the description given of the woodland or wild cochineal of Mexico. In the month of December, the young brood were extremely numerous, very lively, and ready to leave the mother, and spread themselves over the plants. Sulphate of aluminua, added to an alkaline solution of the colouring matter of the native cochineal, threw down a copious deposit, which, when collected and dried, turned out a lake, equal in beauty to the purple lakes found in Ackerman's colour boxes.

"My attempts (adds Dr. Dempster) to make fine carmine, was not so successful; but the process, even with the finest Mexican cochineal, is known to be tedious, difficult, and liable to failure. My experiments in dyeing woollen cloth with the Indian cochineal, have been eminently successful, and have far exceeded my expectations. Using the formulæ employed in Europe for dyeing scarlet with Mexican cochineal, I substituted the indigenous colouring matter, and produced tints which, I think, will be pronounced equal in brilliancy to the best Europe-dyed scarlet broad cloth. After a little practical experience in the manipulation, I can now reproduce these colours with perfect certainty, and have thus, I believe, satisfactorily established the important fact, that the colouring matter of the Coccus of this part of India, is equal in quality to that of the Mexican cochineal.

"I took equal weights of the native and imported cochineal, extracted the colouring matter from both with exactly equal quantities of the same chemical re-agents, and conducted the process, in both cases, precisely in the same manner. The quantity of lake obtained from the native cochineal exceeded that got from the imported article—the former was also of a more brilliant hue! The quantity of native cochineal, which I found capable of dyeing a certain weight of woollen cloth, proves that the indigenous insects contain an amount of colouring matter, not inferior to the fine Mexican cochineal. The native cochineal when dried, has an unseemly appearance, being covered with much cottony matter, which adds considerably to the bulk, though not much to the weight. Yet, if I have not deceived myself as to the quality and quantity of the colouring matter contained in a given weight, I am persuaded it must be of commercial value, even in its present unimproved state."

The natural history of the Mexican coccus shows:

1st. That the production of the fine dye is confined within certain geographical limits.

2nd. That the wild species can be greatly improved by culture and judicious management. The north-west provinces of India (including the hill districts) present a great variety of climate, soil, elevation, &c., circumstances which must tend to modify the character of plants, and the nature of the insects which feed upon them; due favourable locality appears to be found, and others even more favourable may be discovered. There are immense tracts of waste and uncultivated lands, on which the cactus may be planted, and where it would grow luxuriantly. There is already one indigenous cactus, capable of supporting a cochineal insect of the quality above described ; and the true Mexican nopal or *Cactus cochinellifera* is thriving in the Botanical Gardens of Calcutta, and can easily be transferred to suitable localities in those provinces. Lastly, labour is cheap, and little agricultural management requisite.

The attention of the Government and the public has, at various times, been directed to the propagation of cochineal, both in Bengal and Madras ; but, like many other important objects, it has been abandoned as often as it was begun. The Dutch have been more successful, and cochineal has become one of the great sources of public revenue in their Eastern possessions.

About the time that trials were made extensively at Madras, Dr. Roxburgh was engaged in similar trials at Calcutta, and planted several acres, in the Botanic Garden of *Opuntia cochinellifera.* No records exist of the result of the experiment, or why it was abandoned ; but, from the circumstance of a reward having been shortly after offered by the Court of Directors of the E.I. Co. for the introduction of the *Granafina* or species of coccus employed in South America, probably some difficulties arose as to the employment of the indigenous species of Bengal. In 1839, the South American insect was introduced by the Agri-Horticultural Society, Calcutta, and an acre of ground laid out in the Society's nursery for its cultivation, which was likewise abandoned, but for what reason does not distinctly appear.

It is highly probable that the failure of all former efforts to produce a fine cochineal dye in India, is mainly to be ascribed to the selection of unfavourable localities, and the attempt to introduce a foreign insect, instead of cultivating and improving the indigenous one.

Besides the selection of proper localities for the cultivation of the *Opuntiæ*, correct information must be obtained on the following points—viz.:

1st. Number of generations of the Coccus in India during the year.

2nd. Number of crops which can be profitably gathered in twelve months, and proper periods of gathering them.

3rd. Proper seasons of *setting* the young insects.

4th. Most effectual mode of preserving the insects during the rainy season.

Dr. A. Fleming, in a letter, dated March 3, 1848, states :—

" When marching past this village (Gindiala) to get to my tent this morning, I got satisfactory proof that the Indian cochineal is *an article of commerce* in the country, and is used extensively by the Umritsur dyers. All the roadsides and fields near the village are lined with magnificent specimens of the cactus, far superior to any I have seen since I left Loodianah, and their leaves are covered with the cochineal insect, which, it strikes me, attains here, probably from good feeding, a larger size than I have ever seen it before do. As I passed these hedges of the prickly pear, numerous Cashmerees were scraping the cochineal, with a blunt iron instrument, from the surface of the leaves, into a basket such as the natives use for winnowing corn. On asking them what they were collecting this for, they told me it was to sell to the Umritsur dyers, who give them one rupee (2s.) for the 'Angrezi seer' of the substance when dry. In order to dry it, they rub the cottony matter and the insect into balls of a soft consistence, and then dry this in the sun on a *sirky* mat. By this process the insects are squeezed, and their colouring matter absorbed by their cottony envelope. The collecting of the cochineal must be rather a profitable concern for the gatherers of it, as one man, whom I watched, in about two or three hours had collected about four seers of the substance. In Cashmere the Indian cochineal sells for one rupee the half-seer, and hence one would infer that the insect is scarcer there than in this part of the country."*

From a combination of favourable circumstances, not well understood, all the insect tribes are subject, at uncertain intervals, to seasons of excessive propagation. When this takes place, parasitic insects often devour the plants on which they naturally feed, and so cut off the means of such excessive reproduction in the succeeding season. This appears to be the natural check to an increase of creatures which might prove fatal even to man himself ; and this was precisely what took place in the Punjab in 1848 ; the ungathered myriads of the cochineal insects completely destroyed, for a time, all the cactus-plants in the district.

THE COMMERCIAL QUASSIA, OR BITTERWOOD.

BY DR. BOWERBANK.

A good deal of uncertainty exists as to the source of the True Bitterwood of Commerce. This has arisen from confounding together the product of three trees belonging to the natural order Simarubaceæ, namely, the *Quassia amara*—Surinam Bitterwood—the *Simaruba officinalis*, Officinal Bitterwood, or Simaruba, and the *Picræna excelsa*, Lofty Bitterwood.

The first, the *Quassia amara* of Linnæus, is a beautiful tree, seldom exceeding in its growth, twelve or fourteen feet. It thrives well in Guiana, Panama, and Surinam, from the latter of which it was brought to Jamaica. The following is a description of it as given by Dr. Lindley, in his 'Medical Flora :'—"Flowers hermaphrodite, calyx short, 5 parted. Petals, 5, much longer, arranged in a tubular form. Stamens 10, longer than the petals. Ovaries 5, placed on a receptacle broader than themselves ; styles the same number, distinct at the base, then united into one very large one terminating in a nearly equal five-furrowed stigma. Fruit drupaceous—*A de J.*

"Leaves alternate, unequally pinnate ; leaflets in two pairs, opposite,

* Transactions of the Agri-Hort. Soc. of India, vol. ix.

entire smooth, eliptical, acute at each end ; petiole winged, jointed, with the joints obovate. Racemes long, one sided, simple, terminal, rarely branched. Flowers large scarlet ; distant ; pedicels bracteate at the base, jointed below the apex, and there having two little bracts." The wood is white and light, the bark thin, and of a grey colour—the whole plant is intensely bitter. This was originally the Bitterwood of the shops, and was imported in the form of white, scentless, very light, cylindrical pieces, of 1—2 inches in diameter, covered by a thin, greyish-white, and bitter bark. It was chiefly shipped from Surinam, whence it was called Surinam Bitterwood. Its introduction into Europe occurred about the year 1756, after which it came into very general use as a tonic and stomachic. Little, if any, of this kind of bitterwood is now to be procured. Dr. Lindley tells us, "I learn from Mr Lanæ, who resided for many years in Surinam, that although large quantities of Quassia were exported twenty or thirty years since, yet that he did not hear of a single instance of its shipment during the ten years he passed in Surinam. Quassia wood is, in fact, no longer used even in that colony as a medicine, being thought to have some bad properties, along with its intense bitter. The flowers are, however, still infused in wine or water, as a stomachic."

The second is the *Quassia Simaruba* of Linnæus—the *Simaruba amara* of Aublet, the *Simaruba officinalis* of De Candolle.

Simaruba bark was first sent to Europe in 1713 from Guiana, as the bark of a tree called by the natives Simarouba. It thrives well in Guiana, Cayenne, and Jamaica, and in the latter is known as the Mountain Damson, Bitter Damson, and Stave Wood. The following is MacFayden's description of the tree :—"Flowers diœcious, male decandrous, stigmata 5-partite, leaves abruptly pinnated, leaflets alternate, shortly petiolulated, pubescent beneath.

A tree about twenty feet in height, branches few, erect, terete, glabrous leaves towards the ends of the branches, abruptly pinnated : leaflets alternate, shortly petiolulated, oblong, glabrous and shining above, pubescent and pale beneath. Panicles axillary, subterminal, divisions short, few flowered, each furnished with a leafy reversely-wedged-shaped bract at the base : flowers shortly pedicelled, yellow, diœcious—Flowers in June.—*Male flowers* with the calyx small, divisions obtuse, minutely ciliated. Petals three times the length of the calyx, oblong, obtuse. Stamens length of the petals, augmented at the base, with 10 ovate villous scales. Ovary imperfect, 5 lobuled, destitute of style or stigma. *Female Flowers* on a distinct tree and smaller than the male. Calyx and corolla as in the male stamens 0 ; ovaries 5, connected at the inner angle ; style erect, single, stigmata 5 recurved. Fruit of five or by abortion 4—3—2 drupaceous carpels, seated on the enlarged receptacle ; carpels oblong, size of a damson, dark purple, smooth, shining, 1-seeded. Seed ovato-oblong, compressed."

According to Linnæus and others, the male and female flowers are mixed together on the same panicle. This is not the case with the Jamaica plant, as was long ago pointed out by Dr. Wright, and since confirmed by Dr. MacFayden. The bark of the old trees is black and a little furrowed, but that of the younger trees is smooth, grey, and here and there marked with broad spots of a yellow colour. The wood is hard, white, and without any remarkable taste.

The bark of the root is the part used in medicine, and is exported from Jamaica in bales. It is odourless, but bitter, and occurs in broad folded, very fibrous pieces several feet long, which are externally rough, warty, and marked with transverse ridges. The epidermis is of a greyish or whitish yellow colour, beneath it the bark is darker and yellowish brown. On the inner surface the bark is pale yellowish white.

Linnæus, Browne, and others assigned the *Bursera gummifera* as the source of this bark, a fact first doubted by Jacquin. Simaruba bark yields its properties to both water and alcohol. Its infusion appears to be more bitter than a decoction of it. It acts as a tonic, and is used in dyspepsia, diarrhœa, and especially in the latter stages of dysentery ; hence called by the Germans, Ruhrrinde (Dysentery bark). It has also emetic and laxative properties in large doses.

Lastly, we have the *Quassia excelsa* of Swartz, the *Simaruba excelsa* of De Candolle, the *Picræna excelsa* of Lindley, the Bitterwood of Jamaica, and Bitter ash of some of the other West India Islands.

The wood of this tree is the commercial Bitterwood of the present day, and which yields the chips of the shops. It has quite taken the place of the *Quassia amara*—to distinguish it from which, it is sometimes termed Lignum Quassiæ Jamaciensis.

The tree is common on the plains and lower mountains, and thrives also in more elevated mountains, as in some parts of Manchester 2500 feet above the sea level. It flowers in December. The following is MacFayden's description of it in his 'Flora' of Jamaica :

A " tree 50-60 feet in height with the branches spreading ; the bark rimose, ash-coloured, internally albido-florescent, with very tenacious fibrils. Leaves alternate, inpari-pinnate ; leaflets opposite, shortly petioluled, oblong, acuminate, unequal at the base, blunt at the apex, venose, glabrous Racemes towards the ends of the branchlets axillary, very compound, panicled, subcorymose, dichotomoucly branched, spreading, diffuse, many-flowered. Peduncle compressed, rufescenti-puberulous. Flowers small, pale, polygamous. Filaments of the male flower much larger than the petals : in the fertile, of the same length. In the male, merely the rudiments of the pistil, in the fertile ovaries, 3 : style longer than the stamens, 3-quetrous, 3-fid Drupes 3, but only one coming to perfection, size of a pea, black, shining, fixed on a hemispherical receptacle. Not solitary, globose, with the shell fragile."

A lofty spreading tree, with leaves like the English Ash tree. It is an excellent timber. The wood is of a pale yellow colour, becoming darker on exposure ; light, not very hard ; takes a fine polish, and is much used for flooring. Bed posts and clothes-presses are sometimes made of it, as no insect remains near the wood on account of its bitter quality. An efflorescence of nitrate of potash is often found upon it.

Bitterwood is exported from Jamacia in billets of various sizes (sometimes a foot in diameter, and several feet in length), covered externally with a smooth brittle bark. This wood contains a bitter principle called Quassite. Bitterwood is principally employed as a bitter tonic in cases of dyspepsia and other stomach disorders of a functional kind ; besides its tonic properties, it seems also, from recent experiments, to act on animals as a narcotic poison. It has been long known that an aqueous infusion forms an excellent fly poison, but more recently, larger animals as rabbits have been destroyed by it ; in fact, Kurtz mentions that complete paralysis of the hind extremities of a dog affected with mange, was brought on by washing the ulcers with decoction of Quassia ; in seven hours, however, it disappeared.

Mr. Simmonds ('Commercial Products of the Vegetable Kingdom') tells us that 23 tons of Bitterwood were shipped from Montego Bay in Jamaica in 1851. Although prohibited by law, it is frequently employed by brewers as a substitute for hops. The duty of 8*l.* 17s. 6d. per cwt. levied on Quassia, was intended to restrict its use for such purposes. This however, in 1842, was reduced by Sir Robt. Peel to 10s. 6d. (10 + 5 per cent.), it was further reduced in 1853 to 1s. a cwt., and is now imported duty free.

In 'M'Culloch's Commercial Dictionary' it is stated—"Its price in bond varies from 20s. to 30s. a cwt." In 1852 the imports and exports of the article amounted respectively to 675 and 516 cwt.

In the last edition of Dr. Pereira's work on the Materia Medica, published in 1853, we read—"Quassia wood has recently been somewhat scarce, and in consequence, its chips have been adulterated with the chips of other woods, but the intense bitterness of the genuine wood readily distinguishes it."

Were its quality of not being attacked by any insect, and the ease with which it is worked up, generally known, we think there is little doubt that it would be much used for cabinet making, &c.

Messrs. Turnbull and Lee, of this city, have for some time past been turning cups or goblets out of this wood, which, being filled with water, and allowed to stand for a few hours, impart their bitterness to it ; thus affording an efficient and easily made infusion.

[We have received by the last overland mail from a correspondent in Ceylon, a sample of rasped quassia wood, the produce of that island, which, it is stated, could be furnished at half the current selling prices of quassia at the present time, if there was any market for it. Upon submitting it to Dr. Phipson for examination, he reports it to be very much richer in quassia than the ordinary quassia of commerce.—EDITOR.]

Kingston, Jamaica.

MANUFACTURE OF ALKALI.

The works erected for the manufacture of this article generally contain —Close kilns, for burning sulphur or pyrites; leaden chambers, for condensing sulphuric acid gas; furnaces, for making salt cake; furnaces, for making black ash; and furnaces, for making white ash; with the necessary chimneys and flues, or sewers, for carrying off the gases evolved during the process of the manufacture.

The first process is the manufacture of

1. SULPHURIC ACID,

Which is produced at the works in the following manner:—Either pure sulphur or pyrites is burned or heated in the close kilns. By the action of the heat, sulphuric acid gas is evolved. This gas is conducted, by means of a flue, from the close kiln, in a state of vapour, into a leaden chamber, in which chamber, by the help of steam driven into it, through pipes, the gas is condensed into sulphuric acid, which falls in a liquid state to the bottom of the chamber.

The sulphuric acid thus obtained is either sold for the purposes of commerce, or used at the works in the making of

2. SULPHATE OF SODA, OR SALT CAKE,

Which is obtained by the following process:—The sulphuric acid, formed in the manner we have above stated, is run into a furnace upon a quantity of muriate of soda, or common salt, which is a compound of muriatic acid and soda. By the action of the sulphuric acid upon the salt, the muriate is separated from the soda, which it leaves in the form of muriatic gas; and the soda and the sulphuric acid combine, and form sulphate of soda or salt cake.

The next process is the converting of the salt cake into what is termed

3. BLACK ASH.

This is effected in the following manner:—The sulphate of soda, or salt cake, after being mixed with an equal weight of limestone, and a proportionate part of small coal, is put into a separate furnace, and there subjected to a high degree of heat, which brings the whole into a state of fusion. In the course of this fusion the carbonic acid contained in the limestone enters into combination with the soda, and forms an impure carbonate of soda.

This fused matter is drawn out in a liquid state into moulds, in which it is suffered to cool. It hardens of a black colour, and something like the dross of a copper smelting furnace, and in this state is called black ash.

The next process is to refine or separate the carbonate of soda contained in the black ash from its impurities—viz., sulphate of lime (which is formed by the sulphuric acid in the sulphate of soda, or salt cake, leaving the soda in the course of the fusion, and combining with the lime), and the residium of the coal. The refinement produces a substance called

4. WHITE ASH,

Which is thus obtained. The solid masses of the black ash, which have hardened in the moulds, are broken up into large pieces. These fragments are deposited in iron vats, which are then filled with water. The water dissolves a certain portion of the carbonate of soda which is contained in the black ash; and, when the water becomes sufficiently impregnated with the dissolved carbonate of soda, the liquor is drawn out of the iron vats into receivers, and from thence it is pumped into pans, in which it undergoes the process of boiling, until, by evaporation, the liquor becomes of a certain specific gravity or strength.

It is then run into another furnace, called a white ash furnace, into which it is boiled down or roasted into a solid, called white ash or caustic soda, which is a carbonate of soda still in an impure state. In this condition or degree of refinement it is generally sold by the manufacturer, and used by soap manufacturers; but it is capable of a still higher degree of refinement, when it becomes the carbonate of soda used in medicine, and sold by the chemists.

Scientific Notes.

Skeleton Leaves.—A good method of obtaining these beautiful dissected leaves is frequently asked for. The following is a process which we can recommend from experience. Steep the leaves, seed vessels, or other parts of the plant, which are required to be dissected, in rain water; leave them exposed to its influence until the whole of the soft or pulpy matters are decomposed. The period required for this operation varies much in different leaves, &c., according to their texture; thus, some require but a few weeks, others as many months. When the pulpy parts are completely decomposed, the next operation consists in their removal from the fibro-vascular network with which they were originally connected. This requires much care and patience. There are two ways of accomplishing it: one, which consists in carefully exposing them to a stream of fresh water, using at the same time a brush; and the other, by simply placing them in fresh water and removing with care the decomposed portion, in like manner, with a brush. Some difficulty will be found at first in doing this without, at the same time, breaking the fibro-vascular net-work; but a little practice will soon render it easy of accomplishment. The adoption successively of simply fresh water, and a stream of the same, applied by means of a syringe, will be frequently found desirable. The pulpy portions having been removed, and the fibro-vascular network obtained, the latter must then be bleached. For this purpose prepare a weak solution of chloride of lime, by adding about an ounce of a strong solution of that substance to a quart of distilled water; then soak the skeletons in this solution for some hours; generally three or four will suffice, but when they are very thick a longer period will be necessary. After this operation has been performed, wash the skeletons thoroughly in pure water; and, lastly, dry them by freely exposing them to light and air.

Mr C. Muratore of Algiers, has sought to utilise the *Pistacia lentiscus*, which is found in abundance growing spontaneously in Africa. To this end he takes the leaves and fruit of this tree, and boils them in water, filters the liquor, and precipitates it by a solution of salts of iron. He has obtained also a deep blue liquor, which communicates, in its boiling state, to yarn and to tissues a handsome black colour, comparable to that obtained with the blacks from logwood, gall-nuts, &c. The decoction of the leaves and fruit dyes objects black, which are plunged into a solution of iron. To facilitate transport, this colouring matter is reduced to powder, and the powder, mixed with oil, can be used for painting. Other colours may be obtained by combining different salts or acids. Iron gives a yellowish colour; lead, white; copper, brown; mercury, yellow. The stalks and branches of the tree furnish also this colouring matter, but not in such quantity as the leaves and fruit.

Burning Fluids.—Many persons suppose that camphene is an explosive burning fluid, but this is a mistake. Camphene is simply rectified spirits of turpentine. Its vapour, mixed with a certain portion of air, is, no doubt, explosive, but not the fluid. The common burning fluids, known by the name of phosgene, &c., which burn with a clear flame, emit but little smoke, and are so cleanly to use in lamps, are composed of alcohol and turpentine. Were it not that this hydro-carbon compound fluid is so volatile, so liable to assume the gaseous state, become saturated with the oxygen of the atmosphere, and thereby rendered dangerously explosive, it would be preferred to all other fluids for artificial illumination. But dangerous though it is, and notwithstanding the great number of accidents which have taken place from its use, it goes on superseding all kinds of oils with astonishing rapidity.

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THE TECHNOLOGIST.

AN ACCOUNT OF THE ANIMALS USEFUL IN AN ECONOMIC POINT OF VIEW TO THE VARIOUS CHIPEWYAN TRIBES.

BY B. R. ROSS, HUDSON'S BAY CO.'S SERVICE.

While collecting and arranging a series of specimens of the industrial arts of the natives of McKenzie's River District, for the Industrial Museum of Edinburgh, I was struck, not only with their number, but also with their importance to the domestic comfort of these races.

Though doubtless much of the skill of the Chipewyan tribes has been lost since the period of Sir Alexander McKenzie's visit, by the introduction of European manufactures, enough yet remains to prove interesting as exhibiting the arts and manufactures of a people still in the first stages of social existence and civilisation. The manufactures are in themselves rude, and, with the exception of porcupine work, I know of none that would obtain the name of art, or win in a Museum, the meed of more than a passing glance from anyone, save an ethnologist. To the unreflecting, or to those who for mere pleasure visit these "repositories of science," they must indeed be *caviare*, but to the philosophic mind they would speak volumes, as showing the human intellect, though in its lowest stages, attempting, not unsuccessfully, to break through the surrounding crust of animalism, and struggle to emerge into a sphere of higher intelligence.

In the present sketch, I entirely exclude the Eskimos and Loucheux—though recent researches almost confirm me in the opinion that the latter tribe is a branch of the Chipewyan family—as it would swell the paper much beyond the limits to which I have restricted myself, to pass their handicrafts also in review.

The Chipewyan tribes—including the Montaignais, Yellow-knives, Beavers, Dog-ribs, Slaves, Sickannies, Nehaunies, and Hare Indians—draw their resources from the animal, vegetable, and mineral kingdoms ; but I must at present restrict myself to the first of these great sections, hoping, at some future period, to have the pleasure of noticing the others.

In the manufactures of the Indians, no articles hold a more important or more conspicuous position than those drawn from animals ; but this must naturally be expected in a people who subsist almost solely on the products of the chase. The climate of these regions, moreover, in a manner prohibits agriculture, even were the natives willing to turn their attention to such pursuits, which they are not.

I shall pass briefly in review all the species of animals from which they derive any material, noting with each the various purposes to which it is applied.

Foxes. (*Vulpes.*)—The various species of foxes found in this district are the red, cross, silver, white, and blue. The latter is not, as some writers affirm, the young of the white, nor is it that animal in its summer garb, though it is closely allied to it. The only article furnished by these animals is a fine sinew thread for bead-work, and is taken from the tail.

Black, Grizzly, and Barren-ground Bears. (*Ursus Americanus, U. horribilis*, and *U. arctos.*)—The black bear is found throughout the wooded portions of the districts ; but is replaced, on the barren grounds, by a species bearing a strong resemblance to the *U. arctos* of Europe. The grizzly bear dwells among the rocky mountains. From the black, and indeed from all, the natives derive food ; they also cut the summer hides into cords. The prepared fat is extensively used as a pomatum ; but I cannot coincide with those who state bear's grease to be a good hair renovator ; on the contrary, it will in all likelihood, if used pure, cause the hairs to split and fall out. Grizzly and barren-ground bears' claws are much prized for necklaces and coronets by the Indians.

Marmots. (*Arctomys.*)—There are three, if not four, species of this animal in the McKenzie's River District—viz., *A. pruinosus*—inhabiting the northern Rocky Mountains and Nehaunay Hills—*A. Kennicotii*—dwelling in the same localities, with a more northern range, and extending eastward to the Anderson River—and *A. monax* coming as far north, though rare, as the Liard's River. Out of all of these, the mountain tribes make robes, and the flesh is counted sweet and fat.

Beaver. (*Castor Canadensis.*)—The beaver exists some distance within the arctic circle ; and the darkest-coloured pelts that I have seen are from Fort Good Hope. The Slave and Dog-rib tribes make capotes and robes out of the skin ; and the castoreum is extensively used in the manufacture of a medicine or perfume for enticing the lynx to enter into the snaring cabins. The flesh and tail are among the most prized dainties of Indian epicures.

Porcupines. (*Erithezon.*)—These animals are scattered all over the district, principally in the vicinity of the Rocky Mountain ranges, but I do not think that they are often found around the shores of Great Slave Lake. The flesh is considered a great treat, and the quills furnish the materials for embroidering the only really tasteful articles to be found among the natives of these regions. The Slave Indians, dwelling along the McKenzie and Liard's Rivers, are reckoned the most skilful fabricators of this manufacture. The things made out of them consist of belts, bands, garters, bracelets ; and they are also used for ornamenting bark-work, dresses, and shoes. In manufacturing belts, &c., a frame-work of sinew-thread is first laid, through which the quills are interwoven in squares, something in the manner of Berlin-wool work. The articles, when finished, are very pretty, and some of the women are sufficiently adepts, to follow any angular pattern which may be set them. The dyes used are procured principally from the vegetable kingdom, though the natives residing in the vicinity of the Forts often apply to the wives of our servants to tint the quills with imported dye-stuffs.

The Rabbit. (*Lepus Americanus.*)—This animal, so essential to the welfare of the Chipewyan nation, is spread all over the district, except upon the barren grounds. It is subject to periodical failures, which occur with great regularity, and which cause no small amount of privation and suffering to the Indians, when they happen. When the animals are numerous, the Tinné tribes of the McKenzie valley subsist altogether on them, and the skins furnish almost entirely their winter clothing—robes, shirts, capotes, mittens, and socks being made, which afford a sufficient protection against the most severe cold, though they do not form lasting garments, as the hair falls out very quickly.

The Moose. (*Alces Americanus.*)—Is found, in greater or lesser numbers, throughout the wooded portions of the district. Its food consists of the coarse grass of the swamps, and the shoots of various kinds of willows. It produces from one to two at a birth. In size it is rather larger than a horse, and a buck in its grease will weigh as high as 800 lbs., without the offal. When in good condition, the flesh is sweet and tender, and is highly esteemed as an article of food ; but should the animal be poor, or have been subjected to violent exertion previously to death, the meat is scarcely eatable. The nose or *moufle* is considered by some the greatest delicacy of the north-west, contesting the palm with bear's paw, beaver tail, reindeer tongue, buffalo boss, and sheep ribs. The Indians sometimes snare the Moose ; and in the spring, when the action of the sun has formed a thick crust upon the snow, they drive them into drifts, and spear them in numbers. It is not a gregarious animal, and to hunt it requires more skill than is necessary in the pursuit of either reindeer or buffalo. In the winter, for some time before the hunter comes on his chase, he removes his snow-shoes, and despite the thermometer many degrees below zero, sometimes takes off his leggings ; he then makes his approach cautiously, cutting such twigs of willows as may be in his way with his teeth, and avoiding, when possible, dry brush and fallen timber. As the slightest unusual sound is sufficient to frighten this animal, the chosen period for hunting it is during the continuance of a heavy gale of wind. During the rutting season, which happens in the fall, the males are rather dangerous to follow, and instances have occurred of native hunters having been severely injured, and even killed by them. They fight rather with their fore-feet than with their horns.

The uses to which the various parts of the Moose are put are many. The hide supplies parchment, leather, lines, and cords ; the sinews yield thread and glue ; the horns serve for handles to knives and awls, as well as to make spoons of ; the shank bones are employed as tools to dress leather with ; and with a particular portion of the hair, when dyed, the Indian women embroider garments.

To make leather and parchment, the hide is first divested of hair by scraping, and all pieces of raw flesh being cut away, if then washed, stretched, and dried, it will become parchment. In converting this into leather a further process of steeping, scraping, rubbing, and smearing with brains is gone through, after which it is stretched and dried, and then smoked over a fire of rotten wood, which imparts a lively yellow colour to it. The article is then ready for service. Of parchment, as such, the Chipewyans make little use, but the residents avail themselves of it, in place of glass for windows, for constructing the sides of dog-carrioles, and for making glue. The leather is serviceable in a variety of ways, but is principally made up into tents and articles of clothing, and in the fabrication of dog-harnesses and fine cords, wallets, &c. The capotes, gowns, firebags, mittens, moccasins, and trousers made of it are often richly ornamented with quills and beads, and when new, look very neat and becoming. The best dressers of leather in these parts are the Slave Lake Chipewyans and Liard's River Slaves.

The lines and cords are of various sizes, the largest being used for sled lines and pack-cords ; the smaller answer for lacing snow-shoes and other purposes. In order to make sled lines pliant—a very necessary quality when the temperature is 40 deg. or 50 deg. below the zero of Fahrt.—the cord is first soaked in fat fish liquor, it is then dried in the frost, and afterwards rubbed by hauling it through the eye of an axe ; to complete the operation it is well greased, and any hard lumps masticated until they become soft, by which process a line is produced of great strength and pliancy, and which is not liable to crack in the most severe cold.

To obtain thread, the fibres of the sinews are separated and twisted into the required sizes. The Moose furnishes the best quality of this article, which is used by the natives to sew both leather and cloth, to make rabbit snares, and to weave into fishing nets. Sinews can be boiled down into an excellent glue or size.

In mounting knives and awls with the horns, lead, copper, and iron are used for inlaying, and rather handsome articles are sometimes produced. The making of spoons, tipping of arrows, and carving of fish-hooks requires little explanation, nor does the stuffing of dog-collars, and embroidering with the hair need any particular comment, so I shall conclude this imperfect notice of a very valuable animal, which yields food, shelter, and clothing to the savage inhabitants of this remote and dreary portion of the globe.

Reindeer. (*Rangifer.*)—Two species inhabit this district, the Strong-wood (*R. caribou*) and the Barren-ground (*R. arcticus*), which though very nearly allied, are certainly distinct one from the other.

The Strong-wood Reindeer inhabit the thickly-wooded parts of the district, particularly among and in the vicinity of the mountain ranges, where they are of very large size. Though smaller than the Moose, these deer are of considerable bulk, and weigh up to 300 lbs. In most particulars they resemble the Barren-ground species, differing from it in the following points :—smaller horns, darker colour, larger size, not being so gregarious, and not migrating. Both species are equally infested with the larvæ of a kind of gad-fly, which perforate the skins, and cause the animals much pain. These larvæ, or others very similar to them, are also found under the mucous membrane at the root of the tongue and in the nostrils, and I have even found them in the brain. The only hides serviceable for converting into leather are those of animals killed early in the winter, which when subjected to a process similar to that detailed under the head of Moose, and bleached in the frost instead of being smoked, furnish a most beautiful, even, and white leather, which is used for shoe-tops, embroidered with quills and silk.

The Barren-ground Reindeer, during the summer and spring months, frequent the barren plains lying between the wooded country and the shores of Hudson's Bay and the Arctic Sea. Their migrations, which are performed with wonderful regularity, are as follows: They leave the shelter of the woods in the end of March and beginning of April, and resort to the plains where they feed on various kinds of lichens and mosses, gradually moving northward until they reach the coast, where they bring forth their young in the beginning of June ; in July they begin to retire from the sea-board, and in October rest on the edge of the wood, where they remain during the cold of winter. In the northward movement the females lead, while the southward migration is almost invariably headed by a patriarchal male. The horns of these deer are much varied in shape, scarcely any two animals having them precisely alike. The old males shed theirs towards the end of December, the young males and barren females in April, and the gravid females in May. Their hair falls in July, but begins to loosen in May. The new coat is darkish brown and short ; but it gradually lengthens, and becomes lighter in colour, until it obtains the slate-grey tint of winter. A full grown buck will weigh about a hundred-weight ; the flesh, when in prime condition, is very sweet, but bucks, when in season, have their fat strongly impregnated with the flavour of garlic, which, indeed, is always present more or less. The summer food of the Reindeer is lichens, moss, and coarse grass ; in the winter it consists of the dried hay of the swamps, and the hairy moss adhering to the pine trees. I have seen it stated that these animals in the winter, in order to procure food, shovel away the snow from the ground with their horns, but this theory, however plausible, is entirely negatived by the facts of the case, for from my own knowledge, and all that I can learn, both from whites and natives, these deer use *their feet only* for this purpose. Indeed, when the horns would be necessary, the males would have already lost them, and a supplemental addition would be required to the hypothesis, of the females clearing a space for the males to graze on, as the gentler sex, at that period, reversing human fashions, wear *the horns* instead of their lords.

The Barren-ground Reindeer furnishes the principal support of the Yellow-knife, Dog-rib, and Hare Indians, and has the same value to them as the moose to the other branches of their nation. Their clothing for winter is made out of fawn-skins, dressed with the hair on, and consists of capotes, gowns, shirts, leggings, mittens, socks, and robes, which are warm, and when new, nice looking. Hides which are so much perforated by the larvæ of the *Æstrus* as to be unfit for any other purpose, are converted into *babiche,* to make which the skin is first divested of hair and all fleshy matter ; it is then with a knife cut into the desired thickness, the operation beginning in the centre of the skin. There are two sizes of this article, the larger being used for barring sleds and for the foot-lacing of snow-shoes, the smaller as a species of thread for sewing leather, for the fine netting of snow-shoes, and for lacing, fishing, and beaver nets.

The Buffalo. (*Bos Americanus.*)—The Strong-wood variety, which comes so forth north and east as about twenty miles from the mouth of Little Buffalo River, near Fort Resolution, Great Slave Lake, is found most numerously, in the vicinity of the salt plains of Salt River. It is unknown throughout the country inhabited by any of the Slave tribes, and the point mentioned above may be considered as its furthest limits. It is of larger size than the plain variety, of darker colour, and more thickly furred. The Chipewyans eat its flesh, and make robes and parchment from the hides. The horns are made into powder-flasks, and are used for mounting knives and awls ; the tail, mounted on a wooden shank, ornamented with goose or porcupine quills, is used as a fly-flapper. From its scarcity, this animal does not contribute materially to the tribes under consideration.

The Musk Ox. (*Ovibos moschatus.*)—This small but powerful animal is an inhabitant of the Barren-grounds and Arctic coast, from 61 deg. north. It frequents wild, rocky situations, and possesses the agility of the antelope, between which and the buffalo it appears to form a connecting link. During the winter it feeds on lichens, and in the summer on grass. From its remote habit, it is of little service to the Chipewyan tribes, and though the Yellow-knives, Dog-ribs, and Hare Indians sometimes hunt it, yet as it is very fierce, and the flesh is strongly impregnated with the flavour of musk, it is not much looked after. The calf-skins make excellent robes and caps, but the adult hides are almost too hairy for any purpose of that sort. The tails are made into fly-flappers, similar to those obtained from the same part of the buffalo.

The Mountain Goat. (*Aplocerus montanus.*)—Is found throughout all the mountain ranges of this district, to within a short distance of the Polar Sea, if, indeed, it does not reach it. It is a larger animal than the domestic goat, which it resembles only in name and in having a beard. It is covered with long and rather brittle white hairs, beneath which a coat of very fine white curly wool lies close to the skin. The flesh, though rank, is fat and tender, and is much relished by the Mountain Indians, who also make robes, clothing, and leather from the hide. Curious dog-sleds are manufactured out of the skin covering the shank bones, by sewing number of the pieces together with the hair outside, wh ich slides well over the snow.

Birds.—From the various snow geese, of which there are three species (*Anser hyperbo*, *A. albatus*, and another as yet unnamed, the "horned wavy goose" of Hearne); from the white and sand-hill cranes (*Grus Americanus* and *G. Canadensis*); from the Canada geese (*Bernicla Canadensis*, *B. leucomelia*, *B. Hutchinsonii*, *B. leucopareia et B. Barnstonii*); from the trumpeter and wild swans (*Cygnus buccinator et C. Americanus*); and from the white-faced geese (*Anser Gambelii et A. frontalis*), the natives derive the quills so much used for ornamenting round the tops of moccasins, and for similar purposes, as well as for feathering arrows. Fire-bags are made out of the skin of the neck of the great northern diver (*Colymbus torquatus*), and the tail feathers of the golden eagle (*Aquila Canadensis*) are used for head ornaments. The yellow flicker (*Colaptes auratus*), and other gaudily-arrayed summer birds yield their plumage for ornamenting dresses. The Dog-rib and Yellow Indians make belts of goose-quills by dyeing them and sewing them together in longitudinal stripes.

Here concludes the list of the products derived from the animal kingdom by the Chipewyan tribes; the waters furnishing them with food only. Rude in arts, and debased in manners as are these people, they are among the most kind-hearted and merciful of the Indian races; and would doubtless, if dwelling in a more genial climate, prove the most amenable, of any of the red nations, to the humanising influences of civilisation.

ON THE PRODUCTS OF THE PEA FAMILY (*LEGUMINOSÆ*).

BY JOHN R. JACKSON.

PART I.—PAPILIONACEÆ.

The products of the Leguminous order having such an extensive range of appliances, are, perhaps, better known than those of any other natural family. There is, probably, no other class of plants having such a wide geographical distribution, found, as they are, in nearly every part of the globe. As a proof of the magnitude of this order, it may be stated that the number of species amount to between 6,000 and 7,000. From this large assemblage of plants, one might be led to expect a proportionate variety of useful, as they have the advantage of all climes from the Arctic to the Equatorial regions. The properties of these products are, of course, very varied; in some, we have valuable and well-known articles of food; others yield us timber, dyes, gums, &c. It may, therefore, not be uninteresting to give a summary of the products furnished by this useful order, arranging them according to the natural plan of their respective genera in the family.

It may be as well to notice before proceeding further, that there are many articles of commerce well known by botanists to be produced by plants of this order, whose exact species cannot be determined, simply on account of the absence of flowering specimens. Thus, for instance, the rosewood of our cabinet makers remains undetermined for want of specimens of the fruit, flowers, and leaves of the tree producing it, by which means alone the true source of the product can be decided. It would be well if collectors or agents abroad would secure such specimens of the plant furnishing the wood or other commodity which is to be transmitted home. This deficiency was very manifest in the Great Exhibition of 1851, where specimens of wood, apparently valuable for strength, durability, and size, were rendered useless for want of information respecting the source from whence they were obtained. A great deal of the existing ignorance and confusion on these points will probably be dispelled by the specimens which will be sent home to the International Exhibition this year from the colonies, in conformity with the suggestions and instructions of Dr. Lindley. It is well known that it is the character of some natural families to yield hard and valuable woods, while those produced from others are soft and worthless. By this will be seen and understood, the advantage derived from a knowledge of the affinities of the plant yielding a certain timber which may be under dispute. Nor does this apply to woods only, whatever the product, the true name of the plant furnishing it should be known; from this fact, benefits arise both to the commercial, and scientific world. To proceed, then, in their classified order according to the arrangement of Mr. Bentham, we will commence with *Baptisia tinctoria*, Br. This plant, called Wild Indigo, is found growing abundantly in all parts of America. It is used chiefly in medicine. The root is the part in greatest repute. A dye is obtained from the plant, of a pale blue colour, used as a substitute for indigo, though much inferior. An infusion or decoction of the leaves of *Cyclopia genistioides*, Vent., a Cape plant, is employed in South Africa in consumption and chronic catarrh; its native name is "Honig-thee." Several species of the genus, *Gastrolobium* are known in Western Australia as poison plants, on account of the fatal effects to cattle which browse upon them. The leaves of *Borbonia ruscifolia*, Sims, are used at the Cape of Good Hope as tea, and are also employed in medicine under the name of "Stekel-thee." The seeds of the White Lupin, (*Lupinus albus*, Lin.), a native of the Levant, but now cultivated in the South of Europe, are employed in Italy as an article of food. With us the plant is almost unknown except as an ornamental flower. Small quantities of the seeds are, however, occasionally imported, chiefly consumed by Italians residing in this country. The Arabians eat the peduncles of

Lupinus Ternus, Forsk., after being skinned ; the seeds likewise are eaten. In some parts of North America, the tubers of *Lupinus tuberosus* are cooked and eaten by the natives. Sunn hemp, the product of *Crotalaria juncea* L., is a well known Indian fibre ; the plant is extensively cultivated in Mysore and the Deccan. The process of preparing and cleaning the stalks, as at present practised in India, is a very tedious operation. The stems are placed in water for five or six days, when the fibre is separated by the fingers. By careful and proper treatment, it becomes soft and white, so as to be equal, if not superior to Russian flax for spinning ; large quantities are now imported into this country. In India, it is much valued for making cordage, ropes, canvas, fishing-nets, &c. Jubbulpore hemp, said to be produced by *Crotalaria tenuifolia*, furnishes a very strong fibre ; but it differs little from that of *C. juncea*, and, indeed, by some botanists is regarded as a variety of the same plant. Other species of this genus, as *C. verrucosa*, L., and *C. retusa*, L., are employed in medicine in various ways by the Indians. The bark of the latter species is also used in the manufacture of canvas, cordage, &c. From the flowers of *Genista tinctoria*, L., called Dyer's broom, or Greenweed, a bright yellow colouring matter is obtained ; combined with woad, it forms an excellent green, and is said to be preferred by dyers to all other yellows for this purpose. The young twigs of *Genista scoparia*, Lam., are employed in Madeira for making fancy articles, as baskets, table-mats, &c. The plant is there called the Golden Willow, or Yellow Thorn.

The Laburnum (*Cytisus laburnum*, L.,) is a well-known tree. It was introduced to this country in the sixteenth century. The wood is hard, of a beautiful dark colour, and takes a fine polish. It is occasionally worked up into fancy articles ; but hitherto its use for cabinet-work has not been so general as its beauty merits. Clover is so well known as to need only a passing mention. It is the produce of several species of *Trifolium*, *T. pratense*, L., *T. repens*, L., and *T. incarnatum*, L., being the commonest cultivated in England. Large quantities of the seed of the Dutch clover, *T. repens*, are annually imported to this country from Germany and Holland. Clover seed is also imported from America. The total importations of this commodity amounted, in 1860, to upwards of 264,000 cwts.

The flowers of *Melilotus cœrulea*, Lam., contain a volatile principle which gives the peculiar flavour and odour to the celebrated Chapziger cheese of Switzerland. The seeds of the Fenngueek, (*Trigonella fœnum-grœcum*, L.), a native of the South of France, are emollient, and are employed by the Arabs in fomentations. Of Indigo, the produce of *Indigofera tinctoria*, L., and *I. Anil.*, L., so much has been written, and its value is so well known, that it is needless to enlarge upon it in this paper. The plant is a native of the East Indies, from whence we receive our largest imports ; but it is cultivated more or less in all tropical countries. The tubers of *Psoralea esculenta*, Pursh., are eaten by the Black Foot Indians, and other tribes of N. America, and are called "Navet de Prairie," or Prairie turnips. They are about 7 or 8 inches long, and 3 or 4 inches in circumference. The

Liquorice plant—*Glycyrrhiza glabra*, L.—a native of Southern Europe, is largely cultivated in Spain, Italy, and Sicily, and likewise to some extent in this country, as in Yorkshire and Surrey, Pontefract being noted for its growth, from which place the small lozenges called "Pomfret cakes" derive their name. We received large quantities of the juice from Italy under the name of Spanish Liquorice; this usually arrives in boxes, packed in dry bay-leaves. It is also imported in sticks, the finest being known as and stamped "Solazzi." In combination with gum, gelatine, &c., various forms of confectionary are produced in this country from the juice. It is likewise employed in medicine on account of its demulcent and pectoral properties; but one of its most extensive uses is by brewers for colouring porter. *Robinia pseudacacia*, L., a native of N. America, furnishes a strong and durable wood, capable of taking a high polish. It was introduced to this country (where large trees of it are common) about 1640.

A fibre is furnished by *Sesbania picta*, Pers., but appears of little value being very brittle, and of a dark colour. The wood of *Hermeniera elaphroxylon*, Guil et Perrot, growing in Western Africa, is of a remarkably soft texture, having the appearance of a mass of pith, with the medullary rays and annual rings almost imperceptible. It is also very white. It grows to a tolerable size, a specimen in the Museum of the Royal Gardens, Kew, measuring 8 or 9 inches across. It is most probable that the natives employ it in their various manufactures, and for hats, floats, &c., as is the case with *Æschynomene aspera.*

The leaves of *Colutea arborescens*, L., have purgative properties, and are employed to adulterate the blunt senna of the shops. Tragacanth is the gum or sap of several species of *Astragalus;* the most esteemed occurs in flakes of an irregular oval shape. This is produced by *A. gummifer*, Lab., a native of Asia Minor and Koordistan. Tragacanth is known in commerce in two forms, flaky and vermiform, though M. Guibourt, in a letter published in the 'Pharmaceutical Journal' in 1855, says the former variety only "occurs in commerce at the present day." Martius attributes this variety to *A. verus*, Oliv., and the vermiform to *A. creticus*, Lam. Tragacanth is the nutritive juice of the plant; the hygrometric properties of the wood being very great, considerable moisture is absorbed by it during the night, which causes the wood to swell to a great extent, so that the bark cracks, and from these openings the gum or sap exudes. Very fine specimens of plants of *A. gummifer*, Lab., in flower, and also of the stems, showing the exudation of the gum, were procured by Dr. Hooker in his recent visit to Syria. These may now be seen in the Kew Museum.

The Chick Pea is the produce of *Cicer arietinum*, L., an annual plant cultivated to a large extent in the South of Europe, especially in Spain. They contain a large quantity of flesh-forming matter, and are much used by travellers in the deserts, either parched or fried, as they do not become soft by boiling. In India, they are known as "Gram," and are largely employed in curries, cakes, &c., but chiefly for feeding cattle. The natives of Mysore collect the dew from the young plants by spreading a thin muslin over them at night; the dew-drops collect upon the leaves and saturate the cloth, which is removed in the morning and wrung, the liquid being preserved in bottles is ready for use. It is exceedingly acid, and in wringing the cloth, care has to be taken to wash the hands immediately, to prevent injury to the flesh by the action of the acid. The older the plants are, the stronger and more red the acid appears; and the longer it is kept, the more powerful does it become. It is considered a sure medicine in cases of indigestion, being administered in water. The extreme sharpness of the acid may be understood by the fact that the boots of a person walking through a gram-field will be entirely destroyed by its action. It is known in India by the name of "Kudlee Hoolee;" the market price is about two annas (3d.), per tola weight (the weight of a silver rupee, 180 grains). The leaves of this plant are eaten as a vegetable. It has been cultivated from a very remote period, and was known to the ancient Egyptians, Hebrews, and Greeks.

Perhaps the best known of all the products of this order are its true types, beans and peas; the first-named are the produce of *Faba vulgaris*, the latter of *Pisum sativum*. These are largely cultivated in all temperate countries as articles of food. Peas contain a much larger quantity of nutritive matter than beans, the proportion being about 57½ per cent. in peas, and 9 per cent. in beans. The native country of the pea is involved in doubt; but, in all probabilty, it originally came from the neighbourhood of the Black Sea. Its introduction into this country dates many centuries back; for, we find in the reign of the eighth Henry an entry in the privy purse expenses to the effect of a reward being paid to a man "for bringing pescodds to the King's grace, iiij. s. viii. d." In the time of Queen Elizabeth, they were imported from Holland, and must have been considered a great luxury, it having been written of them that they were "fit dainties for ladies," on account of the great price they fetched. Large quantities of peas are annually imported into this country from Dantzic and other places.

The native country of the bean (*Faba vulgaris*), is also obscure; it is certain that it was introduced to this country at a very early date, and is now extensively cultivated here as in other parts of the world, Africa, China, Japan, &c., as an article of food. The importation of beans has of late increased to a great extent, considerable quantities being derived from Alexandria and Cairo. Their use is chiefly for feeding horses. Of lentils, the seeds of *Ervum Lens*, L., there are several varieties, which are extensively cultivated in France, Egypt, many parts of India, and other countries, though almost unknown in England. The small red lentil is chiefly imported for feeding cattle; the seed is not more than half the size of the French lentil, which is the most esteemed; it is sold in this country for making soups. The seeds are also reduced to a flour, the skin or husk being carefully removed; in this form it is advertised and sold as "Revalenta Arabica."

The Tare or Vetch (*Vicia sativa*, L.), is a plant well known in our own fields, being cultivated as fodder for cattle. The seeds are used occasionally as food for pigeons. The importation of tares into this country is small, and chiefly derived from Norway and Denmark. The Ground Nut (*Arachis hypogœa*, L.), probably originally from the west coast of Africa, where it is extensively cultivated, as also in all tropical countries, is known amongst the African negroes as "Munduli," and cultivated chiefly as an article of food. In America, where they are called pea-nuts, the seeds are roasted as a substitute for chocolate. In India and China, it is chiefly employed in the production of an oil, with which the seed abounds ; indeed, to such an extent, that they will sometimes produce half their weight of oil. This oil is much used for burning in lamps, and for pharmaceutical purposes, as well as for lubricating machinery ; in fact, for most of the uses for which olive-oil is employed, being clear, limpid, and not turning rancid so soon as many other oils. The residuum, after the expression of the oil, forms good manure, and the leaves food for cattle. In Java and Malacca, two varieties of the plant are found, each yielding oil in abundance, which is there known as "Katjang" oil.

The wood called green ebony, from Jamaica and other parts of the West Indies, is supposed to be furnished by *Brya Ebenus*. It is a small tree ; the duramen of the wood is a dark green, the alburnum or outer wood, of a light yellow. It is much used for rulers and other small work, also in marqueterie. It is very resinous ; so much so, indeed, that the natives of the West Indies use it for burning as torches ; it is also said that a dye is obtained from it. The wood is hard, and susceptible of a very high polish ; the young branches are tough and elastic, and employed in their native country as riding-whips.

The wood of *Æschynomene aspera*, L., is remarkable for its light cellular tissue. It is found growing in the lakes and jheels of India. Hats of very great lightness are made from it, which are well adapted to the climate, as they are bad conductors of heat. It is employed in many parts of India for various purposes, as fishing-floats, models of temples, and an infinite variety of ornamental applications.

Alhagi maurorum, Tourn., extending from the north of India to Syria, yields a juice which forms in granular masses, and is called Persian Manna. It is collected by simply shaking the branches. It is singular that this substance is not formed on the plants growing in India, Arabia, and Egypt, the climates of Persia and Bokhara seem alone suited for its production. It has been supposed by some writers to be identical with the manna of Scripture. The seeds of *Soja hispida*, Moench., produce the well-known sauce called soy. Large quantities of soy are annually received in this country from India and Japan. The seeds, though not received here as an article of import, are imported into Shanghae, for the purpose of expressing an oil which is much used in lamps. The residuum is made into cakes, and employed as a food for cattle. The Ordeal Beans of Old Calabar are the seeds of *Physostigma venenatum*, Balf. Sudden death being frequently ascribed by the natives to witchcraft, suspicion generally rests on some of the relatives of the deceased, who can only prove their innocence by swallowing a mixture of this poison. The native belief is that the innocent vomit and are safe, while the guilty retain the poison and die ; they are very strong in this belief, and even demand the ordeal as a right. The pods of the "Kiwach," *Mucuna prurita*, Hook., a native of the East Indies, is there used as an article of food. A decoction of the root or pods is said to be diuretic, and a sure remedy for dropsy. The *Mucuna pruriens*, of the West Indies, known as the "Cow Itch," has a place in our Materia Medica, on account of its anthelmintic properties, the setæ or hairs of the pods being the part used. These hairs are supposed to act mechanically upon the animals.

The wood of *Erythina Indica*, Lam., a tree growing to a height of from 20 to 30 feet, and a native of various parts of India, is known as "Mootchie" wood, and employed for making toys and other ornamental articles, it being light and easily worked up. On account of the spines with which the tree is armed, it constitutes a capital fence for keeping out cattle. The leaves and bark are considered by the natives as a specific in fevers ; they are likewise used in other branches of medicine.

E. acanthocarpa, E. Mey., produces large club-shaped tubers about 2 feet in length, and 3 or 4 inches across, when first dug up they are very heavy on account of the moisture contained in them ; but, when this has evaporated, they become of a soft, pithy consistence, exceedingly light, and in this state are much used for making hats, floats, and other light articles. Two fine specimens of these tubers may be seen in the Museum of the Royal Gardens, Kew. This plant is found growing abundantly in the open country north of the Amatola mountains, in the district of North Victoria, South Africa.

Butea frondosa, Roxb., a showy tree with scarlet flowers, a native of the East Indies, known by the name of Dhak, or Pulas, grows plentifully at Malabar, and in other parts of India. The natives beat the bark into a fibre, which furnish them with cordage, &c. Dr. Royle states that this fibre is very strong, but not suitable as an article of commerce in this country. The resin called Butea Kino is produced by this plant, and oozes from wounds in the bark, becoming hard and brittle ; it is slightly soluble in alcohol and ether, very astringent, and contains a large quantity of tannin. It is applied in medicine in various ways. From the flowers an infusion of a bright yellow colour is prepared and used in dyeing cotton, which, by the addition of an alkali, produces a reddish orange. This dye is known in India as "Teesoo." The seeds are occasionally used as an anthelmintic. The wood is much employed—reduced to charcoal—in the manufacture of gunpowder, and in Ceylon for house-building purposes.

B. superba, Roxb., has similar properties to the foregoing species. The gum of *B. parviflora*, Roxb., is given, dissolved in Arrack, in hysteria and colic. The Kidney Beans (of which the well-known "French bean" and "Scarlet runner" are representatives), are produced by the genus *Phaseolus*. The former of *Phaseolus vulgaris*, L., the latter—*P. multiflorus*, Lam., the white variety of the kidney bean is commonly used by the poorer classes as a substitute for potatoes, and during the scarcity of this favourite vegetable in 1847, immense quantities were imported from America, finding ready sale. In India, the seeds of *Phaseolus Mungo*, L., are much used as an article of food, being cultivated to a large extent for that purpose. Large quantities are likewise shipped from Madras to Bombay, Bengal, the Mauritius, &c. There are several varieties of this plant, the most distinct having black seeds, and are called Black Gram. The other varieties are green, and therefore called Green Gram. The seeds of *Phaseolus Roxburghii*, W. et A., form another valuable article of food amongst the natives of India; the seeds are reduced to meal from which bread is made for their religious ceremonies. The straw is said to be eaten by cattle with avidity. *P. trilobus*, Ait., is likewise cultivated for the sake of its seed as an article of food. The roots of *P. rostratus*, Wall., are eaten in India, as well as employed by native practitioners in medicine, both for external and internal application. The same may be said of *P. trinervius*, Heyne., being used in rheumatism, and with other constituents as a remedy for snake bites. In Jamaica there are several varieties of *P. vulgaris*, extensively cultivated and eaten as food, some being used in a green state in the same manner as our French bean. When dry they form an excellent ingredient in soups; they are also ground, forming a wholesome and nutritious flour.

The tubers of *Apios tuberosa*, Moench., were shown in the Exhibition of 1851, as a substitute for potatoes; but, they appear not to have answered the expectations, as they are in no way employed as a vegetable in this country now, though used in America, where they are indigenous. They somewhat resemble a potato in their outward appearance, and vary in size from that of a damson to a large egg plum.

Voandzeia subterranea, furnishes a seed called "Bambarra ground nut," much eaten on the Gambia, and in other parts of Africa. *Abrus precatorius*, L., a native of all the tropics, is called in Jamaica the liquorice plant, having a strong flavour of liquorice. The leaves are employed as a substitute for tea, and likewise in medicine. The small scarlet seeds called "Crab's eyes" are very extensively employed in the East Indies, as an ornament, for necklaces, rosaries, &c.; indeed, they seem to be largely used for ornamentation in all countries where they are obtained, on account of the bright permanent scarlet of the testa. So uniform are these seeds in their weight of one grain, that they are employed as a standard weight by the druggists and jewellers in India, and known as the Retti weights. In a pulverised state, they are employed by goldsmiths to promote adhesion in their finer and more delicate work. They are also used in medicine, in various forms, and for various diseases; and have been stated to be of an intensely poisonous nature unless swallowed whole; but this cannot be fully borne out, from the fact that they are eaten in Egypt as an article of food. East Indian Kino is procured from *Pterocarpus marsupium*, Roxb., a large tree, growing in the Neilgherries, Malabar, &c. It is collected by making incisions in the stem, when the resin flows freely in a fluid state, but quickly hardens, becoming very brittle, and of a deep red colour. It is very astringent, and is used for tannin, as also in medicine. We receive it packed in wooden boxes of from one to three cwts. each, chiefly from Bombay or Tellicherry. Kino is met with in commerce procured from other sources than that of the Pterocarpus, as, for instance, from *Butea frondosa*, before mentioned, and in New South Wales, from the *Eucalyptus resinifera.* The tree furnishes a valuable timber, said to be little inferior to Teak, and is employed for building purposes in India. The Red Sanders wood of commerce, sometimes called Ruby wood, is the produce of *Pterocarpus santalinus*, Lin. fil. It is of a very dark red with black veins, susceptible of a high polish, and so dense as to sink in water. Its chief use is for the extraction of its dye, as a colouring agent in medicine, and occasionally for ornamental work, or for turning. It yields a kind of resin or dragon's blood. The Indians use the powdered wood in medicine in various complaints. Our supplies come chiefly from Calcutta, in logs perforated at one end as if for attaching a rope, and worn from apparently being dragged on the ground. The wood of *Pterocarpus erinaceus*, Lam., called African rosewood, is of a remarkably dark and beautiful colour, well adapted for choice cabinet work, as it takes a high polish. This tree grows plentifully on the Gambia, where a resin is obtained from it called Kino, somewhat resembling that from *P. marsupium*, though, perhaps, not of so deep a colour, or bright a fracture. The wood called Andaman Red wood is furnished by *P. dalbergioides*, Roxb. It somewhat resembles mahogany, but of a coarser grain ; the root being the most beautiful part on account of its variegated and curled appearance. May this not be the same tree that furnishes the Amboyna wood, or Kiabooca of commerce ? The beautiful curls and knots in this wood at once stamp it as a burr or root ; it is obtained from the Islands of Ceram, Borneo, and the East Indies. By some it has been referred to *Pterospermum Indicum*, by others to *Pterocarpus draco*, L. This latter assertion seems the most probable ; indeed, there can be very little doubt that it is produced by a species of *Pterocarpus*, but of which it is impossible to say. Can any reader of the TECHNOLOGIST enlighten us ? The heart of the wood of *Macherium Schomburgkii*, known in British Guiana by the native appellation of "Itikiribourraballi," or Tiger wood, on account of its mottled appearance, is used in cabinet-work and is a very beautiful wood.

From the seeds of *Pongamia glabra*, Vent., an oil is expressed used in India for external application in cutaneous diseases, and likewise for burning in lamps, as well as in veterinary practice. The leaves are eaten by cattle, and the wood is employed for various purposes ; it is light, and possesses no beauty for ornamental work. The stem of *Lonchocarpus nicou*, De., is employed by the natives of British Guiana for poisoning fish ; they beat it into a coarse fibre, from which an infusion is made ; this is then thrown into the water where the fish abound : they soon become intoxicated from the effects of the poison, and float on the surface, from which they are easily captured. Rosewood is produced by species of *Dalbergia.* We receive it from Rio Janeiro, Bahia, Honduras, and the East Indies. The first of these is the most esteemed among cabinet-makers; of this, Mr. Bentham says, it is chiefly produced by *Dalbergia nigra.* He also states that Honduras and Martaban rosewoods appear to be produced by species of the tribe *Dalbergia.* The Sissoo wood of the East Indies is produced by *Dalbergia Sissoo*, Roxb., a valuable tree, very extensively employed in India for various purposes, especially by shipbuilders, where bent timber is required, as it is very elastic, and, it is said, more tough than teak.

Dalbergia latifolia, Roxb., furnishes the wood known as East Indian Black wood. It grows extensively and to a large size on the Malabar coast, takes a high polish, and is much used in the construction of furniture. The wood of *Dalbergia lanceolaria*, Lin. fil., is employed in Ceylon for house-building purposes.

Piscidia erythrina, L., a valuable tree growing in Jamaica, affords an excellent timber known as "Dogwood," and much employed there for piles for wharves, and other work in damp or wet situations, because of its strong, durable, and resinous qualities. The bark constitutes a valuable fish poison amongst the natives, who reduce it to a powder by grinding, place it in a bag, which is deposited in some deep and convenient part of the river, when its effects soon spread, leaving the fish free for capture.

Piscidia Carthaginensis, L., also a native of Jamaica, much resembles the former; the wood is known as "bitch wood," and is more esteemed than any other in the island for making naves of wheels. The wood of *Geoffroya superba*, H.B., is hard and durable, taking a fine polish; it is used for building purposes. The fruits called "mari," are eaten in various parts of Brazil; they form the principal food of the inhabitants of the Isle of St. Pedro. The bark of the "Cabbage tree," *Andira inermis*, H.B., a native of the West Indies, was formerly considered a vermifuge, but its use now is almost, if not quite, obsolete. Its properties are narcotic and emetic, fatal cases having arisen from its imprudent use. The wood is used in Jamaica for various economical purposes. The well-known Tonquin bean, so much employed for scenting snuff, is the seed of *Dipteryx odorata*, Willd., a native of Guiana. It owes its pleasant odour to a peculiar principle called "coumarine." A few hundredweights are annually imported for the sole purpose of scenting snuff. The flowers, or rather the flower buds of *Sophora Japonica*, L., yield a yellow dye much used in China, by the name of Hoai-hoa. An interesting account of this dye will be found in the first volume of the TECHNOLOGIST, p. 3. The seeds of *Sophora tomentosa*, L., are employed in India in cases of bilious attack; an infusion of the root is also employed for the same purpose.

Balsam of Peru is the resin obtained by incisions made in the stems of *Myrospermum Pereira*, and other allied species, natives of Central America and the north-west part of South America. The manner employed by the natives in collecting it is by making incisions of from nine to ten inches long by two inches broad in the bark, which is then lifted up, and the apertures stuffed with rags. The tree being previously heated by a brisk fire round it, the rags are suffered to remain for a few days, when they are removed and placed in a pot called an "Olla;" water is added, and they are allowed to boil for five or six hours, by which means the resin is separated from the rags, which are taken out before the water cools, and the resin, on cooling, being of a greater density, sinks to the bottom, where it is collected after the water is poured off. The rags, after removal from the water, and while yet in a warm state, are submitted to heavy pressure, for the purpose of obtaining the balsam still attached to them. It is imported in large earthenware pots of a pear-shaped form, partly covered with basket-work, or in tin canisters. It is used in medicine as a stimulant, and also for making spills for lighting candles, &c., in churches, and for torches. The source of Balsam of Tolu is but imperfectly known. *Myrospermum Toluiferum*, Rich., is no doubt one of its sources. This, like the former, is a native of the north-west of South America, and the manner of collecting it nearly identical, with this exception, that it is said to be collected in "vessels made of black wax." Its properties are similar to Balsam of Peru, but it hardens with greater rapidity. It is used in perfumery, and as a flavouring agent in confectionery. The well-known Tolu lozenges owe their pleasant flavour to this resin. The large fleshy seeds of *Castanospermum Australe*, Cunn., called the Moreton Bay Chesnut, are eaten in that country, either roasted or raw. When roasted, they are said to much resemble the Spanish chesnut, whence their name. They have also been stated to contain astringent properties; but travellers assert that Europeans have subsisted upon them without any unfavourable effects. The brown shining pods are from four to six inches long, and contain two or three seeds, each cotyledon being nearly or quite as large as an ordinary chesnut; the wood is employed for making cask staves.

There are many other plants in this division of the order which furnish products chiefly medicinal; but, being used only in native practice, and with doubtful effects, it has been thought needless to mention them here.

A RECORD OF THE MOST REMARKABLE SPECIMENS OF NATIVE GOLD;

Their Weight, Specific Gravity, Assay, and Proportion of Pure Gold.

BY WILLIAM BIRKMYRE.

1.—"The Welcome Nugget," found by a party of 24 at Bakery Hill, Ballaarat, Victoria, at a depth of 180 feet, apparently water-worn, and of no regular shape, its length being 20 inches, breadth 12, depth 7, containing about 10 lbs. of quartz, clay, and oxide of iron. Previous to finding this great nugget the same party met with some smaller ones weighing from 12 to 45 ozs. It was first sold in Ballaarat, in 1858, for 10,500*l.* After being exhibited for many weeks in Melbourne it was sold there on the 18th March, 1859 ; it then weighed 2,195 ozs., and fetched 9,325*l.*, or 4*l.* 4s. 11d. per oz. Melted in London, Nov., 1859. Date of discovery, 11th June, 1858. Gross weight, troy, 2,217 ozs. 16 dwts. Assay : Gold per cent. 99·20 ; Carats c. grs. 23·3⅛.

2.—" The Blanche Barkly," found by a party of four, quite by itself, at Kingower, Victoria, at a depth of 13 feet, and within 5 or 6 feet of holes dug three years before. It measured 28 inches in length, and 10 inches in its widest part, and apparently contained 2 lbs. of quartz, clay, and oxide of iron. Melted in London, 4th August, 1858. Value, 6,905*l.* 12s. 9d. This nugget, previous to melting, was exhibited in Melbourne, and at the Crystal Palace, Sydenham,where it was an object of great interest, from its bulk, brightness, and solidity, the returns to the fortunate owners for some time being 50*l.* per week. Date of discovery, 27th August, 1857. Gross weight, troy, 174 ozs. 13 dwts. Assay : Gold per cent. 95·58 ; Carats c. grs. 22·3⅝.

3.—Found at Canadian Gully, Ballaarat, Victoria, by a party of four, at a depth of 60 feet, and immediately after, a smaller one, weighing 76 ozs. Two of the party had not been longer in the colony than three months, when they returned to England with their prize in the steamer " Sarah Sands." This specimen, although large, was not very attractive, for both the gold and the quartz were dark coloured. Melted in London in 1853—weight before melting, 1,615 ozs. 10 dwts. ; after, 1,319 ozs. 1 dwt. 12 grs. of fine gold of 98·96 per cent. of pure gold, equal to 1,423 ozs. standard gold, value at 3*l.* 17s. 9d. per oz. 5,532*l.* 7s. 4d., the loss in weight in melting being 296 ozs. 8½ dwts = 18·6 per cent. Date of discovery, 31st Jan., 1853. Gross weight, troy, 1,619 ozs.

4.—Found by a native boy amongst a heap of quartz, on the surface of the ground at Meroo Creek, River Turon, 53 miles from Bathurst, N.S.W. It was in three pieces when discovered, though generally considered as one mass. The aboriginal who discovered these blocks observed " a speck of some glittering substance upon the surface of a block of the quartz, upon which he applied his tomahawk and broke off a portion." One of the pieces weighed 70 lbs. avoirdupois, and gave 60 lbs. troy of gold ; the gross weight of the other two about 60 lbs. each. These three pieces, weighing 1¾ cwt., contained 106 lbs. troy of gold, and about 1 cwt. of quartz. In the same year another nugget, No. 39, weighing 30 lbs. 6 ozs., was discovered in clay, 24 yards from the large pieces ; and in the following year, also near to No. 4, there were found two nuggets, weighing 157 ozs. and 71 ozs. Date of discovery, July, 1851. Gross weight, troy, 1,272 ozs., weight of crushed gold.

5 and 6.—Found at Dunolly, Victoria, two specimens, with gold distributed through a rust-coloured matrix. Melted in Melbourne, October, 1857,

the produce being 1,363 ozs. 18 dwts. of gold. Value, about 5,500*l.* Date of discovery, 1857. Gross weight, troy, 2,952 ozs.

7.—Found by a party of four, at Burrandong, near Orange, N.S.W., at a depth of 35 feet, when pounded with a hammer it yielded 120 lbs. of gold, for which 5,000*l.* were offered. Melted at the Sydney Mint, when it weighed 1,286 ozs. 8 dwts.; after melting, 1,182 ozs. 7 dwts.; loss, 8 per cent.—fineness, 87·4 per cent., the standard weight of gold being 1,127 ozs. 6 dwts. Value 4,389*l.* 8s. 10d. The gold was mixed with quartz and sulphuret of iron (mundic). Date of discovery, 1st Nov., 1858. Gross weight, troy, 1,286 ozs. 8 dwts. Assay: Gold per cent., 87·40; Carats c. grs. 20·3$\frac{7}{8}$.

8.—"The Lady Hotham Nugget," found near Canadian Gully, Ballaarat, Victoria, at a depth of 135 feet. It contains much quartz and sulphuret of iron, but is a fine specimen. From the same hole, there were obtained upwards of 220 lbs., in smaller nuggets. The value of gold, therefore, from this claim, was not less than 13,000*l.* Date of discovery, 8th Sept., 1854. Gross weight, Troy, 1,177 ozs. Specific gravity, 6·093. Estimate weight of pure gold, 755·0.

9.—Found at Miask, Ural Mountains, Russia, at a depth of 9 feet; weight, 87 lbs. 92 zolotniks Russian, (Tegoborski); 36·025 kilogrammes (Humboldt). In bulk it is almost exactly half of an imperial gallon = 138 cubic inches. Its supposed value, at 22 carats (British Standard), containing 8·33 per cent. alloy, is 4,508*l.* 19s. 3d. Preserved in the Museum of Mining Engineers, at St. Petersburgh. Date of discovery, 7th Nov., 1842. Gross weight, troy, 1,158 ozs.

10.—Found at Canadian Gully, Ballaarat, Victoria, by a party of three, who also obtained No. 12 in the same claim, in a drive at a depth of 60 feet, amongst quartz, boulders, and washing-stuff, containing an ounce to the tub—its length, 20 inches by 8½, and 5 inches thick. The first blow of the pick led the miner to suspect it had struck gold; with the second, the pick stuck in the mass. The gold is finely intersected with quartz. The estimated value of both No. 10 and 12—7,500*l.* Date of discovery, 20th Jan., 1853. Gross weight, troy, 1,117 ozs. 11 dwts.*

11.—Found at Blackman's Lead, Maryborough, Victoria, at a depth of 5 feet. Sold in Melbourne, in 1855, for 3,250*l.* Melted by me in the same year. Date of discovery, June, 1855. Gross weight, troy, 1,034 ozs. 5 dwts. Specific gravity, 8·58. Estimate weight of pure gold, 833·14.

12.—Found at Canadian Gully, Ballaarat, Victoria. This mass was found two days after the discovery of No. 10, in the same claim and tunnel, and within 10 feet of No. 3—length, 12 inches, by 6 in breadth, and 6½ inches thick, being somewhat in the shape of a pyramid. This is a very fine specimen, consisting of much gold, with remarkably white quartz. The two working diggers continued at work nearly a fortnight, when they

* This Nugget, and No. 12, valued without taking the specific gravity, there being some litigation relative to the division of the property.

obtained about 100 ozs. of small gold—they now sold their claim for 80 guineas. Date of discovery, 22nd Jan., 1853. Gross weight, troy, 1,011 ozs. 15 dwts.

13.—"The Heron Nugget," found by two young men, near Old Golden Point, Fryer's Creek, Mount Alexander, Victoria. A solid lump of gold. They were offered in the district 4,000*l.*, but refused—(sold in England for 4,080*l.*) Besides this mass, they were likewise fortunate in gold-seeking, although only three months in the colony. In the same locality about three years before, nuggets of 7 lbs. and 22 lbs. were obtained. Date of discovery, 29th March, 1855. Gross weight, troy, 1,008 ozs.

14.—Found at Ballaarat, Victoria, at a depth of 400 feet, a solid lump of gold, and with it 100 ozs. of smaller gold. Date of discovery, August, 1860. Gross weight, troy, 834 ozs.

15.—Found at M'Intyre Diggings, near Kingower, Victoria. Date of discovery, March, 1857. Gross weight, troy, 810 ozs.

16.—Found by two men, at Kingower, Victoria, within a foot of the surface, 18½ inches long, 5½ broad, and an average thickness of 2 inches. Date of discovery, 1860. Gross weight, troy, 805 ozs.

17.—Found at Kingower, Victoria. Date of discovery, Feb. 1861. Gross weight, troy, 782 ozs.

18.—Found at Daisy Hill, Victoria, at 3½ feet from the surface. Date of discovery, 22nd Oct., 1855. Gross weight, troy, 715 ozs. Specific gravity, 7·147. Estimate weight of pure gold, 521.4.

19.—Found near the City of La Paz, situated 12,170 feet above the sea level, on the eastern slope of the Andes in Bolivia, Upper Peru. This nugget weighed 90 Spanish marcs of 3,550½ troy grains per marc = 665 troy ozs. It varied in composition from 75 to 95·8 per cent. gold. Date of discovery, Raynal, 1730. Gross weight, troy, 665 ozs.

20.—Found at M'Ivor, Victoria, at a depth of 16 feet. Date of discovery, Oct., 1858. Gross weight, troy, 658 ozs.

21.—Found at Back Creek, Taradale, Victoria, by a party of three, at a depth of 12 feet, a solid lump of gold, and at the same time about 80 ozs. in small nuggets. The value of the claim at this depth was nearly 3,000*l.* Date of discovery, May, 1856. Gross weight, troy, 648 ozs.

22.—Found at M'Ivor, Victoria. Previous to melting, 2,500*l.* were offered for this nugget. It was melted at the Oriental Bank, and lost 11½ per cent. = 74 ozs. 2 dwts. Date of discovery, 12th Oct., 1855. Gross weight, troy, 645 ozs.

23.—Found in an old hole, at Eureka, Ballaarat, Victoria, smooth and nearly free of quartz. Dimensions, 9 inches long by 7 broad. Date of discovery, 7th Feb., 1854. Gross weight, troy, 625 ozs.

24.—Found at Yandoit, Castlemaine, Victoria. Weight, after cleansing, 581 ozs. 17 dwts., still containing 6 ozs. quartz; estimated value, 2,180*l.* Length, 16 inches; breadth, 10½; thickness varying from ¾ to 2 inches. In the same locality, and within six weeks, five more nuggets were found. Date of discovery, April, 1860. Gross weight, troy, 600 ozs.

25.—Found at White Horse Gully, Bendigo, Victoria, in the same hollow with No. 40 and No. 41. It was partly encrusted with quartz, valued at 2,100*l.* Date of discovery, Oct., 1852. Gross weight, troy, 573 ozs.

26.—Found at Bakery Hill, Ballaarat, Victoria, at a depth of 185 feet. This nugget, and No. 1, were found within 150 yards of each other. Date of discovery, 6th March, 1855. Gross weight, troy, 571 ozs.

27.—"The Nil Desperandum Nugget," found at a rush near the Native Youth, Ballaarat, Victoria, at a depth of 9 feet, with other lumps weighing from 1 oz. to 9 ozs. This mass was nearly solid gold, sold in Melbourne, 4th April, 1859—it then weighed 505 ozs. Assay, 98·80 per cent. gold = 23 carats 2⅝ carat grains; fetched 1,950*l.*, or 3*l.* 17s. 2¾d.per oz. Date of discovery, Nov., 1857. Gross weight, troy, 540 ozs.

28.—Found at Blackman's Lead, Maryborough, Victoria, at a depth of 6 feet, 15th Jan., 1858. Gross weight, troy, 537 ozs. 5 dwts.

29.—Found by an Indian woman, almost on the surface of the alluvium of the River Haina, near to the city of San Domingo, Hayti. This specimen contained some stone, and was said to weigh 3,600 castellanos, which, at 71 troy grains per castellano, equal to 532 ozs. troy. It was shipped to the king of Spain, as a token of the wealth of Columbus's great discovery, but was lost during a storm with 200,000 castellanos = 29,587 ozs. troy of gold. Date of discovery, 1502. Gross weight, troy, 532 ozs.

30.—Found in Victoria, by two men, at a depth of 18 feet. Date of discovery, 1856. Gross weight, troy, 524 ozs. 5 dwts. Specific gravity, 5·99. Estimate weight of pure gold, 335·10.

31.—Found at Bakery Hill, Ballaarat, Victoria, a solid lump of gold in next claim to No. 26, March, 1855. Gross weight, troy, 480 ozs.

32.—Found at the Twisted Gum Tree, Ballaarat, Victoria. Gross weight, troy, 408 ozs.

33.—Found in Reed's Mine, Cabarras County, North Carolina, United States. It weighed 28 lbs. avoirdupois, and was 8½ inches long, 5 broad, and 1 thick; dug up by a negro from within a few inches of the surface. Date of discovery, 1821. Gross weight, troy, 408 ozs.

34.—Found at Kiandra, Snowy River, New South Wales. Date of discovery, Oct., 1860. Gross weight, troy, 400 ozs.

35.—Found at Yandoit, Castlemaine, Victoria, at a depth of 16 feet. Date of discovery, 1860. Gross weight, troy, 384 ozs.

36.—Found at Robinson Crusoe Gully, Bendigo, Victoria, in an old pillar of earth of a deserted claim. Length, 12 inches; width, 6 inches; thickness, from ½ to 2 inches. Date of discovery, March, 1861. Gross weight, troy, 377 ozs. 6 dwts.

37.—Found in Canadian Gully, Ballaarat, Victoria. It contained a good deal of quartz. Sold in Melbourne, March, 1853, for 1,465*l.* 16s. 11d. = 3*l.* 19s. per oz. Gross weight, troy, 371 ozs. 2 dwts.

38.—Found by two diggers in Canadian Gully, Ballaarat, Victoria, at a depth of 60 feet; at the same time another Nugget, No. 85, weighing 143 ozs. 15 dwts., and both about 30 feet from No. 3. Date of discovery, Feb., 1853. Gross weight, troy, 368 ozs.

39.—"The Brenan Nugget," found at Meroo Creek, Turon River, N.S.W., embedded in clay, twenty-four yards from No. 4, measures 21 inches in circumference. Sold in Sydney, 1851, for 1,156*l.* Gross weight, 30 lbs. 6 ozs.

40.—Found by a negro, in the Province of Choco, New Granada, South America. His master presented it to the Cabinet of the King of Spain. Date of discovery, 1793, Humboldt. Gross weight, troy, 364 ozs. 11 dwts.

41.—"The Victorian Nugget," found in the White Horse Gully, Bendigo, Victoria, close to No. 43. Bought for presentation to the Queen by the Colonial Legislature, who paid 1,650*l.*=4*l.* 17s. per oz. Its surface was partly encrusted with quartz and oxide of iron. Date of discovery, 20th Sept., 1852. Gross weight, troy, 340 ozs.

42.—Found at Bendigo, Victoria, in 1854. Gross weight, troy, 338 ozs. 17 dwts. Specific gravity, 13·09. Estimate weight of pure gold 314·3.

43.—"The Dascombe Nugget," found at Bendigo, Victoria. Bright and free from quartz. It was found close to No. 41, amongst gravel, about a foot from the surface. Sold in London, 5th Nov., 1852 (it then weighed 330 ozs., 15 dwts.) for 1,500*l.*, or 4*l.* 10s. 8d. per oz. This was the first largest mass of solid gold found in the British Empire. Date of discovery, Jan., 1852. Gross weight, troy, 332 ozs.

44.—Found at M'Ivor, Victoria, with smaller gold, weighing 35½ ozs., of which nuggets, weighing respectively, 11½ ozs., 11 ozs., 6¼ ozs., and the washdirt remaining, would yield 1 oz. gold to the load. Date of discovery, 1857. Gross weight, troy, 328 ozs.

45.—Found at MacCallum's Creek, Victoria. Gross weight, troy, 326 ozs. 10 dwts.

46.—Found at Miask, Ural Mountains, Russia, near to the surface. Weight 10·117 kilogrammes (15,432·3 grains troy=1 kilogramme, Professor Miller, *Phil. Trans.*, 1856.) Date of discovery, 1826, Humboldt. Gross weight, troy, 325 ozs. 5 dwts.

47.—Found in the Mines of Eastern Siberia; weight, 24 lbs. Russian, (6,320 grains troy=1 lb. Russian.) Date of discovery, 24th April, 1852, Tegoborski. Gross weight, troy, 305 ozs.

48.—Found at Baycito, California, at a depth of 54 feet. This was the largest nugget as yet found in California. Date of discovery, Sept., 1858. Gross weight, troy, 300 ozs.

49.—Found at the M'Intyre Diggings, Victoria, at a depth of 6 feet, in Aug., 1861. Gross weight, troy, 300 ozs.

50.—Found at Kingower, Victoria, by two men in shallow sinking, in 1852. Gross weight, troy, 288 oz.

51.—Found at Bendigo, Victoria, in 1854. Gross weight, troy, 282 ozs. 2 dwts. Specific gravity, 5·25. Estimate weight of pure gold, 162·16.

52.—Found at Kingower, Victoria, in April, 1861. Gross weight, troy, 281 ozs. 17 dwts.

53.—Found at Evan's Gully, Kingower, Victoria.

54.—Found in Victoria, produced when melted 161 ozs. 14 dwts. of gold, containing 97·4 per cent. pure gold. Date of discovery, 1855. Gross weight, troy, 281 ozs. Specific gravity, 5·3. Assay: Gold per cent., 97·4; Carats c. grs. 23·1$\frac{5}{8}$. Estimate weight of pure gold, 159·12·19.

55.—Found at Jones's Creek, Victoria, in 1856. Gross weight, troy, 281 ozs.

56.—Found at Daisy Hill, Victoria, in Jan., 1856. Sold for 1,019*l.* = 74s. 1d. per oz. Gross weight, troy, 275 ozs. 3 dwts. 18 grs. Specific gravity, 14.05. Estimate weight of pure gold, 259·12·12.

57.—Found at Golden Point, Fryer's Creek, Victoria. Gross weight, troy, 264 ozs.

58.—Found at Brown's Diggings, Victoria, a fine nugget. Sold for 1,022*l.* 4s. 6d., or 3*l.* 17s. 7d. per oz. Date of discovery, 23rd Oct., 1856. Gross weight, Troy, 263 ozs. 8 dwts.

59.—Found at Kingower, Victoria, within 4 feet of the surface, in May, 1856. Gross weight, troy, 260 ozs.

60.—Found at Mount Korong, Victoria, in May, 1856, at 1$\frac{1}{2}$ foot below the surface. Valued at 1,000*l.* Gross weight, troy, 255 ozs. 13 dwts.

61.—Found at Gongo Soco, Minas Gereos, Brazil, gold and quartz. Raised from the mine of the late Imperial Brazilian Gold-Mining Association. Date of discovery, 1832. Gross weight, troy, 242 ozs.

62.—Found at Mount Blackwood, Victoria, on the surface of the ground. Composed of gold, quartz, and oxide of iron. Date of discovery, 1855. Gross weight, troy, 240 ozs. 18 dwts. Specific gravity, 6.57. Estimate weight of pure gold, 167·18.

63.—Found at Yandoit, Castlemaine, Victoria, within 20 feet of the surface. A solid lump of gold. Date of discovery, 1860. Gross weight, troy, 240 ozs.

64.—Found in the Ural Mountains, Russia. Gross weight, troy, 240 ozs.

65.—Found at White Hills, Maryborough, Victoria, in 1856, at a depth of 12 feet, a solid lump of gold. Gross weight, troy, 236 ozs.

66.—Found at Kingower, Victoria, within half an inch of the surface, Feb., 1861. Gross weight, troy, 236 ozs.

67.—Found at Cabarras County, North Carolina, United States. Gross weight, troy, 233 ozs. 6 dwts.

68. Found at Kingower, Victoria, on the surface of the ground by a prospecting party, in May, 1860. It was covered with green moss. When freed of quartz and moss, weighed 188 ozs. 15 dwts. Gross weight, troy, 230 ozs.

69.—Found at Carson's Creek, Stanislaus River, California, August, 1850. The property of the Bank of England. Gross weight, troy, 219 ozs.

70.—Found at the New Chum Hill, Kiandra, Snowy River, N.S.W., Date of discovery, July, 1861. Gross weight, troy, 200 ozs.

71.—Found in the Ural Mountains, Russia. Gross weight, troy, 194 ozs.

72.—Found at Mount Korong, Victoria, in Aug., 1859. Gross weight, troy, 192 ozs.

73.—Found on the surface of the ground, at Bryant's Ranges, 12 miles from Castlemaine, Victoria, white quartz and gold, in 1854. Gross weight, troy, 138 ozs. 8 dwts. 12 grs. Specific gravity, 4·41. Assay: Gold per cent., 95·50; Carats c. grs., 22·3⅝. Estimate weight of pure gold, 87.

74.—Found at Tarrengower, Victoria, in May, 1855. Gross weight, troy, 180 ozs.

75.—Found at Maryborough, Victoria, in 1854, gold, quartz, and oxide of iron. Gross weight, troy, 178 ozs. 16 dwts. Specific gravity, 5·25. Estimate weight of pure gold 108·14.

76.—Found in California—Received at the United States Mint, 1849. Gross weight, troy, 174 ozs.

77.—Found in the Ural Mountains, Russia. Gross weight, troy, 171 ozs.

78.—Found in Victoria, in 1853. On the surface of this nugget there was only a slight indication of gold, and until the specific gravity was taken it was almost valueless. Indeed, this was one of the most remarkable specimens ever tested. After taking the specific gravity it was purchased to the mutual satisfaction of both parties; it was then broken up, when a solid lump of gold of an oval form was found in the centre. Gross weight, troy, 166 ozs. 10 dwts. Specific gravity, 3·1. Estimate weight of pure gold, 29.

79.—Found in Calaveras Co., California, at 15 feet from the surface. Estimated to contain 80 per cent. solid gold, at 17 dols. per oz. = 2,128 dols. or 459*l.* Gross weight, troy, 160 ozs. 10 dwts.

80.—Found at Kiandra, Snowy River, New South Wales, in March, 1860. Gross weight, troy, 160 ozs.

81.—Found at Meroo Creek, Turon River, New South Wales, near to No. 4, in 1852. Gross weight, troy, 157 ozs.

82.—Found at Evans's Gully, Kingower, Victoria, in 1861. Gross weight, troy, 153 ozs. 10 dwts.

83.—Found in Anson County, North Carolina, United States, in 1829, Whitney. Gross weight, troy, 145 ozs. 16 dwts.

84.—Found at Jones's Creek, Mount Moliagul, Victoria, in 1855. Gross weight, troy, 145 ozs. 5 dwts.

85.—Found by Chinamen, at Creswick Creek, Victoria, in May, 1860. Gross weight, troy, 144 ozs. Specific gravity, 6.74. Estimate weight of pure gold, 102.

86.—Found in Canadian Gully, Ballaarat, Victoria, Feb. 1853, at a depth of 60 feet, at the same time with another No. 38. Sold in Melbourne, March 4th, 1853 (when it weighed 142 ozs. 15 dwts. for 567*l.* 8s. 6d. = 3*l.* 19s. 6d. per oz. Gross weight, troy, 143 ozs. 15 dwts.

87.—Found at Jones's Creek, Mount Moliagul, Victoria, at a depth of

20 feet. After pounding to extract some quartz, it weighed 126 ozs. Gross weight, troy, 140 ozs.

88.—Found at the Tooloom Diggings, N.S.W., nearly solid gold. Date of discovery, 1860. Gross weight, troy, 140 ozs.

89.—Found at Jim Crow, Victoria, at a depth of 4 feet, in Sept., 1858. Gross weight, troy, 136 ozs.

90.—Found at Mount Korong, Victoria, 4½ feet from the surface, in Oct., 1856. Gross weight, troy, 132 ozs. 9 dwts. Specific gravity, 5·62. Estimate value of pure gold, 90·14.

91.—Found in Victoria, in 1854. Gross weight, troy, 128 ozs. 2 dwts. 12 grs. Specific gravity, 11·14. Estimate weight of pure gold, 103.

92.—Found at Yecorata, Sinaloa, Mexico. It weighed 16 marcs 4 ozs. 4 ochavas; fineness 22 carats. Deposited in the Royal Cabinet at Madrid. Date of discovery, about 1771, Robertson. Gross weight, troy, 122 ozs. 10 dwts. 5 grs.

93.—Found at Kingower, Victoria, by a boy, a few inches beneath the surface, in Sept. 1858. Gross weight, troy, 120 ozs.

94.—Broken off quartz rock in a mine at Tarrengower, Victoria (quartz specimen), in 1861. Gross weight, troy, 119 ozs. 14 dwts. 18 grs. Specific gravity, 4·94. Estimate weight of pure gold, 64·7·2.

95.—Found in California. Received at the United States Mint, 1849. Gross weight, troy, 115 ozs. 12 dwts.

96.—Found at Dunolly, Victoria, in 1854, gold, quartz, and oxide of iron. Gross weight, troy, 110 ozs. 9 dwts. Specific gravity, 12·05. Estimate weight of pure gold, 100·2·14.

97.—Found at Kingower, Victoria, in Sept., 1861. Gross weight, troy, 106 ozs. 15 dwts.

98.—Found at Mount Moliagul, by Chinamen, in Nov., 1857; a solid lump of gold. Value 400*l.* Gross weight, troy, 104 ozs. 8 dwts.

99.—Found at Kingower, Victoria, in Sept., 1861. Gross weight, troy, 100 ozs. 10 dwts.

100.—Broken off quartz rock in a mine at Tarrengower, Victoria, in 1861. Gross weight, troy, 99 ozs. 10 dwts. 17 grs. Specific gravity, 4·00. Estimate weight of gold, 28·6·0.

101.—Found at Sonora, Mexico. Weight, 3 kilogrammes. Humboldt. Gross weight, troy, 96 ozs. 9 dwts.

102.—Found, in 1855, at Jim Crow, Victoria. Gross weight, 95 ozs. 6 dwts. Specific gravity, 4·88. Estimate weight of gold, 50·12.

103.—Found at Kiandra, Snowy River, New South Wales, in March, 1860. Gross weight, troy, 93 oz. 18 dwts.

104.—Found at Black Hill, Ballaarat, Victoria, Oct., 14th, 1851, a solid mass of gold, being the first largest piece of solid gold raised in the colony, or in any part of the British dominions. Gross weight, troy, 90 ozs.

105.—Found at Louisa Creek, New South Wales, gold and quartz, Oct. 25th, 1851. Gross weight, troy, 90 ozs.

106.—Found at Louisa Creek, New South Wales, a solid lump of gold, in 1851. Gross weight, troy, 82 oz.

107.—Found at Mount Blackwood, Victoria, in 1851. Gross weight, troy, 78 oz. 19 dwts. 6 grs. Specific gravity, 5·84. Estimate weight of pure gold, 50·90.

108.—Found in Canadian Gully, Ballaarat, Victoria, in the same hole with No. 3, Jan. 31st, 1853. Gross weight, troy, 76 oz.

109.—Found in Victoria, in 1854. Gross weight, troy, 65 ozs. 3 dwts. Specific gravity, 7·3. Estimate weight of pure gold, 48·40.

110.—Found by two boys at Gundagai (new diggings), N.S.W., in July, 1861. Gross weight, troy, 64 ozs. 7 dwts.

111.—Found in Victoria, in 1855. Gross weight, troy, 61 oz. 18 dwts. Specific gravity, 5·18. Estimate weight of pure gold, 34·17.

112.—Found in Victoria, in 1854. Gross weight, troy, 60 oz. 9 dwts. Specific gravity, 5·05. Estimate weight of pure gold, 33·12.

113.—Found in Victoria, in 1851. Sold in Melbourne, 7th January, 1852, for 72s 9d. per oz., the price of gold-dust, at the same time and place, being 59s. the oz. Gross weight, troy, 58 ozs. 18 dwts.

114.—Found at Store Creek, a tributary of the Nicholson river, Gipps Land, Victoria, being the largest lump yet found in Gipps Land. Date of discovery, Jan., 1861. Gross weight, troy, 58 oz.

115.—Found in Victoria, in 1855. Gross weight, troy, 57 oz. 15 dwts. Specific gravity, 6·56. Estimate weight of pure gold, 40·20.

116.—Found in Victoria, in 1854. Gross weight, troy, 51 ozs. 17 dwts. 12 grs. Specific gravity, 12·06. Estimate weight of pure gold, 47·1.

117.—Found at Louisa Creek, N.S.W., gold and crystalline quartz, in 1857. Gross weight, troy, 50 ozs.

118.—Found in Victoria, in 1854. Gross weight, troy, 49 ozs. 14 dwts 12 grs. Specific gravity, 4·829. Estimate weight of pure gold, 26·2.

119.—Detached from the parent rock, Tarrengower, Victoria (quartz specimen.) Date of discovery, 1861. Gross weight, troy, 49 ozs. 19 grs. Specific gravity, 5·01. Estimate weight of pure gold, 26·15·0.

120.—Found in Victoria, in 1855. Gross weight, troy, 47 oz. 17 dwts. Specific gravity, 4·55. Estimate weight of pure gold, 23·8.

121.—Broken from the quartz of a mine at Tarrengower, Victoria (quartz specimen.) Date of discovery, 1860. Gross weight, troy, 44 ozs. 4 dwts. 6 grs. Specific gravity, 3·53. Estimate weight of pure gold, 13·2.

122.—Found at Mount Blackwood, Victoria, in 1855. Gross weight, troy, 42 ozs. 11 dwts. Specific gravity, 9·43. Estimate weight of pure gold, 36·5·0.

123.—Found at New Chum Hill, Kiandra, N.S.W., in July, 1861. Gross weight, troy, 42 oz.

124.—Found in Victoria, in 1854. Gross weight, troy, 39 ozs. 17 dwts. Specific gravity, 4·52. Estimate weight of pure gold, 19·4·0.

125.—Broken off quartz rock in a mine at Tarrengower, Victoria (quartz specimen), in 1860. Gross weight, troy, 28 ozs. 15 dwts. 12 grs. Specific gravity, 4·11. Estimate weight of pure gold, 11·4·0.

126.—Found at Leadhills, Lanarkshire, Scotland, about 1502. Gross weight, troy, 27 oz.

127.—Found at Croghan Kinshela, County Wicklow, Ireland. It contained about 92·3 per cent. gold, 6·27 silver, and 0·78 iron. Date of discovery, 1797. Gross weight, troy, 22 ozs.

128.—Found at Merri Jig Creek, Gipps Land, Victoria. Gross weight, troy, 18 ozs. 16 dwts.

129.—Broken from quartz rock at Tarrengower, Victoria (quartz specimen.) Date of discovery, 1861. Gross weight, troy, 18 ozs. 16 grs. Specific gravity, 6·87. Estimate weight of pure gold, 12·3·16.

130.—Found at Croghan Kinshela, County Wicklow, Ireland, in 1797. Gross weight, troy, 18 oz.

131.—Found at Summer Hill Creek, New South Wales, 13th May, 1851. The earliest nugget found in New South Wales, after the gold discovery there by Hargreaves. Gross weight, troy, 13 oz.

132.—Found at Mount Blackwood, Victoria, in 1855. Gross weight, troy, 11 oz. 3 dwts. 11 grs. Specific gravity, 5·69. Estimate weight of pure gold, 6·18.

133.—Detached from quartz rock, at Tarrengower, Victoria (quartz specimen), in 1861. Gross weight, troy, 9 oz. 7 dwts. Specific gravity, 10·10. Estimate weight of pure gold, 7·19·21.

134.—Found at Weisskirch, Austria, in 1851. Gross weight, troy, 9 oz.

135.—Found at Rocky River, Nelson, New Zealand, quite free from quartz, in 1858. Gross weight, troy, 8 ozs. 14 dwts.

136.—Found at Newfane, Vermont, United States, in 1826 ; gold, with rock crystal. Gross weight, troy, 8 oz. 10 dwts.

137.—Found in New Zealand ; gold and dark-coloured quartz. 1853. Gross weight, troy, 8 oz.

138.—Found at Canoona, Port Curtis, Queensland, in 1859. Gross weight, troy, 7 ozs.

139.—Found at Touffe des Pins, Canada. Gross weight, troy, 4 ozs.

140.—Found at Echunga, South Australia, in Oct., 1852. Gross weight, troy, 2 ozs. 14 dwts.

141.—Found in Breadalbane, Perthshire, Scotland. Gross weight, troy, 2 ozs.

142.—Found at Leadhills, Lanarkshire, Scotland ; in the Cabinet of the late Lord Hopetoun. Gross weight, troy, 1 oz 10 dwts.

143.—Found at Echunga, South Australia, seven feet below the surface in 1852. Gross weight, troy, 1 oz. 10 dwts.

144.—Found at Avoca, Victoria, in 1856, encrusted with black oxide of manganese. Gross weight, Troy, 17 dwts.

145.—Found in the parish of Creed, Cornwall, England, in 1756. Borlase. Gross weight, troy, 15 dwts. 3 grs.

146.—Found at Tangier (new diggings), Nova Scotia, in 1861. Gross weight, troy, 15 dwts.

147.—Found in Fingal, Tasmania. Gross weight, troy, 12 dwts.

148.—Found at Ballaarat, Victoria ; much water-worn. Gross weight, 10 dwts. 19 grs. Specific gravity, 18·871. Assay : Gold per cent., 99·18 ; Carats c. grs. 23·3⅛.

149.—Found in Kildonan, Sutherlandshire, Scotland. Gross weight, troy, 10 dwts.

150.—Found at Kingower, Victoria ; it contained 61·9 per cent. gold, and 0.25 silver—the remainder composed of carbonate of bismuth and oxide of iron. Its appearance led many dealers in gold to suppose it was spurious metal. Any particles dropped into an acid effervesced strongly. An uncommonly rare specimen. Gross weight, troy, 5 dwts. Specific gravity, 11·1.

The following data are deduced from the above Record. 1st. That gold in nuggets, even of large size, may be found on the very surface of the ground as in No. 4, and at a depth of 400 feet as in No. 14. 2. Gold in large masses may be found, as in No. 14, without a particle of quartz, or any other non-metallic body. 3. Though it is usual to find with nuggets quartz (oxide of silicon), alumina (oxide of aluminum), and rust (oxide of iron), these solid bodies being the most abundant in nature, yet such gold is also found with substances which are not common, such as iron pyrites, black oxide of manganese, and the very rare salt carbonate of bismuth. 4. It is interesting to observe that where carbonate of bismuth has been found along with gold, as at Kingower, the same locality has yielded an unusual number of large nuggets. 5. That gold in large masses, as in No. 1, is almost as pure, viz., 23 carats 3⅛ c. grains, as the very finest gold-dust, viz., 23 carats 3⅜ c. grains. 6. The purest nuggets, like native silver and iron, have never been found absolutely free from alloy, that is chemically pure. 7. Silver and iron form the usual alloy of the purest gold in large masses, and these metals are also found in the purest gold-dust. 8. The variety of substances recorded above as accompanying masses of gold, seem to confirm the fact lately announced, that though gold be obtained almost invariably in the metallic state, yet like silver and all the common metals, it may also be found as an oxide. Dr. Percy, of London, having produced minute traces of gold from litharge (protoxide of lead) white lead (carbonate of lead) and sugar of lead (acetate of lead), and I have—after many careful experiments —extracted gold from the red crystals of tin-ore (peroxide of tin) found at the Ovens. 9. The largest mass of gold on record (No. 1) was found in Victoria in 1858 ; this pepita was almost twice as heavy and valuable as the great Russian nugget found in 1842, and four times that of the famous "grain of gold" found in Hayti in 1502. 10. As the largest lumps (pepitas Nos. 1 and 2) of gold ever known were discovered in Victoria, though not until six years after the gold discovery there, it is probable that still larger masses will yet be found.

Assay Office, Melbourne.

THE MANUFACTURE OF KELP.

BY EDWARD C. C. STANFORD F.C.S.

The manufacture of kelp, or the burning of sea-weed to obtain its ash, was commenced about the middle of last century, and was first carried on for the value of the carbonate of soda contained in it, but when the high war duties were taken off foreign barilla and salt, kelp, for which the demand had been very great, deteriorated in value and was scarcely worth making. The carbonate of soda is never now extracted from this source; the yield was always small, and it is now obtained so cheaply from common salt. At the beginning of the present century, during the war, Highland kelp realised from 20*l.* to 22*l.* per ton. M'Culloch states that the kelp shores of the island of North Uist alone let for 7,000*l.* per annum: that the Hebrides afforded 6,000 tons of kelp per annum, and the total produce of Scotland was 20,000 tons per annum, an amount which has never been manufactured since throughout Great Britian. When the duty was taken off barilla, Highland kelp fell to 3*l.* per ton, and very little was produced. In 1812, iodine was discovered by M. Courtois manufacturer of saltpetre, in Paris. The discovery was announced by M. Desormes, at the meeting of the French Institute on the 19th of November, 1813. The attention of the discoverer was first arrested by the destruction of his copper pans employed in the decomposition of nitrate of lime by the alkaline lye of the kelp. Having constantly observed this phenomenon, he attempted its solution, and after much patient research, and many failures, he succeeded in tracing the effect to the cause, and in preparing iodine in a state of purity. The manufacture of saltpetre having failed, Courtois took to the preparation of iodine as a source of profit, but in consequence of its then very limited application, the enterprise was unsuccessful, and the project was abandoned, but it was taken up afterwards by MM. Cournerie, at Cherbourg, and there are still iodine works in that neighbourhood. Although, like many inventors, Courtois gained nothing by his discovery; a late distinguished English chemist turned it to good account, and made a large sum of money by buying up all the mother liquors of the Scotch kelp works, and extracting the new body. This element, iodine, has since been found widely diffused in nature, particularly in some aluminous slates, in varieties of coal and turf, in Chili nitre, in the silver and mercury ores of Mexico, and also recently by M. Chatin, though his conclusions are doubted by some chemists, in fresh-water plants, rain water, and dew. It exists also in many mineral waters, some of which owe their medicinal effects to its presence, and in cod liver oil. Some marine animals also contain it, oysters and sponges for instance. Kelp, however, is the only commercial source for its production, and the immense value of iodine, in photography and medicine particularly, has given an impulse to the manufacture of kelp, which renders it by far the most important of all the applications of seaweed.

As at present carried on, it has many disadvantages; these are well-known to chemists, but, probably from the fact that it is conducted on desolate shores, at a considerable distance from centres of civilisation, it has not yet received that attention its importance demands.

The manufacture is at present limited to a few parts of Great Britain, the western and northern islands of Scotland, the north-west coast of Ireland, and Guernsey.

In the Scotch islands the weeds are collected in the summer, dried in the sun, and burned in shallow rectangular pits; the fire requires a very high temperature, and the salts enter into igneous fusion; the fused mass is broken up by throwing water on it, and the kelp thus produced is a vitreous conglomerate, in the best specimens of which the carbonised stems of *Laminaria digitata* may be distinguished. It is of this plant—called bardarrig or the "drift weed"—that the most valuable kelp is made; if unadulterated it will yield the lixiviator from 10 lbs. to 15 lbs. of iodine per ton. The "cut-weed" is the *Laminaria saccharina*, called "Slatenvarra," but this is mixed with several Fuci, and generally the latter predominate; the kelp produced from it does not afford more than half the iodine yielded by the former.

The kelp in the north-west of Ireland is made principally from the "drift weed" consisting of "sea rods," as the *Laminaria* is there called; it is burnt in small heaps, and at a lower temperature; the kelp produced is, consequently, more porous and much richer than that from the western islands. Some of the drift weed, too, is stacked in the winter for burning in the summer; a portion of the Irish kelp is made from "cut weed," principally the Fuci.

Professor Graham first directed attention to the seaweed ash of Guernsey as the richest source of iodine; this results from the fact that the *Laminaria digitata* is used, and a very low heat is employed in the production of the ash. Mr. Arnold, of Guernsey, is the only lixiviator of kelp there, and he informed me that the local government had more than once tried to stop the lixiviation altogether, and owing to the peculiar laws of that island he is unable to carry it to any great extent. A large manufactory in one of the Channel Islands could produce immense quantities of iodine and potash, and the insoluble ash would still be retained as manure.

I am indebted to Mr. William Paterson, of Glasgow, who alone lixiviates nearly four-fifths of the kelp of commerce, for the following statistics of the actual annual average amounts of kelp paid for, with the prices on the kelp shores. Those prices do not include freight and other charges incidental to the carriage of kelp to Glasgow. The average is taken on the last two years.

WESTERN ISLANDS.

1,800 tons cut weed kelp, at £2	... ...	£3,600
800 „ drift weed „ „ 4	... ...	3,200
400 „ „ „ „ 6	... ...	2,400
3,000		£9,200

ORKNEY AND SHETLAND ISLANDS.

1,200 tons drift weed kelp, at £6		£7,200
150 „ cut „ „ „ 2 10s.		375
1,350		£7,575

IRELAND.

2,500 tons drift weed kelp, at £4		£10,000
500 „ „ „ „ 3 10s.		1,750
1,000 „ „ „ „ 5		5,000
500 „ „ „ „ 6		3,000
200 „ „ „ „ 6 5s.		1,250
80 „ „ „ „ 7		560
1,300 „ cut weed „ „ 2 13s.		3,445
6,080		£25,005

TOTAL AMOUNT OF KELP, AND AVERAGE PRICE, FOR THE YEARS 1860-61.

Scotland, ...	4,350 tons,	at about £3 17s.,	valued at £16,775
Ireland ...	6,080 „	at 4 2s.,	„ 25,005
	10,430		£41,780

In round numbers, the average yield of British kelp may be taken at 10,000 tons, giving, at 4*l.* per ton, an annual income of 40,000*l.*

This quantity of kelp represents about 200,000 tons of wet weed, an amount which, large as it seems, is insignificant compared to the immense masses of sea-weed annually deposited on the coasts of Great Britain and Ireland. The best drift weeds appear to be torn up from the Atlantic, as they are found chiefly on the western coasts in Guernsey and Jersey, the best are taken from the bays on the west coast. The "cut weed" is the same all round the islands. A great deal of drift weed, however, finds its way up the Channel, and is washed in and out of the numerous harbours and thrown on the flat coasts, this is particularly the case in Brading Haven, in the Isle of Wight, where it is carried in and out in large quantities. Many thousands of tons of sea-weed of various kinds are deposited annually on the coasts of Sussex, but a small portion of which is utilised. Kelp is also still manufactured on the coast of Normandy in France. The weeds obtained are very similar to those of the Channel Islands. MM. Tissier, ainè, et fils, of Finisterre, are the principal manufacturers of iodine and potash in France. Their statements will astonish those who consider England to be in advance in this branch of industry ; their position among the first and largest lixiviators of kelp, and their well-known name, are alike guarantees of their ability to judge, and to speak practically of this question They estimate the total annual production of kelp (soude brut) in France at 25,000,000 kilogrammes ; this is about 24,000 tons, or more than double the yield of the kelp shores of Great Britain. MM. Tissier alone, in their Usine de Conquet, work annually 4,000,000 to 5,000,000 kilogrammes. They have favoured me with the following interesting table of the products annually extracted from this source by the seven principal factories in France :—

Usines.	Iode et Iodure de Potassium	Brome et Bromure de Potassium	Chlorure de Sodium.	Chlorure de Potassium.	Sulphate de Potasse.	Nitrate de Potasse.
	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.
Le Conquet .	20,000	1,500	800,000	500,000	200,000	200,000
Granville .	20,000	800	800,000	...	...	1,000,000
Cherbourg .	5,000	...	200,000	180,000	80,000	...
Montsarac .	4,500	...	180,000	150,000	75,000	...
Pont-l'Abbé .	4,000	200	150,000	140,000	70,000	...
Portsall . .	4,000	...	150,000	140,000	65,000	...
Quatrevents.	2,500	...	100,000	90,000	50,000	...
	60,000	2,500	2,380,000	1,200,000	540,000	1,200,000

The lixiviation of British kelp is almost confined to Glasgow ; a small portion only is worked in Ireland and Guernsey. There are six principal lixiviators—of these, Mr. W. Paterson is by far the largest ; he works from 7,500 to 8,000 tons per annum. His enormous factory is well worth a visit, and I am glad of an opportunity of acknowledging his attention and courtesy in showing me over it. The process usually followed is sufficiently simple ; the kelp is lixiviated with water, and the solution evaporated ; the sulphate of potash deposits first in small crystals, and then the chloride of sodium ; these are separately collected, and the solution is then run off into iron coolers, where a crop of crystals of chloride of potassium is deposited in three or four days. This process is repeated with the mother liquor, and after the second crop of chloride of potassium has crystallised out, the mother liquor is very dark and contains sulphides ; oil of vitriol is added to decompose these, and much sulphur is precipitated ; this is one of the bye-products of the factory. The liquor, after the addition of the oil of vitriol, is decanted from the deposited sulphur, and distilled with binoxide of manganese in leaden retorts ; the iodine sublimes, and is received in earthern vessels.

This process is simple and effective, and I can suggest no improvement ; but its success is entirely dependant on the preparation of the kelp employed, and it is in the primary treatment of the seaweeds that reform is so much needed. As I shall have further to speak of the working up of seaweeds containing little iodine, I may just indicate that probably the best means of extracting it from the mother liquor of these, would be that recently discovered by MM. Stephanelli and Doveri. In their process, the liquor is evaporated to dryness, mixed with peroxide of manganese, and the iodine distilled off from earthern retorts ; this saves the oil of vitriol, which is always used in Glasgow. I propose first briefly to enumerate the disadvantages of the present method of making kelp ; then to examine some suggestions for its improvement already proposed by others ; and, lastly, to publish my own researches on the subject, and their results.

The disadvantages of the present method are principally the following:—

1st. The high temperature developed in burning, by which much of the iodine is volatilised, and some of the potash; the loss of iodine is equal to the present yield.

2nd. The high temperature also enables the carbon to deoxidise the alkaline sulphates, reducing them to sulphites, hyposulphites, and sulphides. These become concentrated in the mother liquor, remaining after the extraction of the salts, and entailing a large expenditure of oil of vitriol for their reconversion into sulphates. Dr. Wallace (in a paper read before the British Association, at Aberdeen, September 14, 1859), estimates the cost of extracting all the salts and the iodine from kelp, at from 25s. to 28s. per ton, of which from 11s. to 13s. are expended in oil of vitriol. The importance of this disadvantage is therefore obvious; the addition of the oil of vitriol to the mother liquor sets free large volumes of sulphuretted hydrogen, a noxious gas, very difficult to get rid of, resulting from the decomposition of these sulphur compounds. To such an extent is this deoxidation carried, that kelp prepared from the *Fuci,* which are rich in sulphates, gives off sulphuretted hydrogen on simple solution in water.

3rd. The crude manner in which the weed is burned in a rough clay pit, or in heaps on the beach, the kelp thus becoming mixed with the clay, sand, or stones, which are sometimes also employed as adulterations to the extent of 50 per cent.

4th. The general neglect of the winter supply, on account of the difficulty of drying the weeds at that season. This consists principally of the deep sea algæ, torn up by storms; it occurs in the greatest quantity, and is also much the richest in iodine and potash. Yet this is almost entirely lost. Even in the summer, during a wet season, large quantities of drift weed collected by the kelpers are rotted by the rain, and rendered useless for burning; and this, says Mr. Paterson, "was the fate of many thousands of tons during the last kelp season."

5th. The entire loss of the heat produced, and the products of combustion.

6th. The dense smoke and unpleasant odour evolved in burning, banishes the kelp burner to desolate shores, and, consequently, increases the distance of the lixiviating factory; the ash in its long transit suffers much by exposure to rain; and the residuum of lixiviation, a valuable manure in the country, is a bye product in a city. It may be urged, also, that the poor kelpers in their arduous work, receive but a small part of the real value of their labour. These evils have been frequently urged, and are universally admitted; some reforms have even been proposed.

Dr. Kemp has suggested a process, which consists in selecting the stems of those algæ which are the richest in iodine, and crushing them; they are then set by in a tank for a few days, and the most soluble salts, including the iodides, extracted by cold water acidified with hydrochloric acid. The solution is then treated with chloride of lime, and the iodine thus set free precipitated by amido-acetate of lead. The cakes of weed left after pressure are dried and used as fuel, the ashes being preserved *on account of the iodine they still retain*, as well as the other salts. This process has not been adopted probably because the manipulation, down to the burning of the fuel into ashes, is a complicated labour, superadded to the ordinary process, and with little advantage, for the ashes have still to be worked for iodine and potash. The crushing of the weeds, and the drying of the crushed cakes, present great practical difficulties, which those who have had any experience in compressing fresh vegetables will fully appreciate. Dr. Wallace's suggestion in the paper before referred to is more simple ; he states that it is rather given to call attention to the subject than as a perfect process. He wishes to supersede the present fused kelp by a loose charred ash. He recommends the weed to be charred rather than burnt, and, as this ash, from its bulk, would be inconvenient for carriage, that it should be lixiviated with a small quantity of water, and the solution roughly evaporated to dryness. He says, "By this treatment a very pure salt would be obtained, the iodine would be wholly preserved, while the cost of working would be more than counterbalanced by the saving of vitriol that would be effected by the absence of the sulphur compounds." This idea meets some of the difficulties of the question, but not all, the saving of iodine would to a great extent be effected, it would make just the difference which now exists between the best Highland kelp and that of the Channel Islands—the former a vitreous mass, with more than half the iodine volatilised, the result of igneous fusion—the latter a loose charred ash, the result of slow combustion, at a low temperature, and containing much more of the iodine. The difficulty, however, of completely charring on open slabs such a substance as seaweed, is considerable, and the salts resulting from its lixiviation would be coloured by any portion not thoroughly carbonised. The Guernsey kelp gives coloured solutions and dirty salts, which require recrystallisation before they can be brought into the market. It may be remarked of Dr. Wallace's suggestions, that they could not be carried out under cover, except by elaborate arrangements, on account of the offensive smoke occasioned by the products of combustion, which in his process are entirely dissipated.

My own researches were commenced by an estimation of the potash and iodine in seven of the commonest species of seaweeds ; the results are shown in the following Tables :—Nos. 1, 2, 3, 4, and 5, are the present kelp-bearing species. Nos. 1 and 2, *Laminaria digitata* and *Laminaria saccharina* are the general constituents of "drift weed," or "vraic venant" of the Channel Islands. Nos. 3, 4, and 5, the *Fucus vesiculosus*, *Fucus serratus*, and *Fucus nodosus* are generally the "cut weed," or "vraic scié," of the Channel Islands. Nos. 6 and 7, the *Zostera marina* and *Rhodomela pinastroides*, have not yet been employed in the manufacture of kelp. They are exceedingly common all round the English coast, particularly the south ; the latter has received no application, the former is largely used in stuffing mattresses.

The analyses are stated so as to show at a glance the relative value of each weed for commercial purposes. The water is that driven off at 212°.

The organic matter includes the charcoal and everything dissipated in burning. In the analyses of the soluble portion of the ash, the potash and sulphuric acid are stated separately, and the alkaline chlorides indicate the total amount of chlorides of potassium and sodium, supposing the two alkalies existed entirely as chlorides. This was considered the best means of stating the results for comparison. A small proportion of carbonic acid contained in some of the salts was not estimated, because practically it is not separated. The kelp is the fused ash obtained in an open porcelain crucible. The best seaweed for working commercially would be that containing the most iodine and potash, and the least sulphuric acid.

The estimations of iodine were the results of a separate set of experiments, in which the weeds were carefully carbonised in a covered porcelain crucible, at a low red heat. The iodides were dissolved from the charcoal with water, and the iodine estimated as iodide of palladium. Thus treated, the weeds were found to yield much more iodine than when burnt, even at the same temperature, in an open vessel. When thoroughly burnt, the poorer weeds gave results which could scarcely be appreciated. *Laminaria digitata* gave 19 per cent., or less than half the yield from the charcoal; 19 per cent. corresponds to 12·77 lbs. per ton of kelp, and the iodine usually obtained from the best commercial kelp made from this weed seldom exceeds this amount. Mr. Paterson, who may be considered the highest authority on this question, states the present yield of iodine from good drift weed kelp to vary from 8 to 14 lbs., but the low quality of drift weed kelp produced in the islands of North and South Uist, and the county of Donegal, does not yield him more than from 4 to 6 lbs. per ton of 22½ cwt. He accounts for the bad quality of the kelp of Uist by the large admixture of sand from the shores of those islands. It is probably also much mixed with inferior seaweeds. The statement of the amount of iodine from the *Laminaria digitata* is the average of three estimations, and to show the amount that ought to be obtained from this species, I may state that this corresponds to 32 lbs. of iodine per ton of kelp (20 cwt.) Many of the analyses of seaweeds hitherto published have been performed on different kelps, and as these always contain the ash of several species, little dependence can be placed on them as an index of the relative composition of each species. The plants here experimented on were carefully selected. The amount of iodine will be seen to be exceedingly small in the *Fucus vesiculosus*, and kelp made from that seaweed alone would be valueless. It would yield only ·99 lb. per ton, but practically it always contains the ashes of others sufficient to bring it up to about 4 lbs. per ton. Sarphati estimated the iodine in this species to be ·001 per cent.

I would call attention to the large yield of potash from that very common weed, No. 7. The soluble ash it yields is very variable in quantity, the fronds being always more or less covered with zoophytes, which largely increase the amount of ash without adding to the soluble portion. The results given are the mean of three analyses. The potash was in all cases estimated as the double chloride of platinum and potassium.

TABLE I.

Wet Seaweeds, Centesimal.	1 Laminaria digitata.	2 Laminaria saccharina.	3 Fucus vesiculosus.	4 Fucus serratus.	5 Fucus nodosus.	6 Zostera marina.	7 Rhodomela pinastroides.
Water - - - - -	82·000	81·000	71·000	78·500	58·000	82·000	83·000
Organic Matter - - -	12·710	12·920	23·280	16·220	35·030	14·720	12·878
Soluble Ash - - - -	4·170	4·810	4·100	3·360	4·880	2·580	2·940
Insoluble Ash - - -	1·120	1·270	1·620	1·920	2·090	·700	1·182
Total - - -	100·000	100·000	100·000	100·000	100·000	100·000	100·000
Yield of Kelp - - -	5·900	6·600	7·100	6·100	7·630	3·320	6·368
Dry Seaweeds, Centesimal.							
Organic Matter - - -	70·112	67·646	80·358	75·079	83·412	81·796	65·748
Soluble Ash - - - -	23·560	25·598	14·079	15·859	11·614	14·319	17·297
Insoluble Ash - - -	6·328	6·756	5·563	9·062	4·974	3·885	16·955
Total - - -	100·000	100·000	100·000	100·000	100·000	100·000	100·000
Yield of Kelp - - -	33·335	35·112	24·381	28·782	18·159	18·444	37·460
Composition of the Soluble Ash.							
Total amount of Sulphuric Acid	2·135	1·627	4·165	4·620	2·927	1·498	2·619
Total amount of Alkalies expressed as Chlorides - -	21·526	23·886	11·400	14·396	10·733	13·209	15·910
Total amount of Potash -	6·893	8·958	2·043	4·408	2.546	3·940	6·075
Total amount of Iodine - -	·4788	·1583	·00985	·0382	·0422	·0457	·0378

Many have been struck by the peculiar odour evolved in burning sea-weed; this at the outset of these experiments arrested my attention, and led me to examine the products evolved in combustion. For this purpose various species of algæ were dried, and submitted to a low red heat in a cast-iron retort; and the products of distillation collected in a series of large Woulff's bottles; these products were in all cases the same, differing only in quantity:—

An inflammable gas;

Water, containing carbonate and acetate of ammonia, and a kind of naphtha;

A fluid tar, containing a volatile oil, some of which also floated on the water.

A light charcoal remained in the retort; this was lixiviated with water, and treated as ordinary kelp; the solutions obtained were colourless, and the salts perfectly white and pure. The mother liquor formed a striking contrast to those usually seen; it was nearly colourless, and contained mere traces of sulphur compounds; the amount of iodine yielded was unusually large.

The products of distillation were then examined. The gas burnt exceedingly well, giving a flame of little luminosity at first, but becoming very luminous towards the end of the distillation. A portion collected at first gave 41·66 per cent. of carbonic acid. Another portion, collected towards the end of the distillation, gave only 13·3 per cent. of carbonic acid, and contained olefiant gas. The gas given off in the distillation of wet weed is also inflammable, but the flame is occasionally extinguished by the vapour of water thus simultaneously generated; a portion of this gas gave 50·84 per cent. of carbonic acid.

The condensed liquid was very alkaline; it yielded ammonia in abundance on distillation with lime. The ammonia appears to exist in the liquid as bicarbonate—crystals of this salt were found in some of the gas tubes. The chloride of ammonium in the crude state prepared by neutralising this with hydrochloric acid has an odour of picoline, an alkaloid which is also found in the volatile oil. The naphtha distilled from this liquid burns with a slightly luminous flame. Rectified over lime, its specific gravity is ·826, this commences to boil at ·155°; it is not a simple substance, but appears to be a mixture of acetone and methylic spirit; by repeated rectification I have succeeded in reducing the boiling point of the first portion below 140° Fah., but I have been unable to effect any definite separation of it, either by treatment with chloride of calcium or by repeated fractional distillation. It has been found impossible to separate methylic spirit from alcohol by this means, although the boiling points of the two liquids differ by about 30° Fahr. I was not surprised, therefore, that I failed to separate the two spirits believed to be the components of this naphtha, the boiling points of which differ only 10°. The presence of acetone considerably improves its value, as a solvent of sandarac and shellac. It has also, in the crude state, a peculiar odour, from the presence in small quantity of some ethereal body, of which I have not yet obtained sufficient for examination.

The residuum in the still, after the distillation of the ammonia and naphtha, was found to be a solution of acetate of lime ; distilled with hydrochloric acid, this furnished acetic acid, the last portions of which contained also butyric acid.

The tar was distilled with water, a volatile oil of very peculiar odour was thus obtained ; the odour recalls that of burning seaweed. In the crude state it contains about 1·2 per cent. of the naphtha, and about 1·6 per cent. of a body analogous to kreosote. Diluted hydrochloric acid removes from it about 3·7 per cent. of a mixture of volatile alkaloids containing picoline, &c., and a red pitchy colouring matter is separated. It also contains pyrrol. After purification with oil of vitriol and caustic soda, the oil presents the appearance and properties of a mixture of pure hydrocarbons analogous to those from coal-tar naphtha. Its sp. gr. is 841, and its boiling point rises from about 180° to above 400° Fahr. This oil must not be confounded with that obtained by Dr. Stenhouse, in distilling some species of Fucus with sulphuric acid, and named by him fucusol, and from which he prepared fucusamide and fucusine. The oil here treated of is a pure hydrocarbon, and has not been hitherto obtained from this source. It will be applicable to many of the uses for which coal-tar naphtha is so much in demand. The colouring matter separated by an acid from the oil is a product of decomposition. It is soluble in oil of vitriol, gacial acetic acid, alcohol, and methylic spirit. It is insoluble in water, either cold or boiling, and separated from all its solutions by its addition ; it is also insoluble in chloroform, ether, benzole, bisulphide of carbon, oil of turpentine, the fixed oils, and dilute acids. It is unaffected by boiling hydrochloric acid. Nitric acid has no effect on it in the cold, but decomposes it when boiling, forming oxalic acid. Boiling oil of vitriol carbonises it. It is decolorised by chlorine. The caustic alkalies partially decolorise, but do not dissolve it ; the colour is restored by an acid. It is, however, chiefly remarkable in containing iodine, and it holds it in such close combination that boiling solution of potash does not remove it, and it is only when fused with hydrate of potash that it can be detected. It is thus converted into oxalate of potash and iodide of potassium, it was found to contain 35 per cent. of iodine. I do not anticipate that it will be valuable as a dye, as it shows a tendency to fade ; in a chemical point of view I look forward with interest to its thorough examination when I shall have obtained it in sufficient quantity ; the greater the heat employed in distilling the weed, the more of this substance is produced. The tar, after the volatile oil had been removed, presented the appearance of Stockholm tar, which it might well replace ; it was then distilled alone, and a fixed oil thus separated ; this contains on an average 5·2 per cent. of a crude acid, analogous to kreosote. The oil, after this has been removed by potash, is purified with oil of vitriol, and it then resembles the paraffin oil of commerce. It will thus be seen that all these products are of considerable commercial value, and it remains now to show what are the quantities yielded—the same species were experimented on for this purpose—the weeds were compressed into cakes, and distilled in a small iron gas retort—the quantitative results are shown in the following tables.

TABLE II.

Products Obtained by the Destructive Distillation of Dry Seaweeds, Centesimal.

Species.	Laminaria digitata.	Laminaria saccharina.	Fucus vesiculosus.	Fucus serratus.	Fucus nodosus.	Zostera marina.	Rhodomela pinastroides.
Charcoal, including Ash -	43·750	47·040	38·040	45·450	35·166	43·272	56·610
Tar - - - - - -	1·861	2·123	3·835	2.474	3·116	·805	1·078
Aqueous portion - - -	24·509	27·151	31·988	24·978	24·434	25·341	29·931
Gas - - - - - -	29·880	23·686	26·137	27·098	37·284	30·582	12·381
Total - - -	100·000	100·000	100·000	100·000	100·000	100·000	100·000
Products from the Water and Tar.							
Volatile Oil - - - - -	·707	·708	·989	·825	not estimated.	·312	·319
Paraffin Oil - - - -	·698	·796	1·438	·928	1·168	·302	·404
Naphtha - - - - -	·450	·427	·616	·315	not estimated.	·355	·480
Ammonia, or as - - -	·609	·965	·736	·862	·929	·537	·611
Sulphate of Ammonia - -	2·362	3·713	2·794	3·348	3·606	2·086	2·373
Acetic Acid, or as - - -	·194	·245	·620	·652		·181	·272
Acetate of Lime - - -	·259	·326	·816	·469		·241	·363
Colouring Matter - - -	·041	·093	·127	·077	not estimated	·028	·029
Volatile Iodine - - -	·00724	·007039	not estimated.	·003128		not estimated.	not estimated.
Products from the Charcoal.							
Pure Charcoal - - -	13·862	14·695	18·398	20·529	18·578	25·068	22·358
Chloride of Potassium - -	10·831	14·104	3·216	6·940	4·008	6·203	9·693
Chloride of Sodium - -	10·695	9·782	8·184	7·456	6·725	7·006	6·217
Insoluble Ash - - -	6·328	6·756	5·563	9·062	4·974	3·885	16·955
Iodine - - - - -	·4788	·1582	·00985	·0382	·0422	·0457	·0378

TABLE III.

Products Obtained by the Destructive Distillation of Dry Seaweeds, per Ton.

Species.	Laminaria digitata.	Laminaria saccharina.	Fucus vesiculosus.	Fucus serratus.	Fucus nodosus.	Zostera marina.	Rhodomela pinastroides.
	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.
Charcoal, including Ash	8 84	9 46	7 68	9 10	7 4	8 73	11 36
Tar	41·8 lbs.	47·5 lbs.	86 lbs.	55·4 lbs.	69·8 lbs.	18 lbs.	24·1 lbs.
Aqueous Portion	55 galls.	61 galls.	72 galls.	56 galls.	54 galls.	57 galls.	67 galls.
Gas (Approximative)	1,205 c. ft.	956 c. ft.	1,052 c. ft.	1,089 c. ft.	1,504 c. ft.	1,234 c. ft.	500 c. ft.
Products from the Water and Tar.							
Volatile Oil	253·4 oz.	253·7 oz.	254·5 oz.	295·7 oz.	not estimated.	111·8 oz.	114·3 oz.
Paraffin Oil	250·2 oz.	285·3 oz.	515·4 oz.	332·6 oz.	418·6 oz.	108·2 oz.	144·8 oz.
Naphtha	161·3 oz.	153 oz.	220·8 oz.	112·9 oz.	not estimated.	127·2 oz.	172 oz.
Sulphate of Ammonia	52·9 lbs.	83·2 lbs.	62·6 lbs.	75 lbs.	80·8 lbs.	46·7 lbs.	53·2 lbs.
Acetate of Lime	5·8 lbs.	7·3 lbs.	18·3 lbs.	10·5 lbs.	not estimated (Acetate of Lime, Colouring Matter, Volatile Iodine)	5·4 lbs.	8·3 lbs.
Colouring Matter	·92 lbs.	2 lbs.	2.8 lbs.	1·7 lbs.		·63 lbs.	·65 lb.
Volatile Iodine	·1622 lbs.	·1576 lbs.	not estimated.	·07007 lb.		not estimated.	not estimated.
Products from the Charcoal.							
	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.
Pure Charcoal	2 86	2 105	3 76	4 12	3 80	5 7	4 52
Chloride of Potassium	2 19	2 92	0 72	1 43	0 90	1 27	1 105
Chloride of Sodium	2 15	1 107	1 71	1 55	1 38	1 44	1 27
Insoluble Ash	1 30	1 39	1 13	1 91	0 111	0 87	3 43
Iodine	10·72	3·54	·221	·856	·645	1·024	·847

The following table is constructed to show the great loss of valuable products in the present manufacture of kelp. The quantity of iodine estimated as lost is approximative, as it is impossible exactly to calculate it; but I believe it to be here rather under than over-stated. The actual difference I found in the *Laminaria digitata* is shown in the first column. The amount of chloride of potassium stated as obtained is above the actual yield on the large scale, as part exists as sulphate, and much is driven off by the high temperature of the kelp fires.

Products now Obtained from a Ton of Kelp, and those which would be added by the New Process of Manufacture.

Now Obtained.

Species.	Laminaria digitata.	Laminaria saccharina.	Fucus vesiculosus.	Fucus serratus.	Fucus nodosus.	Average.
	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.	Cwt. lbs.
Chloride Potassium - -	6 56	8 20	2 72	4 96	4 46	5 35
Chloride Sodium - - -	6 45	5 53	6 78	5 24	7 41	6 25
Insoluble Ash - - -	3 89	3 103	4 63	6 38	5 53	4 92
Iodine - - - - -	0 12·77	...	...	...	...	0 5

Added by the New Process.

Volatile Oil - - - -	$4\frac{3}{4}$ galls.	$4\frac{1}{2}$ galls.	$9\frac{2}{3}$ galls.	$6\frac{1}{2}$ galls.	not estimated.	$6\frac{1}{4}$ galls.
Paraffin Oil - - - -	$4\frac{3}{4}$ galls.	$5\frac{1}{6}$ galls.	$13\frac{1}{5}$ galls.	$7\frac{1}{3}$ galls.	$14\frac{1}{3}$ galls.	9 galls.
Naphtha - - - -	3 galls.	$2\frac{3}{4}$ galls.	$5\frac{2}{3}$ galls.	$2\frac{1}{2}$ galls.	not estimated.	$3\frac{1}{2}$ galls.
Sulphate of Ammonia - -	1 cwt. 46 lbs.	2 cwt. $17\frac{1}{4}$ lbs.	2 cwt. $32\frac{1}{2}$ lbs.	2 cwt. $38\frac{1}{2}$ lbs.	3 cwt. $108\frac{1}{2}$ lbs.	2 cwt. 48 lbs.
Acetate of Lime - - -	$17\frac{1}{2}$ lbs.	21 lbs.	75 lbs.	$36\frac{3}{4}$ lbs.	not	37 lbs.
Colouring Matter - - -	$2\frac{3}{4}$ lbs.	$5\frac{3}{4}$ lbs.	$11\frac{1}{2}$ lbs.	6 lbs.	estimated.	$6\frac{1}{2}$ lbs.
Pure Charcoal - - -	8 cwt. $35\frac{1}{2}$ lbs.	8 cwt. 59 lbs.	15 cwt. 10 lbs.	14 cwt. 41 lbs.	20 cwt. 49 lbs.	13 cwt. 39 lbs.
Gas (approx.) - - -	3615 c. ft.	2771 c. ft.	4313 c. ft.	3811 c. ft.	8272 c. ft.	4456 c. ft.
Iodine - - - - -	19·39 lbs.	...	...	...	...	5 lbs.

The tar is that left after distilling in the presence of water. The volatile oil, having thus been removed, is stated separately, its weight being included in the aqueous portion. The paraffine oil is distilled from this tar; the paraffin in it was not estimated. The pitch left behind in the distillation was not weighed. The naphtha, volatile oil, and paraffin oil were in all cases measured, as (in the crude state) impurities tell more on the weight than on the measure.

The *Fucus nodosus*, No. 5, I could not obtain in sufficient quantity for distillation. The ammonia, tar, and oils were estimated in a tube experiment on the small scale. The measures of gas in all the tables are only approximative. A portion of the iodine is found among the products of distillation, and that is expressed in the tables as volatile iodine.

The products obtained from the residual charcoal are also shown in the tables, the alkalies, for convenience, being expressed as chlorides. The pure charcoal is the total amount of pure carbon yielded, and shows the value of each weed for heating purposes. The ash is pure, containing 20 per cent. of earthy phosphates; unadulterated kelp, as usually obtained, contains about double the quantity of ash there stated, the difference being unconsumed carbon; as, however, it contains the same amount of phosphates, it would be worth no more than the quantity here indicated.

These analyses conclusively prove that the present method of manufacturing kelp is an exceedingly wasteful one; for not only are the constituents of the ash largely dissipated, but these valuable products of distillation are all volatilised into the air; and taking as a rough calculation 10,000 tons to be the annual yield of kelp, we have the following quanties annually disposed of in this manner:—

Volatile oil	62,500 galls.
Fixed oil	90,000 „
Naphtha	34,000 „
Ammonia:—(Calculated as sulphate)............	1,216 tons.
Acetic Acid:—(Calculated as acetate of lime)...	167 „
Pure carbon..	6,674 „
Colouring matter	29 „
Gas	45,560,000 cubic ft.
Iodine..	50,000 lbs.

I leave commercial men to affix the values to these products, and then weigh the amount against the 40,000*l.* at present paid for the residuum of this waste. Can we wonder that the kelper works in rags? Can we be surprised that his operations are confined to desolate sea shores? Or is it astonishing that the kelp districts bring little revenue to their proprietors —that the tenants pay little or no rent, when they thus throw half their harvest away? It is difficult for those who have not visited these coasts to form an idea of the vast accumulations of seaweed thrown up in the winter, yet these, universally admitted to be the most valuable, are all lost. Is it possible that the utilitarian spirit of this age will permit this enormous waste to continue? Unless the lairds of the kelp districts take the subject up themselves it will still be so, for they cannot expect their poor tenants to erect works for this purpose, as the lion's share of the advantage must ultimately fall to their own lot. With the view of interesting them in the subject, I beg to call attention to the following proposed improvements:—

1. Seaweeds of all kinds are to be stored in sheds; they keep perfectly well under cover; they should be first collected in heaps, to drain off the superficial water, and then laid out in drying sheds; in summer, advantage may be taken of the sun's rays. Seaweeds when laid out thin, are not so difficult to dry as is generally supposed, and when dry keep perfectly well under cover.

2. The seaweeds thus dried are then to be compressed into cakes, by hydraulic or other pressure; this is not essential, but the cakes occupy less room in stowage, and if the charcoal obtained is to be used for fuel, this treatment improves it.

3. The cakes, or the unpressed weed, are then to be distilled at a low red heat, in iron retorts; the tar and aqueous products to be collected in suitable condensers, and the gas in a gasometer. The gas may be employed for heating the stills used for rectifying the products, for heating the drying sheds, or even for lighting the factory; it might even be treated according to Pettenkofer's method of superheating, and used as a means of lighting a district. The best kind of retort for the purpose will, I think, be cylindrical vessels of wrought iron, heated externally, and placed vertically, having the base and also the upper end conical; the former furnished with an air-tight iron damper plate, for withdrawing the charge when the carbonization is complete, and the latter provided with a moveable iron hopper for introducing the charge.

4. The charcoal is to be lixiviated and treated as ordinary kelp, and then thrown out in heaps to dry in the air. When raked from the retorts it should be allowed to fall into the lixiviating water, or into iron boxes, to protect it from the air; if the latter plan be adopted their heat may be rendered available for drying the weeds by wheeling them into the drying shed. The lixiviation will require larger tanks for its conduction than those at present employed, on account of the greater bulk of the charcoal; it has the advantage, however, of floating on water, and as the water in contact with it, when saturated, sinks to the bottom, it is quickly replaced by a fresh portion, and the solution is thus rapidly effected. The solution would be roughly evaporated to dryness, and the salt thus obtained sold to the lixiviator.

5. The washed and air-dried charcoal is to be used for heating the retorts and evaporating the solution of the salts. Should, however, peat be very abundant in the neighbourhood this charcoal may be manufactured into manure, by treating it with the ammoniacal liquid; or be applied to some of the many uses for charcoal, and the peat employed as the fuel. The ash from the charcoal is a valuable manure; it usually contains over

20 per cent. of earthy phosphates. A few samples I have examined gave me the following results :—

	1	2	3	4
	Laminaria digitata.	Laminaria saccharina.	Highland kelp.	Zostera marina.
Phosphates of lime and magnesia	24·16	18·50	22·83	15·90
Carbonates of lime and magnesia	16·10	20·11	18·38	16·37
Sand, &c.	56·76	57·78	56·56	65·36
Charcoal	2·98	3·61	2·23	2·37
	100·00	100·00	100·00	100·00

The phosphates of magnesia predominate, and these are partially soluble in water. The proportion of phosphate is about that in Peruvian guano, and if the crude ammoniacal salt obtained by distillation were added in the proportion of about 40 per cent., a manure would be obtained worth from 10*l.* to 12*l.* per ton, of which from 3 cwt. to 4 cwt., would be sufficient for an acre of land. The phosphate of magnesia it contains points to its special application to beet-root and clover. Mixed with about 5 per cent. of the chlorides of potassium and sodium, it would be equally beneficial to other root and cereal crops. Liebeg divides crops, according to their wants, into three classes—potash plants, lime plants, and silica plants ; such a manure contains the food for all or either of these.

6. The products of distillation I recommend to be treated as follows :— The tar is syphoned off, and distilled with an equal measure of water in an iron tar still ; the light volatile oil passes over with the condensed water, on which it floats. This is decanted, and treated with a dilute sulphuric acid, which removes picoline and other oily bases, and the red colouring matter is deposited. This substance is washed and dissolved in spirit, and the solution deposits it on evaporation. The light oil is then agitated with from 5 to 10 per cent. of oil of vitriol, washed with water and caustic soda, and finally re-distilled. The residual tar, from which the light oil has been removed, is then pumped into another iron still, and a stronger heat applied. The paraffin oil is thus obtained, and purified by oil of vitriol, caustic soda, and re-distillation. The residual pitch may be employed for the manufacture of patent fuel, &c., or pumped while hot into brick ovens provided with an iron pipe to carry off the heavy vapours, and subjected to a red heat, by which a further portion of paraffin oil is obtained, and a good coke left in the still, commercially valuable to ironfounders on account of its freedom from sulphur. The liquid in the condensers, being separated from the tar, which sinks to the bottom, is mixed with excess of lime, and distilled in a capacious iron still provided with a suitable condenser. Ammonia and naphtha pass over, and are received into hydrochloric acid. The solution of acetate of lime remaining in the still is run out, evaporated to dryness, and the black, impure acetate thus obtained purified by charring, re-crystallisation, distillation, or conversion into acetate of soda. The ammoniacal distillate which has been neutralised by hydrochloric acid is re-distilled till the specific gravity of the distillate rises to nearly that of water.

This is best distilled by the agency of steam. The first portion which comes over is the naphtha ; this is collected separately, the weaker liquor subsequently distilled being returned to the still with the next charge. Redistillation over quick lime yields it in a state of purity. The solution of chloride of ammonium remaining in the still is run out, evaporated, crystallised, and the crystals sublimed according to the ordinary method of making sal ammoniac of commerce.

This, then, is the process, and it offers the following advantages :—

1. Retention of the whole of the iodine.

2. Easy and rapid lixiviation, colourless solutions and pure salts.

3. Absence of sulphur compounds in the mother liquor, great saving of oil of vitriol, and no evolution of poisonous gases.

4. Factory to a great extent self-supporting, having its own means of heat and light, the fuel being extracted from the weed itself.

5. Manufacture continuous, affording employment to the kelpers all the year round, and at a higher rate of remuneration.

6. Extension of the manufacture, as this process allows a much larger margin for profit, and admits of the lucrative working of the commonest weeds, which will not, I anticipate, be allowed to rot on the shores of Great Britain when their commercial value becomes known.

These, then, are the principal features and advantages of this process ; no doubt improvements may be developed in its minor details when it is worked on a large scale, but its general plan I believe to be the desideratum. If it be advisable that the ash should be sold for lixivation to replace the kelp of commerce, it may be made more portable by raking the charcoal out into the air, when it gently consumes at a low temperature, and forms a loose ash containing very little carbon ; the charcoal would thus be sacrificed, though an arrangement could easily be made by which it might be allowed to fall into an open chamber under the drying shed, and its heat of combustion thus made available. This might be adopted with poor weeds, such as the grass wrack, which are largely mixed with sand ; but all those employed in the present manufacture of kelp should, I think, be treated as I have recommended. I have also tried distillation in a blast of air, but although the products obtained are nearly the same, the temperature is so liable to rise with the attendant evils alluded to, that I prefer the method I have indicated. Theories have been circulated amongst scientific men to show that the weeds on the Irish and Scotch western coasts only contain iodine in quantity, because they are nourished by the Gulf Stream, which impinges on these coasts, and is considered to be the carrier of iodine from the Gulf of Mexico. My experiments have led me to the conviction that iodine is pretty universally distributed in sea-water ; that a large proportion of iodine is confined to a very few species of algæ, though nearly all contain traces ; and that those species contain the same proportion wherever they may be found, but differing for each species and the way in which they are burnt. Thus, the weeds on which my experiments were conducted, were all collected on the south coast of England where they have been supposed to contain no iodine. Reference to my analysis, will afford a conviction to the contrary. There are many seaweeds, however, which contain little iodine, but are well worth working for potash; thus grass wrack contain 15 per cent. in the ash, and *Rhodomela pinastroides* 16 per cent., and these have never been worked. The extraction of chloride of potassium from sea-weed is not sufficiently thought of, as it is now one of our principal sources of saltpetre, on which so much depends in time of war; this is now made very largely by the decomposition of nitrate of soda by chloride of potassium. Considering, then, the great value of seaweeds as a source of potash, and as the only available source for that very valuable element iodine, it is not a question as to whether they should or should not be worked, but it is an absolute commercial necessity that the iodine and potash should be extracted from them and the question is, what is the best method of doing it?

It is a remarkable fact that the principal commercial sources of ammonia are carbonised plants, in the shape of coal; and that these plants were mostly cryptogamic, and very near the algæ in the botanical scale; the present century has developed a source of unbounded national wealth in the former, and I believe that a great future is open to the latter. We reckon a country's riches not so much by its gold and silver as by the coal it is enabled to produce and consume; and although we do not now believe in the transmutation of metals, and we have desisted from our ancestors fruitless searches for the philosopher's stone, the spirit of alchemy is still amongst us, and it presides over the extraction of valuable products from cheap and apparently useless materials. Seaweeds have been regarded in the latter class, and these researches will I hope be the means of directing attention to their intrinsic value.

If I am not too sanguine in my expectations, a great reform will be introduced into, and a largely increased income will be derived from, the kelp-bearing districts of Scotland and Ireland, the social state of their inhabitants will be greatly ameliorated; and even in wealthy England "Algæ inutilis est," will be no longer a proverb.

ON BALSAM SEEDS.

BY THOMAS D. ROCK.

New products, as a rule, meet with a very indifferent reception in the English market, and the enterprise of travellers and foreign merchants in developing the varied resources of the universe, is often but ill-requited. Sometimes the fault lies in selecting materials which satisfy no present want of commerce, but for which a demand has to be created; and although the product itself may be intrinsically valuable, and subsequently come into general use, yet the process of establishing a new trade, amongst a people with such strong prejudices as the English, is so slow, that the original importer almost invariably suffers loss, and rarely derives any benefit from his enterprise. Deficiency of information concerning the origin and properties of a new substance, is another fertile source of injury to experimental importations; and inasmuch as the TECHNOLOGIST is specially designed to aid merchants and manufacturers in identifying such products as are introduced, from time to time, without any sufficient description attached to them, I propose to write a few lines on some Leguminous pods which were recently sold at public sale under the title of Balsam seeds.

These Balsam seeds, or, as botanists will say, Balsam *fruit*, had been in the country some time, and were offered for sale on several occasions, but were bought in because the price tendered was too low and unremunerative. They proved to be the leguminous pods of the Peruvian Balsam tree *Myrospermum peruiferum* of De Candolle, *Myroxylon peruiferum* of other authors, a tree inhabiting certain parts of Central America.* It is represented as an elegant tree, with a thick and straight trunk, and having a grey, coarse, and heavy bark of a pale yellow colour. Leaflets oval, obtuse, and nearly opposite. Flowers white, calyx bell-shaped, with five petals. Stamens ten in number, and free. The seed-vessels, which form the immediate subject under consideration are samaroid or club-shaped legumes of a dingy straw colour, and slightly shrivelled when ripe and dried; most usually one-celled, though frequently found with two. The seeds, which are of variable shape, bordering on the crescent form, occupy the clubbed and broad part of the capsule in the centre, the pod tapering towards the edges on all sides. On both sides of the seed, cell, and adjoining, are convex cells filled with white balsam, the quantity for each fruit being about the size of a pea in bulk; this balsam is precisely like that which exudes naturally from the tree, and its presence in the seed-vessels serves to show how completely the tree is charged with the odoriferous resin.

1. Fruit of Myroxylon.
2. Longitudinal Section of Ditto.
3. Transverse Section of Ditto, showing seed and Balsam cells on either side.
4. Seed of Ditto, medium size.

* An article on Balsam of Peru will be found at vol. i., p. 59 of the TECHNOLOGIST.—EDITOR.

The seeds themselves possess a delicious odour when fresh, greatly resembling the Tonquin bean, and might possibly be used as a substitute for that much-admired perfume, but they will not keep for any length of time without losing their value as a scent, and turn rancid.

Previous to the passing of those laws which forbade the adulteration of snuff with Tonquin beans, these balsam seeds would, perhaps, have been appreciated, and might have realised a price remunerative to the shippers; but with the present low value of the former, consequent upon a very limited demand, I fear these seeds are not likely to be seen again in the English market for many years to come, unless they shall be found to possess other virtues than those which are so pleasingly palpable to the olfactory sense.

The odoriferous principle of the Tonquin bean is termed Coumarline with the formula $C_{18} H_6 O_4$, that of these balsam seeds is either the same or something nearly analogous. A faint perfume of laurel is sometimes traceable. I have also fancied that oil of bitter almonds could be distinguished, and this may be derived from the Benzole, $C_{14} H_5 O_2$ which the balsam contains largely.

When sold a few months since without reserve, these balsam seeds (three bags) realized 5d. to 6d. per lb. The balsam they contain may possibly be extracted by boiling, but the quality will suffer in the process, and the quantity, doubtless, prove small in proportion to the bulk.

Reviews.

Researches on the Principal Vegetable Productions of Tahiti. By G. Cuzent. Rochfort: Ch. T. Lege.

This is an admirable work, full of valuable technological information, to which we would especially direct the attention of enquirers after useful practical information respecting tropical products, and more especially those indigenous to, and cultivated in, the Pacific Islands. Mr. Cuzent has given us the results of his careful examinations and chemical analyses of most of the roots, barks, woods, gums, and oils, having any economic value, and of the dye-stuffs, starches, &c.; he has also corrected many prevalent errors as to plants and products, and furnished an amount of practical and recent useful information respecting the Society Islands, which may be sought for in vain elsewhere.

In a conspectus of the flora of Tahiti, contributed chiefly by M. Planchir, the Government botanist, we find 532 plants enumerated, of which 248 had been introduced, and had become more or less naturalised.

The Canadian Naturalist and Geologist for December contains a paper, by Dr. Dawson, F.G.S., on the recent discoveries of gold in Nova Scotia, an account of animals useful to the Indian Tribes (which we have extracted), and a notice of the Parsnip Chervil.

THE TECHNOLOGIST.

ON KAVA OR AVA *(PIPER METHYSTICUM.)*

BY G. CUZENT.

Pharmacien in the French Navy.

Formerly, the natives of Tahiti were only acquainted with one intoxicating drink, which they prepared by chewing the fresh root of the "Ava" (*Piper methysticum*), and immediately rinsing the disintegrated tissues impregnated with saliva, in water. But about the year 1796, the Europeans having taught them to ferment the fruits of the country, they acquired an immoderate passion for the new and boisterous drunkenness that these spirits produced. From that time, they submitted to fermentation the juice of oranges (*Anani*), the "pomme cythere" (*Visi*), the baked and macerated roots of the *Dracœna terminalis* (Ti.), the juice of the pineapple (*Païnapo*), the fruits of the Pandanus (*Fara*), the bruised pulp of the fruit of the Fehii (*Musa fehii* of Bertero), &c., &c.

In order to distinguish these new spirits from their original ava, which they named *Ava Madhi* (indigenous), or *Ava-Tahiti*, they called them *Ava Papœa* (foreign), applying to them likewise the names of the fruits from which they had been prepared: *Ava-Anani* (orange brandy), *Ava-Vihi, Ava-Ti, Ava-Painapo, &c., &c.*

The *Piper methysticum* of Forster, *Macropiper methysticum* of Miquel, belongs to the family of the *Piperaceœ* indiginous to the isles of the Pacific, it is known at Tahiti under the names of *Ava, Ava-Ava, E vava;* at the Marquesas islands it is called *Kava, Kava-Kava.* The Anglo-Tahitien dictionary designates it under the names of *Ava, Kawa, Kawa-Kawa.* The plant is cultivated in several islands for preparing the intoxicating drink of which we have spoken. Many varieties of it occur, of which some grow in dry soils, others on the banks of rivulets, or in very damp ground. The properties of the latter species are generally very feeble. The natives employ indifferently this or that Kava, and recognise the species by the mild form, the rapid action, or the lasting effects of the intoxication which it produces.

The *Piper methysticum* is a shrub, the root of which weighs, on an average, from 2 to 4 lbs., but which often attains larger dimensions, weighing 22 lbs. and more. It is entirely covered with a grey epidermis, white in the interior, sometimes of a citron yellow colour, as in the variety called *Marea.* The spirit prepared with this variety is yellower than that which is obtained from all the others. Occasionally it acquires a rosy tint, by exposure to the air, as in the variety *Avini-Ute.* The root loses 55 per cent. of water on drying, becomes very light, and assumes a yellowish colour.

Chewed in the freshly-gathered state, it tastes first sweet and aromatic, then bitter, acrid, and pungent. It provokes abundant salivation, and in the course of a few seconds, occasions a sensation of burning on the tongue.

Ava is not much cultivated in Tahiti, the use of the drink being nearly obsolete. Some old men may still be met with, however, on the Peninsula who are unable to acquire a taste for our alcoholic liquors, and who, whenever a great occasion occurs, subject themselves to privations in order to save sufficient money to purchase a root of Ava, for which they sometimes pay as much as 5 piastres.

At the Marquesas, its cultivation is carefully attended to, and many varieties of the plant are found there. The natives drink, in company, every morning, one or more draughts of this inebriating beverage, but like the Tahitiens, they prefer the more powerful intoxication produced by wine, gin, absinth, and brandy, to the milder effects of Kava. At the Tonga islands, this indigenous spirit has maintained all its ancient uses and reputation.

Method of preparing the Kava Spirit.—The roots are chewed by girls, or in their absence, by boys. For this delicate operation only those are selected who have good teeth. Before commencing, they wash their mouths and hands, and arrange special vessels, of unexceptionable cleanliness, for the reception of the masticated root.

They never use any other than fresh roots, which chew very much better than the dry. The mastication is slowly performed, and no morsel of root is ejected until the fibrous tissue is thoroughly divided, and the whole forms a homogeneous bolus.

When the supply of Kava is chewed (the quantity varies according to the number of those who are to partake of it), the fibrous boluses, yellow and viscid with saliva, are collected in a large bowl of wood, supported on three legs, called Umete,* and they are then mixed with a certain quantity of water, and gently squeezed by the hand. The mixture being effected, the ligneous particles, which float in the liquid, are removed by means of a handful of the filaments of the *Cyperus cinctus* (Môu), prepared at the time by crushing the green and tender stalks of the plant, and drawing them repeatedly between two pieces of wood. Passed with care and fre-

* Specimens of these vessels may be seen in the Museum at Kew.—Ed.

quently through the liquid, the filaments collect the fibrous particles, and soon nothing is left in suspension except a tolerably large proportion of fecula. They sometimes use the fluid contained in the cocoa-nut instead of water, for mixing with the chewed root. The beverage is always served out immediately after its preparation, without allowing it to undergo the least fermentation.

Kava is essentially a fluid drink, and of by no means attractive appearance, uninviting especially to a person who has witnessed its preparation. The colour reminds one of café-au-lait, but sometimes, when the leaves of the plant have been chewed with the root, a green colour is imparted to the beverage, which gives it a resemblance to the liquor absinth, but it does not partake of the flavour of that liquor, as has been stated in the excellent article on the Islands of the Pacific (Oceanie), published in the 'Revue Contemporaire.'

The aromatic odour of the Kava spirit rapidly attracts the little flies; the natives, therefore, take the precaution of covering the vessel containing it either with the leaf of the Taro (*Arum esculentum*), or with a piece of the leaf of the banana.

The flavour is at first sweet, it then tastes pungent and acrid. In some islands, the Kava root is mixed with very little water; its effects are then rapid, and half a cupful—that is, one of our glasses full—suffices to overpower the most robust of the natives. At the Marquesas, the draught is calculated by the number of mouthfuls of chewed root. Two mouthfuls mixed in a glass of water constitutes the ordinary dose for each individual. There are some drinkers, however, who mix three or four mouthfuls of it in that quantity of water. Intoxication follows then almost instantaneously. When the ordinary draught is taken, drunkenness does not ensue until twenty minutes after the draught has been swallowed, but its effects are immediate on those not accustomed to it. In many of the islands in the Pacific, Kava is given on the occasion of an official reception; it is the offered and accepted token of hospitality, a sign of alliance. Formerly the drinking of it always preceded warlike enterprises and religious festivals. It was a sign of peace, of reconciliation, or the object of a rich present.

At Nukahiva it is a daily beverage, analogous to our tea or coffee. Its use is interdicted to women and children. Taken in small doses, its effects are tonic and stimulating, and it imparts the power of supporting easily great fatigues. In large doses, it gives rise to a melancholy, silent, and drowsy state of drunkenness, quite different to that brought on by alcoholic liquors. The intoxication that it induces does not last longer than two hours, but if a person only takes it occasionally, the effects may continue for twelve. When taken at intervals of some days, the intoxication continues for six hours. The confirmed Kava-drinkers, in order to sustain their drunken state, imbibe it six or eight, or even more times a day. Arrived at the sixth or eighth dose, they are seized with a nervous tremor, so violent that they can no longer carry the cup to their lips, and require aid to enable them to continue tippling it, which they persist in. Different effects attend the drinking of Kava when made from the root grown in damp soils—the drinkers then remain plunged in a deep torpor, and become irritated by the least noise.

The effects of Kava have some analogy to those of opium, and the drinkers of it, like the Meriakis, may be seen borne down by the weight of their bodies.

A peculiar kind of skin disease, called at Tahiti *Arevareva*, results from the daily use of Kava. In old drinkers, the vision becomes obscure, the conjunctivas very red, the teeth acquire a deep yellow colour, their skin is dry, scaly, cracked, and ulcerated, especially where it is thick, as on the hands and feet, and they finish by falling into a state of complete emaciation and decrepitude.

The Nukahivians drink Kava as a remedy for phthisis, and they find it valuable for bronchitis, taking a small dose before going to bed at night.

A chemical examination of the root shows it to contain an essential oil of a lemon-yellow colour, combined with a balsamic resin. It is to this oleo-resin that some of the therapeutic effects described by Lenon are no doubt due. It also contains a large quantity of small rounded grains of fecula, and a neutral principle *Kavahine.* It is probably to this substance that the stupifying and intoxicating effects of Kava are to be attributed.

Kavahine may be prepared by treating the powdered root with alcohol, in a displacement apparatus, filtering the yellow liquor thus obtained, and concentrating it by distillation: the Kavahine then crystallises out on on cooling. When recrystallised from alcohol, and decolorised by animal charcoal, it is obtained in white tufts: these, on analysis by M. Roux, yielded—

Carbon - - - - - - -	65.847
Hydrogen - - - - - - -	5.643
Oxygen - - - - - - -	28.510
	100·000

It may be distinguished from Piperine and Cubebine by the colour tests which it gives with acids. Hydrochloric acid colours it red, which passes, by exposure to the air, into a bright yellow; concentrated sulphuric acid, of a rich purple violet colour. This beautiful colour disappears at the end of some minutes, upon exposure to the air, and becomes greenish. Upon the addition of water, the mixture turns instantly to green. The results of experiments upon its remedial effects will be made known at a future period.

THE FISHES OF AUSTRALIA.

BY FREDERICK M'COY,
Professor of Science in the University of Melbourne, and Director of the Natural Museum of Victoria, &c.

In the class of fishes of Victoria, many species remain yet to be determined. The more important fishes used as food are the "Schnapper," of colonists, *Pagrus unicolor*, abundant, and often of great size, with large numbers of which the market is regularly supplied, and which is caught and dried in great quantities by the Chinese fishermen in Hobson's Bay, and supplied to their countrymen or the various gold-fields. The next most important species, from its being almost equally abundant at times in the market, and of equally large size and superior flavour, is the great Cod Perch, the "Murray Cod" of colonists, the *Grystes Peeli* of Mitchell, or *Oligorus Macquariensis* of modern writers. A very much larger (occasionally five feet in length), and finer fish for table, only an occasional visitor, however, is the "King fish" of colonists, which seems to me completely identical with the great "maigre" of the Mediterranean (*Scinœa aquila*). Dr. Gunther, the most recent European writer on Ichthyology, in his general catalogue of Acanthoptarygian Fishes, states that the family *Sciœnidœ*, to which this fish belongs, has never been found in Australia. The fishes, commonly called "Mullet," (*Dajanus Diemensis*), and "Whiting," by the colonists (*Sillago punctata*), are common in the fish-shops for the table, together with three species of flathead (*Platycephalus nematophthalmus*, *P. tasmanius*, and *P. lœvigatus*), which are caught abundantly in the Bay at all times. Another tolerably good table fish is known to the colonists, and is found in the market under the name of "Pike," though, like all other fishes bearing the names of English species, it has little resemblance and no affinity to the fish of that name in Europe, it is the *Sphyrœna obtusata* and *S. Novœ Hollandiœ*. The so-called "herring" of the fishermen, is the *Centropristis Georgianus*, with which the market is also abundantly supplied. The "*Barracoota*," which visits us regularly, and is in some request for the table, is certainly the Cape of Good Hope *Thyrsites atun*. The small ling (the *Lota brevinscula*) is occasionally procured for food on the coast, but is chiefly remarkable for the old full-grown fish (about a foot long), having two or three years ago been stated by some fishermen to be the young of the great Newfoundland cod ; it was in vain that I pointed out the generic difference in the number of the fins, &c., and that these supposed young were adult ; the practical men carried conviction so far with them that the merchants of the town subscribed some hundreds of pounds, twice, to fit out a vessel to commence a great cod-fishing, on a supposed cod-bank, a few miles out, as a mercantile speculation. The Dory (*Zeus faber*) is a rare visitant, and whether as delicious here as in Europe, I cannot say, although a party of my scientific friends actually ate one of the three specimens I known to have occurred during the seventh year I have been in the colony, instead of sending it to the Museum. A Guard-fish (*Hemiramphus*), a Tunny (*Thynnus*), and an Eel (*Myrœna*), are also commonly used for food.

Amongst useful fishes not good for food, I may mention the common European Sunfish (*Orthagoriscus Mola*), as not uncommonly caught in the Bay, for its large supply of oil.

Of Crustacea, few kinds are used for food in Victoria ; there are no true lobsters, and no crabs (*Canceridœ*) fit for the table ; but a spiny crayfish, of about the same size and shape as the English species, is very common at the Heads, and is supplied abundantly to the market. It is nearly or quite identical with the *H. annulicornis,* the gigantic Murray river crayfish (the *Astacoides serratus*), is now sent down alive in great numbers, to the markets for the table ; the smaller river crayfish, the *Astacoides quinquecarinatus,* is also often eaten in the country, but is not sent to market ; it forms the chief food of the so-called "Murray cod," from the stomach of one of which I took twenty nearly perfect.

ON THE PRODUCTS OF THE PEA FAMILY (*LEGUMINOSEÆ*).

BY JOHN R. JACKSON.

PART II.—CÆSALPINIEÆ.

Hœmatoxylon campechianum L., yields the well-known Logwood of commerce. It is a native of Campeachy (whence its specific name), and other parts of tropical America, and is now naturalized in Jamaica, where it grows in great quantities. The tree attains a height of from 20 to 30 feet, with a diameter of about 20 inches ; very irregular and crooked in growth. The duramen or heart-wood is the part used and so much valued for dyeing. It owes its colouring properties to a peculiar principle called Hæmatin or Hæmatoxylin which, in some specimens, is found in such great abundance as to be perceptible in distinct crystals. A decoction of this wood is of a deep blood red, changing by the action of acids to a brighter hue, while alkalies turn it to a purple. It is largely used by dyers, &c., and is also employed in medicine on account of its astringent and tonic properties. We receive it in large quantities from Campeachy, Honduras, and Jamaica, in logs of about three feet in length, with the sapwood taken off. The introduction of this wood into England dates from the reign of Queen Elizabeth. Logwood is of a very dense nature, and takes a high polish ; but it is very rarely used in turning or for ornamental work.

Guilandina Bonduc, L., a shrub growing in all the tropics, produces hard shining seeds of a slate colour ; but sometimes yellow, and about the size of a large Barcelona nut. These seeds are employed for various ornamental purposes, as necklaces, bracelets, &c. The cotyledons or kernels are very bitter, and said to have astringent properties. They are used in India in medicine by the native practitioners, who consider them a powerful tonic; they are also employed for external use in the cure of hydrocele, pounded and mixed with castor oil. The natives of Amboyna consider them to have anthelmintic properties. The Egyptian women and children use them as amulets against witchcraft and sorcery, while on the Gambia they are employed by the natives for playing a game called "Warree Warree." The leaves are considered to be deobstruent, and the root astringent, and are used as such in Cochin China. The seeds are frequently washed ashore on the Scottish coast, where they are known as Molucca beans, and are said to have germinated after their voyage.

Poinciana pulcherrima, L. (perhaps the most beautiful bush in the family), is a native of the East Indies, but cultivated in all the tropics. In Jamaica it is called the 'Barbados flower fence,' as it makes good ornamental hedges in gardens, from the showy appearance of its variegated crimson flowers. The wood is in high estimation for the manufacture of charcoal, and a decoction of the leaves and flowers are said to have been successfully employed in fevers in the West Indies. Dr. McFadyen says, "The leaves, when bruised, have a smell resembling that of savine, and the infusion of either them or the flowers, is considered a powerful emenagogue, so as even to bring on abortion. The leaves are also said to be purgative, and to have been used as a substitute for senna." The pods of *Coulteria tinctoria*, H. & B., are called "Tarra" by the people of Lima, and used by them for making ink. *Cæsalpinia coriaria*, Willd., a native of the sea shore of St. Domingo, Carthagena, and other parts of the North coast of South America, furnishes the pods known amongst tanners as Divi Divi; they contain as much as 50 per cent. of tannin, which causes them to be extensively employed for tanning purposes in combination with valonia and oak bark, but rarely alone. It is stated that the amount of pods annually produced by a full grown tree is 100 lbs. weight; by deducting 25 lbs. for seeds and refuse matter, 75 lbs. would be left of good tanning material. The pods are said to contain a large quantity of mucilage, which made them unfit for the dyers use. They are imported into this country in large quantities, chiefly from Maracaibo, Rio de la Hache, and Savanilla, free of duty. Sappan wood is produced by *Cæsalpinia Sappan*, L., a tree attaining a height of about 40 feet, native of Eastern India, Ceylon, Siam, &c. It is largely used for dyeing, affording a colour similar to that produced by Brazil wood, though not of such good quality, or in such large quantity. It is also extensively employed for a like purpose in India; a decoction of the wood is there employed as a powerful emenagogue. In Scinde it is known as Bukkum wood. We receive it in large quantities from India and Ceylon. The true names of the plants furnishing Brazil wood and Brazilletto wood seem to be somewhat obscure; some authors referring the former to *Cæsalpinia echinata*, Lam., others to *C. Cristo*, L.; the first named species (*C. echinata*) is most probably the plant producing this wood. It is sometimes called Pernambuco wood, and is known by the name of "Ibirapitanga" in Brazil. It grows abundantly in the West Indies and South America, and is imported into this country chiefly from Pernambuco and Costa Rica. The principal use of Brazil wood is for dyeing, its colour being changed by the use of different mordaunts, from yellow to red or rose colour; but the dye obtained from this wood is not lasting. When first cut, it is of a light colour, but becomes a dark red by exposure to the air. It is also used as an ingredient in red ink, and is employed occasionally in turnery, and in the manufacture of violin bows. The Peach wood, Nicaragua wood, and Lima wood of commerce are supposed to be produced by the same plant; although the wood is of an inferior kind, it yields a beautifully bright red, but very fugitive. Brazilletto wood is supposed to be furnished by *C. Brasiliensis*, L. Of this there can be little doubt. The tree grows in Jamaica and other parts of the West Indies, where it attains a height of about 20 feet. It is imported into this country for dyeing, but is much inferior to Brazil wood, and is consequently not so largely employed. This wood is also applied in turnery and for making violin bows. In Jamaica, it is much used for spokes of wheels as well as in cabinet work. In India, an oil is expressed from the seeds of *C. digyna*, Rottl., which is used for burning in lamps.

The well-known and important purgative called senna consists of the leaves of several species of Cassia (*C. obovata*, Coll., *C. acutifolia*, Del., *C. lanceolata*, Forsk., &c.); there are several varieties known in commerce. The Tinnivelley senna is stated to be the finest, and is attributed to *C. elongata*, Lam.; this species thrives well in the southern provinces of the Madras Presidency. Much doubt exists in the identification of the species furnishing the commercial varieties of this useful drug. It is imported in large quantities from India, Egypt, and North Africa. Its early history seems involved in obscurity, though it was probably known to Dioscorides, and perhaps to Theophrastus, but this seems doubtful. Dr. Royle says, "senna has been distinctly known only since the time of the Arabs."

Cassia occidentalis, L., is a native of both the East and West Indies, but found abundantly in the latter, and likewise in South America. The leaves of this plant are used in India as a purgative, and are considered a remedy for cutaneous diseases, by internal and external application, both upon man and animals; they are also used in baths and for fomentations, and with a coating of grease spread upon them, are applied as plaisters to sores and wounds. The Brazilian name for this plant is "Gajamarioba." The bark of *Cassia auriculata*, L., is employed in India to a considerable extent in tanning leather, also for dyeing a buff colour. The root is used by smiths or iron-workers for tempering iron with steel. The seeds pulverised are considered a certain cure in cases of ophthalmia, while from the branches the natives form tooth brushes. The yellow flowers are said to yield a dye much used in some parts of India. The seeds of *C. absus*, L., are considered in Egypt a remedy for ophthalmia; they are mucilaginous and bitter, and are brought to Cairo from the interior of Africa. A juice is obtained from the leaves of *C. alata*, L., which, when mixed with lime juice, is a reputed cure for ringworm. It is stated by Roxburgh, that the Hindoo practitioners consider it a remedy in all poisonous bites, as well as cutaneous eruptions. The bark and leaves of *C. torosa*, L., are used medicinally in India ; the latter, fried in castor-oil, are applied to ulcers. The seeds, ground and mixed with butter-milk, are are also used for poultices ; a blue dye is likewise procured from them. The leaves and bark of *C. glauca*, L., are said to have medicinal properties, and are used in native practice in India, as are also the leaves of *C. obtusa*, Roxb.

Cathartocarpus fistula, Pers., a native of the East Indies, but now introduced to South America and the West Indies, bears long, dark-coloured pods, measuring from one to two feet in length. The seeds are enveloped in a black, sweetish pulp, which is a gentle and valuable laxative. The pulp has been submitted to analysis, and found to consist chiefly of sugar and gum. The pods are imported from Madras, Ceylon, Barbados, and Carthagena in South America. Those most esteemed are said to come from the East Indies ; they are small compared with those from the West Indies, but their pulp is sweeter, and of a darker colour ; it is the chief ingredient in the confection of Cassia, which is administered as a laxative. The pods containing the largest quantity of pulp are heavy leaving no room for the seeds to rattle when shaken. In India, the natives use the bark and leaves ground together and mixed with oil as a poultice for pustules. The bark is slightly astringent, and occasionally used for tanning, while the roots are reputed to be a valuable febrifuge. A decoction is prepared from the fragrant flowers, and given in stomachic affection. The wood is employed for various purposes, amongst others for spars for native craft. The bark of *Swartzia tomentosa*, called Panococco bark, is said to be a powerful sudorific, and the wood extremely bitter. From the dried flowers of *Brownea grandiceps*, Jacq.,—called in Venezuela "Rosa de Montaña" or "Palo de Cruz,"—a decoction is prepared which is said to be a powerful astringent, and very much used in the cure of dysentery ; it is sold in the chemists' shops, and is to be found in the house of nearly every country inhabitant in the province of Caraccas. *Schotia tamarindifolia*, Afzel., and *S. latifolia*, Jacq., yield strong, tough, and durable woods, both much used at the Cape for fellies, posts, &c. The seeds of both species are eaten by the natives. The wood of *Afzelia bijuga*, A. Gray, called "Vesi" in the Fiji Islands, is extensively employed by the natives in the construction of their war clubs and for other purposes ; this wood is of a dark colour, heavy, and apparently very durable. Another species of Afzelia, perhaps *A. africana*, produces in Africa a wood which would probably prove useful in this country were it better known and more easy to be procured ; this remark may equally apply to a bright clear resin furnished by a species of this genus. Specimens of these may be seen in the Museum at Kew, and are part of the enormous collections which were obtained and sent home by the Niger expedition under Dr. Baikie, R.N.

Eperua falcata, Aubl., known in British Guiana as "Wallaba," produces a strong and valuable wood of a deep red colour; it is hard and heavy, but splits freely and smoothly, and is much used for shingles, staves, palings, posts, house-frames &c. It is impregnated with a resinous oil, which makes it very durable both in and out of water. A roof well shingled with this wood will last more that forty years. The tree is very abundant throughout the colony, growing generally on the banks of the rivers. Timber may be cut from it 30 or 40 feet long, by 15 to 20 inches square. Lindley says the bark is bitter and is used by the Arawaak Indians as an emetic. *Melanoxylon Brauna*, Schott., a native of Brazil, furnishes a hard wood, the duramen of which is of a dark colour, somewhat resembling rosewood, but of a silvery transparent appearance. It takes a good polish, and can be obtained in tolerably large blocks, as the tree grows to a good size. A reddish brown colouring matter is said to be contained in both the wood and bark. The well-known preserve called "Tamarinds" is made with the pods of *Tamarindus Indicus*, L., a native originally of the East Indies, but cultivated now to a large extent in the West Indies and South America. The early history of this plant has been traced to the Arabians, from whom the tree derived its name, from *tamar*, signifying a date, and *indus* its country. Tamarinds as they appear in commerce consist of the pulp of the pods after the epicarp or outer shell has been removed; this is done in their native country, and they are afterwards packed in layers in a cask, and boiling syrup poured upon them. In the West Indies, layers of sugar are frequently added. Those from the East Indies possess a larger quantity of pulp, but are dryer than the West Indian, owing, it is said, to their being preserved without sugar. Tamarinds are imported to this country in very large quantities, amounting, in 1859, to 634,697 lbs., chiefly from the West Indian Islands; they are used largely in medicine as an agent in the composition of cooling drinks. The pulp is nutritious and refrigerant, and is also employed as a laxitive. The tree producing this pod grows to a height of from 30 to 40 feet; the wood is very dense, and so heavy as to sink in water. It is beautifully mottled with wide streaks of a deep plum colour.

Trachylobium Martianum, Hayne, is said to yield a resin called copal in Brazil. The West Indian locust tree—*Hymenæa Courbaril*, L., is a native of the South American forests, where it grows to an enormous size, frequently attaining a height of from 60 to 80 feet, before any branches are given off, and leaving a diameter of from 8 to 9 feet. Martius in speaking of the magnitude of these trees says, that fifteen Indians with outstretched arms could scarcely encircle the base of one of them. He attributes their age to the days of Homer, and assumes the probability of their being 332 years old in Pythagoras's time; some have even ventured to give them a greater antiquity than this. The wood of these trees is hard and close-grained, of a fine, brown colour, streaked with dark veins. It takes a good polish, and might be employed for furniture, but its chief use is for beams and timbers for steam engines, planking vessels, &c. The farinaceous saccharine pulp enclosing the seeds is eaten by the natives, and an intoxicating beverage, resembling beer, is prepared from it. The bark is used in the construction of canoes. This tree is the one from which some of the gum anime of commerce is supposed to be obtained ; it is procured by digging near the roots from which the resin flows, and buries itself in the ground, or it can be obtained by tapping the trees. Copal resin is also supposed to be produced by this, or allied species, but much doubt exists upon the point ; indeed, the term copal is very generally employed for most bright clear resins.* There are several species of Bauhinia growing in India, the different parts of which are employed in native practice in various complaints. The bark of *B. acuminata*, L., is considered a remedy in cutaneous affections, and the flowers mixed with pepper are applied as a cure for the headache. The flower-buds and dried leaves of *B. tomentosa*, L., are given in dysentery, while the bruised bark is applied as a plaister to wounds, &c., and a decoction of the bark of the roots used as a vermifuge. The bark of *B. variegata*, L., is astringent, and is said to be employed by tanners and dyers. It also has medicinal properties, and the flowers are reputed to be a gentle laxative. The thick bark of *B. racemosa*, Lam., is used as a slow match ;—to prepare it, it is simply boiled and beaten, and is said to burn well without the addition of any other substance. The Indians make ropes from this bark, which are very strong, and used for various purposes. A fibre of great strength is likewise obtained from *B. scandens*, Willd., which has been said to equal the best Sunn hemp. From *B. retusa*, Roxb., a brownish coloured gum is procured. A similar substance is likewise obtained from *B. emarginata*, Mill., and is called "Sem-ke-gond." *B. valilic*, W. and A., grows to very considerable size, and produces leaves a foot across ; these are collected and sold in the Indian bazaars for making baskets, plates, and various other articles. From the bark ropes are made which are sometimes used in the construction of the suspension bridges across the valleys of the Himalaya. The seeds form an article of food, and are eaten raw, resembling the cashew nut in flavour. The mountain ebony of Jamaica is furnished by *B. porrecta*, Sw. The stems of some of the Bauhinias are of a very curious growth, flattened, and corrugated transversely, somewhat resembling steps, from which fact they are called in Brazil "Land-turtle's ladders."

The seeds of *Inocarpus edulis*, Forst., are roasted and eaten in their native country, and are said to have the flavour of chestnuts. *Cercis siliquastrum*, L., a small tree growing in France, Italy, Spain, &c., produces a beautifully dark coloured wood streaked with brown, which takes a high polish. The flowers of *C. Canadensis* are used as a pickle or mixed with salads, and the young branches are said to afford a fine dye for wool. The wood much resembles that of the former species (*C. siliquastrum*).

The fruits of *Cynometra cauliflora*, L., are eaten in Java as table fruits, and are much esteemed by the natives, though to the taste of an European

* See an article on African Copal, TECHNOLOGIST, vol. i., p. 306.

they are very disagreeable. They are grown in almost every village, their price being about twopence per dozen. In outward appearance, these fruits somewhat resemble the Souari nut (*Caryocar nuciferum*) though not so large. Their native name is "Buah namman." Copaiba balsam, so much used in medicine on account of its stimulant, cathartic, and diuretic properties, is procured from several species of Copaifera, though *C. multijuga*, Hayne, is supposed to be its chief source. Information is much wanted on this point. Balsam of copaiba is received chiefly from Para and Maranham, though small quantities are imported from the West Indies. It arrives in casks containing from one to one and a half cwts. each. To collect the balsam, incisions are made in the stems, when the liquid is said to pour out in great abundance; as it exudes it is very thin and quite colourless, but immediately thickens and changes to a clear yellow. In British Guiana the wood of *C. pubiflora* is much used for furniture on account of its beautiful purple colour; hence, the tree is known as the purpleheart; it is also invaluable for mortar beds, or where great strength is required, having been found to sustain the shock of artillery with little or no damage. The wood of another species, (*C. bracteata*) growing in the same country, is likewise much used on account of its strength and durability. It has been suggested that this wood might serve for the ornamental work of ship's cabins, in the place of rosewood, were it better known. The small one-seeded fruits of *Dialium Indicum*, L., contain an agreeable acid pulp, which is eaten in Java, and is there known as the Tamarind plum. In Ceylon, *Dialium œcarpum* is called the rock tamarind, the pulp being eaten like the former. The fruits of *Codarium acutifolium*, Afzl., called in Africa the velvet tamarind, on account of the velvety appearance of its pods, are also used as an article of food. The large drupes of *Detarium senegalense*, Gmel, are eaten by the natives in Central Africa; but the seeds are said to be poisonous. On the Gambia, the tree is called "Dattock," and grows to a great size, producing a hard, compact, and apparently durable timber. *Mora excelsa*, Bth., is one of the most majestic trees of the forest of British Guiana, where it frequently attains a height of 100 or 150 feet, and sometimes 50 feet before the appearane of any branches, The wood is very hard, and of great strength and durability. It is one of the woods acknowledged at Lloyd's as first class for ship-building, being considered equal, and in some respects, superior even to oak. *Ceratonia siliqua*, L., a tree growing in the south of Europe and the Levant, produces the carob bean, which has of late become so common an article of sale in the small shops of the poorer neighbourhoods of London, where children purchase them for the sake of the sweet pulp which surrounds the seeds. It is asserted that singers chew this pulp for improving or clearing the voice. Large quantities of these beans have been imported into this country as food for horses, and it is one of the chief ingredients in the patent cattle foods so much advertised. These beans formed the principal food of our cavalry horses during the Peninsular war. By some they have been thought to be identical with the locusts and wild honey of Scripture, upon which St. John the Baptist fed in the wilderness; hence the derivation of their common name of St. John's Bread. The carat weight of the jewellers is said to be originally derived from the seed of this pod.

Baphia nitida, Lodd., a West African tree, furnishes both the dye-woods known as barwood and camwood ; the bright red colour of the English bandana handkerchiefs is produced from these woods. By the use of sulphate of iron, the intensity of colour is very much increased. We receive the wood in square logs with the bark taken off. In the African markets it appears in a ground state made up into balls.

Alœxylon Agallochum, Lour., is said to " produce one of the two sorts of Calambac, Eagle-wood, or Lign aloes, a fragrant substance, which Loureiro states consists of a concretion of the oily particles into a resin in the centre of the trunk ; it is brought on by some disease, and the tree dies of it." The perfume of this wood is well known, and is in high estimation among the Orientals.

Kew, April, 1862.

ON THE SAMADERA WOOD (*SAMADERA INDICA*).

BY W. C. ONDAATJE.

Since my " Notes on the Febrifuge Plants of Ceylon" appeared in your valuable periodical, I have been induced to try the efficacy of the Samadera, simply as an anti-febrile remedy, and the result of my trial at this large hospital has been satisfactory.

The following " Directions for the use of the Samadera wood" have been adopted at the Government Civil Hospital at Colombo, where the average daily sick amounts to 180. A small portion of the rasped wood was sent to you by the last mail.*

Decoction of the wood to be used as a febrifuge : Take six ounces of the rasped wood ; three pints of water ; boil over a slow fire, until reduced to one pint, and strain.

* We have had an analysis made of the sample sent us by Mr. Ondaatje, and append the report of Dr. Phipson thereon. A concentrated decoction of the wood is of an intense bitter taste, like quinine. There is but a limited demand for Quassia wood for medicinal purposes in this country. Whether the Samadera wood could be safely used by the bitter-beer brewers, we cannot say.—EDITOR.

Report to P. L. Simmonds, Esq., upon a sample of Quassia wood from Ceylon : I have carefully examined the sample of Quassia wood from Ceylon you have handed to me, and, upon comparing it with that which is generally found in commerce, I find that, both in physical and chemical characters, it is very superior to the latter. It furnishes a larger proportion of the bitter principle, Quassine, and less ash than the ordinary Quassia-chips of commerce.—L. PHIPSON, F.C.S. Lond., Member of the Chemical Society of Paris, &c., &c.

Feb. 24, 1862.

Dose—Two ounces to be taken three times a day.

The decoction is of a light brown colour, and of an intensely bitter taste, like Quinine. It may be given in all stages of fever. When taken during a febrile paroxysm, it should be given in three ounce doses. It will be found to abate the severity of the symptoms,—it shortens the paroxysms, and hastens the cure.

Sometimes nausea and vomiting occur after taking a dose of the decoction. This effect will be found rather to favour the recovery of the patient than otherwise.—In such instances the dose of the decoction should be lessened to one ounce, and repeated at greater intervals, or it may be given during the paroxysm only. In recent cases the fever is generally speedily subdued by the decoction.

The infusion of this wood may be used at all times as a general tonic,' and is a perfect substitute for the infusion of Quassia, in the following form :—

Take two drachms of the rasped wood, one pint of boiling water ; infuse for two hours in a covered vessel, and strain.

Dose.—One ounce, as a bitter tonic to improve the appetite and invigorate the system.

It is of a light lemon colour, and a good vehicle for the administration of iron, iodide of potash, &c., &c.

Government Civil Hospital, Colombo, January, 1862.

NEW INDIAN PRODUCTS AT THE EXHIBITION OF 1862.

BY M. C. COOKE, F.S.S.

It is impossible, within the limits of two or three pages, and at this early stage, to do justice to the Indian collection, superior as it is to that Department in 1851, and interesting beyond the Exhibitions of either 1851 or 1855, from the closer association of India with the British crown. In the event of a continuance of the civil war in America, and an untoward success to the rebel arms in China, we are taught by the present Exhibition that India *can* supply us with cotton, tobacco, and tea, sufficient to compensate us for the deficiencies which those events might occasion. What may be necessary to ensure such a supply does not fall within our province at this juncture to indicate. The fact that three hundred samples of tea are shown, and more than a hundred of cotton, with some tobacco, are features not to be forgotten in passing through the Indian collection.

Starchy products, though not numerous, present two or three novelties. A kind of arrowroot from a plant growing wild in Cuttack is of very good quality. The manufacture has been but recently introduced into that province, and is conducted in a remarkably simple manner. This product, which is known in the bazaars under the name of *Palvoa,* is collected by the Sahars and made into cakes, or boiled with milk, and used as an article of food. The plant which produces it grows abundantly in the jungles, and might be cultivated with very little trouble. It is at present uncertain what this wild plant may be.

From Akyab, another kind of arrowroot has been sent, which is known under the native name of *Rembowah.* It is said to be prepared from a root called Pemban Oo, which is obtainable in large quantities, and the cost of the article when manufactured would be about four rupees per maund.

From Chota Nagpore we have also a similar product, obtained from a wild jungle plant; and from Chittagong, "wild ginger starch." The wild ginger grows abundantly everywhere in Chittagong, and is with difficulty eradicated from the soil. The present specimen is only an experimental one, but as the supply of the root is unexhaustible, and the process of manufacture simple, there seems, no doubt, that if found to be a valuable product, a large quantity might be obtained at a price below that of Arracan rice.

Behchandee is prepared by the Gonds, and is sold in the bazaars of Jubbulpore. It is not an arrowroot, but bears some resemblance to it when pounded. The natives prepare it for food in a variety of ways, and use it on fast days. It is obtained from the stems of a jungle-plant, after being soaked in running water for several days.

Elastic Gums, though not exhibited in great profusion, contain also some novelties. From Gorruckpore, four samples of Caoutchouc are sent, which are stated to be obtained from sources new to commerce, though what those sources may be has not transpired. From Chingleput, Dr. John Shortt contributes india-rubber, obtained from the Mudar plant (*Calotropis gigantea*), and also from the milk-hedge (*Euphorbia antiquorum*), and another species of Euphorbia (*E. tortilis.*) Amongst the gutta-percha of the Malayan Peninsula will be found a substance greatly resembling it, called Gutta Terbole, and which it affirmed to be employed, not only as a substitute, but as an adulterant of the genuine article. What Gutta Gree Grip and Gutta Babee from the same locality may be, we have not yet had the opportunity of determining. Somewhat allied in its uses is the Buglar tree bark, from Chota Nagpore, where it is employed as a glue for joining wood.

Soluble gums and Resins are similar to what have been exhibited on former occasions; Gum Kino, from Rangoon, probably the produce of *Pterocarpus Wallichii,* might be obtained in almost any quantity, the tree which yields it being one of the most abundant. Of oleo-resins, the turpentine of *Pinus longifolia,* and wood-oils, are most important; of the latter, several kinds are exhibited. The Gurjun of Chittagong is obtained by cutting a hole in the tree, about three feet from the ground, and about four or five inches deep into the tree. The base is hollowed out to retain the oil. The hollow is cleared with fire, without which, no oil exudes. After it is cleared the oil issues, and is removed as it accumulates. The oil is thus extracted year after year, and at times there are two or three holes in the same tree. The oil is allowed to settle when the clear part separates from the thicker portion. If a growing tree is cut down and cut in pieces, the oil exudes, and concretes on the stem and the ends of the pieces, very much like camphor, and with an aromatic odour. A tree yields from 250 to 400 lbs. yearly, and the same tree will yield for several years. This substance has been employed as a substitute for Balsam of Copaiba, and would be useful as a varnish. It can be had in any quantities, at ten rupees per maund.

In the oil series, and amongst oil-seeds, are some deserving notice, but to which we cannot at present refer, except by directing attention to the Nahor oil, obtained from the seeds of *Mesua ferrea*, and the oils of *Aleurites triloba*, and *Rottlera tinctoria*. Although the latter are not new oils, they are both worthy of a better appreciation in this country. The curiosities in this section are the oil of Cocoa-nut shells, and the veritable oil of Macassar. Atturs and essential oils belong rather to the second-class (Pharmaceutical products), which is so fully represented, that we dare not attempt indicating objects of interest.

The dye-stuffs will attract attention on account of the presence amongst them of the Roum dye of Assam, *Ruellia* leaves, a series of illustrations of the green dye of Malda, with cloths dyed therewith, and a similar series illustrative of a new yellow dye, from the same locality, which can be obtained in any quantity. The flowers of *Trapa bispinosa* ; the *Thitna* dye, from Akyab ; *Neepa* dye, of Burmah ; *Kamla Goondee*, of Cuttack ; *Jackwood*, of Akyab ; and *Mug* dye, of Chittagong, are amongst the novelties in this section. A series of sixteen lichens are contributed from Darjeeling, but these require testing before anything can be affirmed as to their tinctorial properties. An interesting book is shown from Nepaul, containing specimens of colours obtained from native dyes, but unfortunately barren of information. Two or three new tanning substances are exhibited from Chittagong and elsewhere.

The stimulants, whether alcoholic or narcotic, are well represented ; amongst the former, we notice rice arrack, Mowha spirit, Mango whiskey, prepared from the Mango fruit, and cane-juice spirits. Amongst the latter, *Gunjah*, *Bang*, and varieties of *Churrus*, or hemp resin. Full illustrations of the manufacture of opium, with specimens of the product. *Bynee* seeds, used as a substitute for Betel-nuts. Tobacco from a few localities, and other narcotics amongst the medicinal products.

The grains and pulses are more numerous than ever, and in connection with these, Dr. Forbes Watson exhibits a series of the chief varieties, with the results of his analyses attached, showing the nutritive value of each.

Textile materials must not now be ventured upon, and the same may be said of woods, of which latter there are from twelve to fifteen hundred specimens.

Amongst the curiosities of food, we have, in addition to the usual contributions of shark's fins, bird's nests, trepang, agar-agar, &c., some potted fish gnapie, dried mushrooms from China, dried fungi, and other delicacies.

It was not our intention to note anything of mineral or animal products, or articles of manufacture of any kind, but simply to point out amongst the raw products of the vegetable kingdom such as by their novelty or interest deserved attention, but even in this limited field we do not find it so easy to execute our desire, and on the day that this passes into our readers' hands they will be enabled to judge for themselves whether our Indian possessions do not deserve to be considered as the most brilliant jewel in the British crown.

THE WOODS OF BRITISH BURMAH.

BY D. BRANDIS.

The following is a descriptive list of the Burmese woods sent home to the International Exhibition by the Superintendent of Forests in the Pegu, Tenasserim, and Martaban Provinces. The particulars given are the systematic name. The Burmese name. The weight of one cubic foot in lbs. The average size of full-grown trees on good soil. The girth measured at six feet from the ground. The length of trunk is to the first branch. The price is the rate per cubic foot. The figures marked "Br. weight," denote the weight required to break a piece 4 ft. long, 1 inch square, laid on supports 36 inches apart. These results were obtained by a few preliminary experiments.

1. Dillenia aurea, Sm. Zimbjoon. Weight, 48 ; girth, 9 ; length, 20 ; price 1s. 6d. Abundant in the plains and on the hills ; wood occasionally used in house-building, but mostly for firewood. Br. weight, 198 lbs.

2. Dillenia pentagyna, Roxb. Bjooben. Weight, 69 ; girth, 6 ; length, 20. Abundant in the Eng Forest (Forest of *Dipterocarpus grandiflora*); wood hard and strong, used for rice-mills.

3. Dillenia speciosa, Thunb. Thabyoo. Weight, 41 ; girth, 5 ; length, 15. On the banks of the mountain streams. Wood not used.

4. Meliusa Velutina, Hf. and Th. Thabootkyee. Weight, 42 ; girth, 5 ; length, 15. All over the plains ; wood used for the poles of carts and harrows, yokes, spearshafts, oars, &c. &c.

5. Bombax malabaricum, D. C. Lepan. Weight, 28 ; girth, 15 ; length, 60. The cotton tree. Abundant in the plains ; wood light and loose grained, used for coffins. The Cotton used for stuffing pillows.

6. Sterculia fœtida, L. Let-Khop. Weight, 33 ; girth, 10 ; length, 50. Common in the plains and on the hills ; wood not used.

7. Heritiera, sp. Pinlay Kanazoe. Weight, 66 ; girth, 6 ; length, 30. Common in the Delta of the Irrawaddy ; wood used for house-posts and rafters, and for firewood for the manufacture of salt. The tree is nearly related to the "Soondra" of Bengal.

8. Berrya mollis, Wall. Petwoon. Weight, 56 to 62; girth, 7; length, 50; price 1s. 6d. Found on elevated ground; wood red, much prized for axles, the poles of carts, and ploughs, also used for spear-handles.

9. Eriolœna, sp. Dwa-Nee. Weight, 47; girth, 7; length, 50; price 1s. 6d. Trees not uncommon but not very large; wood of a beautiful brick-red colour, tough and elastic, used for gun-stocks, paddles, and rice-pounders. A wood well worth attention, the weight being moderate.

10. Grewia Microcos, L. Mya-ya. Weight, 51; girth, 4; length, 10. Found on elevated ground; wood not used.

11. Dipterocarpus alata, Wall. Ka-nyin. Weight, 38; girth, 25; length, 100; price 6d. The wood oil-tree of Burmah; the wood decays very fast; used for canoes, which last only from three to four years.

12. Dipterocarpus grandiflora, Wall. Eng. Weight, 55; girth, 10; length, 60; price 1s. This tree forms, in company with a few other kinds, extensive Forests, which cover upwards of 2,000 square miles in the Province of Pegu; wood somewhat more durable than that of "Kanyin" (No. 11); used for canoes, house-posts, planking, &c. &c.

13. Dipterocarpus, sp. Kyau-thoo. Weight, 43; girth, 20; length, 80. A large tree found in the hills; wood used for canoes and cart-wheels.

14. Hopea odorata, Roxb. Thingan. Weight, 46; girth, 12; length, 80. One of the finest timber-trees of the country; found near mountain streams and in the ever green Forest; large specimens of this valuable tree are common East of the Sittang river, but rather scarce in the greater part of Pegu; wood much prized for canoes and cart-wheels; boats made of this wood are said to last for more than twenty years.

15. Hopea, sp. Thingadoe. Weight, 52; girth, 20; length, 100; price 1s. 6d. Large trees abound in the same localities as the foregoing, but the wood is not equally valued.

16. Hopea Suava, Wall. Engyin. Weight, 55; girth, 7; length, 60. This faluable tree is found in the Eng Forest; large trees not common in Pegu; wood tough and hard, but heavy, used in house-building, for bows and a variety of other purposes, said to be as durable as Teak.

17. Shorea obtusa, Wall. Theya. Weight, 57; girth, 7; length, 50; price 1s. 6d. In the Eng Forest and on the brow of hills in Pegu; wood valued equally with Engyin.

18. Mesua Ferrea, L. Gangau. Weight, 69; girth, 5; length, 20. Cultivated in Pegu on account of the beauty and fragrance of its flowers, but wild in Tenasserim; wood said to be used for furniture.

19. Garcinia cowa, Roxb. Toung-tha-lay. Weight, 42; girth, 6; length, 20. Scattered over the hills; wood not used.

20. Calophyllum, sp. Tha-ra-phee. Weight, 57; girth, 4; length, 20. Wood used for carving images, occasionally for canoes.

21. Calophyllum, sp. Poonyet. Weight, 39; girth, 12; length, 60; price 1s. 6d. Firewood.

22. Schleichera trijuga, Willd. Gyo. Weight, 70 ; girth, 12 ; length, 25. One of the heaviest woods known in Burmah ; common in the plains as well as on the hills ; used for cart-wheels, the teeth of harrows, the pestles of oil-mills, &c. &c.

23. Sapindus, sp. Tsheik-khyee. Weight, 66 ; girth, 6 ; length, 40. Found on the hills and in the Forests skirting them ; wood prized for house-posts, ploughs, &c. ; colour grey, with a beautifully mottled grain.

24. Xylocarpus granatum, Koen. Pinlay-oong. Weight, 47 ; girth, 7 ; length, 20. In the Forests of the Delta ; wood used for house-posts and musket-stocks.

25. Cedrela Toona, Roxb. Thit-kadoe. Weight, 28 ; girth, 8 ; length, 40 ; price 1s. On the hills and in the plains ; plentiful in some districts ; if not identical with the Toon of Bengal certainly nearly related to it.

26. Chikrassia tabularis, Juss. Yimma. Weight, 24 ; girth, 8 ; length, 80 Scattered throughout the Forests on elevated ground ; large trees scarce ; either identical with "Chittagong wood" or nearly related to it.

27. Albizzia stipulata, Boiv. Boomayza. Weight, 66 ; girth, 9 ; length, 30 ; price 1s. 6d. Common throughout the Forests, on elevated ground ; heartwood brown, beautifully streaked, but rather small, the sap-wood being very large, much prized for cart-wheels, also used for the bells of cattle.

28. Albizzia elata. Seet. Weight, 42 to 55 ; girth, 10 ; length, 40 ; price 1s. 6d. Abundant throughout the country in the plains, particularly near the banks of rivers ; this wood may at a future time become an important article of trade ; the heartwood is strong and durable, and less heavy than that of most trees of the same family ; the only drawback is, that the proportion of sapwood is large ; used by the Burmans for bridges and house-posts. Br. weight, 250 lbs.

29 and 30. Acacia catechu, L., var. *a*. Sha. Weight, 56 ; girth, 6 ; length, 20 —Acacia catechu, L., var. *b*. Sha. Weight, 70 ; girth, 6 ; length, 20. Common all over the plains, and scattered over the hills ; immense numbers of these trees are annually cut down and made use of for the extraction of cutch ; the wood is considered more durable than teak, and is used for house-posts, spear and sword-handles, bows, &c. &c. ; there are several varieties differing in shade, specific weight and yield of cutch.

31. Bauhinia malabarica, Roxb. Boay-gyin. Weight, 42 ; girth, 4 ; length, 15. Common in the plains ; wood used for the cross-pieces of harrows, house-posts, &c. &c.

32. Bauhinia racemosa, Lam. Hpa-lan. Weight, 44 ; girth, 3 ; length, 10. Resembles No. 31.

33. Cathartocarpus fistula, L. Gnoo-shwoay. Weight, 66 ; girth, 4 ; length, 15. Common in the plains and on the hills ; wood used for bows, axles of carts, &c. &c.

34. Cassia, sp. Gnoo-gyee. Weight, 57 ; girth, 4 ; length, 15. Same as No. 33.

35. Cassia florida. May-za-lee. Weight, 58 ; girth, 6 ; length, 15.

Cultivated; heartwood almost black, used for helves, walking-sticks, mallets, &c. &c.

36. Dalbergia, sp. Yin-dike. Weight, 64; girth, 9; length, 35; price 1s. 6d. Common in the plains and on the hills; a kind of blackwood well worth notice; the sapwood of this tree decays rapidly, but the heartwood is extremely durable, it is black, sometimes with white and red streaks, elastic, but full of natural cracks; used for ploughs, bows, handles of Dahs and spears; there are probably two kinds in the country.

37. Inga xylocarpa, L. Pynkado. Weight, 60 to 66; girth, 9; length, 50; price 1s. 6d. A magnificent tree, abundant throughout the Forests on and near the hills; the "Ironwood" of Pegu; the sapwood is attacked by white ants, and decays easily, but is very small in large trees; the heartwood of full grown trees is said to last as long as teak; this wood would be invariable if it were not for its weight; used for house and bridge-posts, ploughs, boat-anchors, in the construction of carts and for other purposes.

38. Leguminosa. Thitpouk. Weight, 35; girth, 4; length, 20; price 1s. A light-wood not much used.

39. Pterocarpus dalbergioides. Padouk. Weight, 60; girth, 9; length, 35; price 1s. 6d. Trees of the largest size of this strong and beautiful timber abound in the Forests, east of the Sitang River, also in the valley of the Salween River, and its tributaries, the Thoungyeen, Yoonzalen, Hlineboay, Houndraw, and Attaran; much less frequent in Pegu, and entirely wanting in some districts; wood prized beyond all others for cart-wheels; the trees are felled green, and are split up into short planks, 3 ft. 6 in. long, 2 ft. wide, and 9 inches thick; three of these pieces make one wheel, and a pair is sold on the spot in the Forests of the Prome District at from twelve to twenty-five rupees (24s. to 50s.); the wood is extensively used in the gun-carriage manufactories in India.

40. Albizzia, sp. Kokoh. Weight, 48; girth, 12; length, 60. In the Northern districts of Pegu, on and near the hills; the wood is valued by the natives as much as Padouk (No. 39) or even more so; it is used for cart-wheels, oil-presses, and canoes; in the Prone district a special tax was levied on the felling of "Kokoh" and "Padouk" under the Burmese rule; large trees are becoming very scarce in the Irrawaddy valley, but are not uncommon in the Toungoo district.

41. Pongamia, sp. Thinwin. Weight, 60; girth, 6; length, 20; price 1s. 6d. Not uncommon in the dry Forest, in the plains and on the hills; the heartwood which is black and tough, but rather small, is used for the cross-pieces of Burmese harrows, the teeth being made of Sha (No. 29), Myoukkhyau (No. 58), and Gjo (22).

42. Leguminosa. Poukthenma-myek-kyouk. Weight, 58; girth, 5; length, 15. A light-coloured, close-grained wood; much prized by Burmans.

43. Leguminosa. Tounkatseet. Weight, 45; girth, 10; length, 50. Not uncommon on the hills; wood used for canoes.

44. Melanorrhœa usitatissima, Wall. Thitsee. Weight, 54 ; girth, 9 ; length, 30. The varnish tree of Burmah ; rare in the Irrawaddy valley ; common in the Forests East of the Sitang River, prrticularly South-east of Sitang Town ; wood dark red, hard, and close grained ; used by the Burmese for the stocks of their wooden-anchors, tool-helves, &c.

45. Garuga pinnata, Roxb. Khyong-yook. Weight, 52 ; girth, 9 ; length, 40 ; price 1s. Tree rather common in plains and on the hills : wood not much used.

46. Odina Wodier. Nabhay. Weight, 65 ; girth, 12 ; length, 50 ; price 1s. 6d. Tree rather common on the hills ; heartwood red ; used for sheaths of swords, spear-handles, oil-presses, and rice-pounders.

47. Terminalia Bellerica, Roxb. Titseim. Weight, 40 ; girth, 12 ; length, 80. Common throughout Pegu ; wood not used.

48. Terminalia Chebula, Retz. Pangah. Weight, 53 ; girth, 12 ; length, 80 ; price 1s. 6d. Common on the hills ; a valuable wood, used for yokes and canoes ; heartwood yellowish brown.

49. Terminalia bialata, Roxb. Lein. Weight, 39 ; girth, 12 ; length, 80. Common ; wood not used.

50. Terminalia macrocarpa. Htoukgyan. Weight, 58 ; girth, 12 ; length, 80. One of the largest trees in Pegu ; very common, and the stems of very regular shape, heartwood dark brown, used for house-posts and planking.

51. Conocarpus acuminatus. Yoong. Weight, 50 to 57 ; girth, 12 ; length, 80 ; price 1s. 6d. Almost equal to the preceding in size and the regular growth of its stem ; wood reddish brown, hard, and strong. Br. weight, 226 lbs. If it were not for their weight, Nos. 46, 48, 50, and 51 would be most valuable for furniture.

52. Careya arborea, Roxb., var. *a.* (dark.) Bambouay. Weight, 55 ; girth, 9 ; length, 20 ; price 1s. 6d. Common throughout the country ; wood used for gun-stocks, house-posts, planks, &c.

53. Careya arborea, Roxb., var. *b.* (light.) Bambouay. Weight, 55 ; girth, 9 ; length, 20 ; price 1s. 6d. Same as foregoing.

54, 55, 56, and 57. Eugenia obtusifolia, Roxb. Thabyehgjo. Weight, 48 ; girth, 9 ; length, 20 ; price 1s. Eugenia cerasoides, Roxb. Thabyehgyin. Weight, 51 ; girth, 9 ; length, 40 ; price 1s. Eugenia, sp. Thabyehthapan. Weight, 50 ; girth, 9 ; length, 30 ; price 1s. Eugenia caryophyllœ-folia, Roxb. Thabyehgah. Weight, 56 ; girth, 6 ; length, 20 ; price 1s. The different kinds of Thabyeh have a hard red-coloured wood, but not straight-grained, and supposed to be brittle ; the stems are occasionally used for canoes, especially those of Thabyehgah. Br. weight of the Thabyehgah, 254 lbs.

58. Blackwellia tomentosa, Vent. Myouk-kyau. Weight, 56 ; girth, 6 ; length, 70 ; price 1s. 6d. Wood tough, of a light yellow colour ; used for the teeth of harrows.

59. Lagerstrœmia pubescens, Wall. Laizah. Weight, 53 ; girth, 12 ; length, 100 ; price 1s. A very large tree, stem not always perfectly round,

inclined to form buttresses ; timber valued for bows and spear-handles, also used for canoes and cart-wheels.

60. Lagerstrœmia, sp. Thitpyoo. Weight, 30 to 38 ; girth, 12 ; length, 80 ; price 6d. A light, but comparatively strong wood, colour white and pinkish, probably a valuable wood for furniture ; used for planking. Br. weight, 153 to 179 lbs.

61 and 62. Lagerstrœmia reginæ, Roxb., var. *a.* wood light red. Pyimma. Weight, 37 ; girth, 12 ; length, 30 ; price 1s. Lagerstrœmia reginæ, var. *b.* wood dark red. Pyimma. Weight, 44 ; girth, 12 ; length, 30 ; price 1s. A splendid tree, abundant throughout the country ; wood used more extensively than any other, except Teak, used generally for the fittings of boats, sometimes for the hulls of canoes, for house-posts, planking, beams, scantling for roofs, carts, and a variety of other purposes ; large quantities are now employed for ordnance purposes ; the wood of the light-coloured variety is less heavy, and is said to be less durable.

63. Lagerstrœmia parviflora, Wall. Tsambelay. Weight, 40 ; girth, 5 ; length, 15 ; price 1s. Wood not much used.

64. Duabanga grandiflora, Wall. Myoukgnau. Weight, 30 ; girth, 12 ; length, 80 ; price 1s. Wood used in house-building.

65. Nauclea cordifolia, Roxb. Hnau. Weight, 42 ; girth, 10 ; length, 80 ; price 1s. 6d. Trees large, of regular growth, but not very common ; wood yellow, rather close grained, used to make combs ; may be expected to prove valuable for furniture.

66. Nauclea diversifolia, Wall. Bingah. Weight, 45 ; girth, 7½ ; length, 60 ; price 1s. Wood of a light yellow colour ; not much used, but may be recommended for furniture.

67. Nauclea Cadamba, Wall. Maookadoon. Weight, 37 ; girth, 15 ; length, 70 ; price 1s. Wood of a deep yellow colour, but loose grained ; recommended for furniture.

68. Nauclea undulata, Wall. Ma-oo lettan. Weight, 23 to 34 ; girth, 15 ; length, 100 ; price 3d. A soft useless wood, decays in less than a year. Br. weight, 80 to 100 lbs.

69. Nauclea parviflora, Roxb. Htein. Weight, 43 ; girth, 6 ; length, 30. Used for planking.

70. Nauclea, sp. Hteingalah. Weight, 43 to 56 ; girth, 6 ; length, 40 ; price 1s. Wood of a light chesnut colour, recommended for furniture. Br. weight, 208 lbs.

71. Nauclea, sp. Hteinthay. Weight, 35 ; girth, 6 ; length, 30 ; price 1s. Wood not used. Br. weight, 170 lbs.

72. Gardenia lucida, Roxb. Tsaythambyah. Weight, 49 ; girth, 3 ; length, 15. A white close-grained wood, apparently well adapted for turning ; this wood, like that of several other species of Gardenia and Randia, is used for making combs.

73. Diospyros, sp. Ouk-khyin-za. Weight, 41 ; girth, 9 ; length, 30 ; price 1s. A beautifully white and black mottled wood, used for house-posts.

74. Diospyros, sp. Gjoot. Weight, 49; girth, 3; length, 15. Wood similar to that of the foregoing, but a much smaller tree; small quantities of black-heart wood (Ebony) are occasionally found near the centre of very old trees, of this and another kind nearly related to it. (Taybeu).

75. Strychnos Nuxvomica, L. Khaboung. Weight, 52; girth, 3; length, 15. Trees small, but common; wood close-grained and hard.

76. Wrightia, sp. Toung-za-lat. Weight, 55; girth, 5; length, 40. A beautiful wood.

77. Spathodea stipulata, Wall. Paet-than. Weight, 48; girth, 4; length, 20. Used for bows and spear-handles, also for paddles and oars.

78. Spathodea, sp. Thit-lin-da. Weight, 63; girth, 6; length, 50; price 1s. A white wood, not much used.

79. Spathodea Rheedii, Spreng. Tha-khoot-ma. Weight, 35; girth, 7; length, 30; price 1s. Wood used for yokes and cart-poles.

80. Bignonia, sp. Than-day. Weight, 33 to 36; girth, 7; length, 30; price 6d. A light loose-grained wood, not much used. Br. weight, 125 lbs.

81. Bignonia, sp. Kyoun-douk. Weight, 23; girth, 2; length, 15. Wood not used.

82. Cordia Myxa, L. Thanat. Weight, 33; girth, 4; length, 15. Wood soft, not used; leaves collected extensively, sold for cover-leaves for cigars.

83. Vitex, sp. Kjeyoh. Weight, 45; girth, 3; length, 15. Wood used for tool handles, much prized, but rather scarce.

84. Vitex Leucoxylon, Roxb. Htouk-sha. Weight, 42; girth, 12; length, 30; price 1s. A large tree, very common in the plains, wood grey, deserves attention for furniture; used for cart-wheels. Br. weight, 142 lbs.

85. Premna pyramidala, Wall. Kyoon-na-lin. Weight, 52; girth, 5; length, 30. Wood strong, used for weaving shuttles; trees small.

86. Tectona grandis, L. Kuyon—Teak. Weight, 40 to 51; girth, 18; length, 90. The best Teak Forests in British Burmah are on the hills between the Sitang and Irrawaddy rivers, and in the Thoungyen valley, but even these Forests are poor compared with the extensive tracts covered with Teak, producing Forests to the North of the British boundary, especially on the feeders of the Sitang and Salween rivers, and some of the tributaries of the Meinam, or Bankok river. The trees also, are as a rule, much larger, and the shape of the stem more regular, in the Forests of the Burmese Empire, the Siamese Kingdom, and the Karennee country. The tallest Teak tree measured in Pegu was 106 feet high to the first branch. The strength and density of Teak Timber vary exceedingly, according to the locality where the tree is grown. The extremes observed in preliminary experiments were 40 and 50 lb. per cubic foot, and 190 lbs. to 289 lbs. breaking weight. Teak when young, grows very rapidly. The two stems sent were dug out by me in July, 1858, at the Thinganenoung nursery in the Attaran Forests. The seed had been sown in March and April, 1856. The plants therefore were two years and three months old. The largest seedlings had a girth of 13 inches, measured one foot from the ground, and

of 8 inches, at 6 feet from the ground. They were 32 feet high, but this is an instance of uncommonly rapid growth. Trees ten years old, have usually a girth of 18 inches, measured at six feet from the ground, with 22 years a girth of 3 feet is attained, but full-grown trees of 9 feet in girth cannot be supposed to be less than 160 years old.

87. Gmelina arborea, Roxb. Yemaneh. Weight, 35 ; girth, 12 ; length, 50. A large tree, with white light wood, used for house-posts, planks, and for carving images ; recommended for planking and furniture.

88. Quercus semiserrata, Roxb. Thit-kya. Weight, 48 ; girth, 4 ; length, 20. Used for plugs or pins to join together the three pieces which compose the body of a Burmese cart-wheel.

89. Salix lepto sperma, Roxb. Momakha. Weight, 37 ; girth, 3 ; length, 10. Wood not used.

90. Artocarpus mollis, Wall. Tounbein. Weight, 30 ; girth, 12 ; length, 80. Immense trees, wood used for canoes and cart-wheels ; on the hills, large trees rather scarce.

91. Artocarpus, sp. Toun-pein-nai. Weight, 39 ; girth, 12 ; length, 80. Wood yellow, used like the preceding.

92. Artocarpus lacoocha, Roxb. Myouklouk. Weight, 40 ; girth, 6 ; length, 30. Used for canoes.

93. Ficus lanceolata, Roxb. Thaphou. Weight, 27 ; girth, 12 ; length, 25. Wood soft, useless.

94. Podocarpus neriifolius. Theetmin. Weight, 50 ; girth, 6 ; length, 20. The meaning of the Burmese name is, "the prince of trees." Large trees with stems not very regularly shaped are found on the higher hills between the Sitang and Salween Rivers, and on the range which skirts the coast of the Tenasserim provinces ; the wood is close-grained, and may prove a substitute for box-wood.

95. Pinus Massoniana, Lamb. Tinyooben. Girth, 6 ; length, 50. A moderate sized tree, found in the Forest of *Dipterocarpus grandiflora* (Eng Forest), east of the Salween river ; spars of this species have occasionally been brought down to Maulmain.

96. Pinus Khasyana. Tinyooben. Girth, 9 ; length, 80. Found on the hills between the Sitang and Salween rivers, at an elevation exceeding 3,000 feet ; it is a stately tree, sometimes as high as 200 feet to the top, but owing to the difficulties of transport from these hills, no timber of this species has as yet been brought to Maulmain ; the wood of both kinds is very rich in rezin.

97. Pierardia sapida. Kanazoe. Weight, 61 ; girth, 4 ; length 15. A small tree, wood not used.

98. Phyllanthus, sp. Nasha. Weight, 35 ; girth, 6 ; length, 30. A light-coloured wood, exhibiting a natural shine or polish, when planed.

99. Rottlera, sp. Yagine. Weight, 35 ; girth, 6 ; length, 30 ; price 6d. A moderate-sized tree, common on the low ground near streams. Br. weight from 153 to 170 lbs.

100. Unknown. Bamau. Weight, 52 ; girth, 6 ; length, 30. Close-grained, possibly a substitute for box-wood, prized by Karens for bows.

101. Unknown. Palawah. Weight, 52; girth, 6; length, 45; price 1s. 6d. A beautiful red, but heavy wood.

102. Unknown. Nattamin. Weight, 33; girth, 6; length, 60; price 6d. Wood loose-grained, reddish-grey, recommended for cigar-boxes. Br. weight, 129 lbs.

103. Unknown. Moondein. Weight, 33 to 38; girth, 10; length, 50; price 6d. Wood fine-grained, light, recommended for furniture. Br. weight, 121 lbs.

104. Unknown. Koothan. Weight, 28; girth, 6; length, 40; price 6d. A loose-grained light wood, recommended for packing-cases, used for black-boards in Burmese schools. Br. weight, 114 lbs.

105. Stereospermum chelonioides. Thakooppo. Girth, 5; length, 30; price 1s. Wood used in house-building.

106. Carallia integerima, D.C. Maneioga. Weight, 60; girth, 10; length, 50; price 1s. A large tree, common north of Rangoon and throughout Pegu; wood of a peculiar structure, thick medullar rays going through from the centre to the circumference, colour red, may possibly be found useful for cigar-boxes; used for plank and rice-pounders.

107. Unknown. Thitnee. Weight, 80; girth, 8; length, 50; price 1s. 6d. A beautifully red, but heavy wood.

108. Buchanania latifolia. Lumbo. Weight 36; girth, 6; length, 30; price 6d. A soft light-wood, not used.

109. Erialœna, sp. Chloetni. Price 1s. 6d. A red wood, used like Dwanee (No. 9).

110. Pongamia, sp. Thitpagan. Girth, 9; length, 40; price 6d. A soft wood, said to be useless.

111. Dipterocarpus, sp. Kaungmhoo. Girth, 12; length, 100; price 1s. Trees of an immense size, used for canoes.

112. Unknown. Katsitka. Girth, 6; length, 30. A red wood, abundant in the Forests north of Rangoon, used for boats, said to last from five to six years.

113. Henslowia paniculata, Migu. Anambo. Girth, 9; length, 50. A reddish-coloured wood, not straight-grained, used occasionally for cart-wheels, mostly for fire-wood.

Camp Pounglin Forests,
January, 1862.

THE BETEL-NUT OF COMMERCE.

BY THE EDITOR.

An extensive commerce is carried on in the east, in the fruit of a well-known and graceful palm, the *Areca Catechue*, which forms a main ingredient in the eastern masticatory. Blume tells us that the Asiatic nations would rather forego meat and drink than their favourite Betel-nuts, whole ship-loads of which are annually exported from Ceylon, Sumatra, Malacca, Siam, and Cochin China. One hundred millions of people use the Betel-nut. There are said to be twenty different species of Areca, but probably many of these are only varieties. This palm often grows 50 feet high, with a diameter of less than 2 feet ; it has no branches. The fruit, a drupe, about the size of a pullet's egg, does not fall from the tree even when ripe ; it has a yellowish shell ; thin, with arched veins, cohering with the pulp all round. In Johanna, the nut is used for dying cotton red or making ink. A cargo of betel-nuts generates so much heat that the crew cannot sleep between decks. A good tooth-powder is made from the nuts. The nuts turned are used for bracelets. In the Cossyah or Khasia country the natives measure distances by the number of mouths of betel-nuts chewed on the road.

The nuts vary in size ; their quality, however, does not at all depend upon their size, but upon their natural appearance when cut, indicating the quantity of astringent matter contained in them. If the white or medullary portion which intersects the red or astringent part be small, has assumed a bluish tinge, and the astringent part itself be red, the nut is considered of good quality ; but when the medullary portion is in larger quantity, the nut is considered more mature, does not possess so much astringency, and is, therefore, not so much esteemed.

It is stated, that a fruitful palm will produce, on an average, 850 nuts annually. The average production in a plantation is, however, about 10,000 pounds of nuts per acre.

In the Island of Yap, Western Pacific, the betel-nut tree is cultivated with the greatest care. It is a beautiful slender palm, and grows amongst the cocoa-nut trees, which it resembles in appearance. The nuts are pulled before they are ripe, and are chewed with the usual condiments, lime and aromatic leaves, by both sexes. They are called Addaca in Travancore. In the Bombay market three kinds are met with : white, from Shevurdhun, which are three times the value of those from other countries ; red, which are half the value of the best white, and nuts in the husk sold by the thousand. The crushed nut is generally, used with the leaf of the betel pepper (*Chavica betle* or *Piper Siriboa*), and chunam or shell-lime. Prepared slices of boiled betel-nut, called Callyareka, are sold in Cochin at about 6d. a pound.

The mastication of the betel is considered very wholesome by those who are in the habit of using it. Mr. Crawfurd thinks that like tea, coffee, and tobacco, the areca-nut stimulates the nervous system, and hence its general use. It may be so, but the black hue it gives to the teeth (although it is said to be an excellent preserver of them), together with the blackened lips and mouth, give anything but an agreeable appearance. Its use certainly does not impart additional beauty to the native females who habituate themselves to an equal extent to those of the opposite sex. Though the quantity of tannin contained in the betel-nut must exercise an injurious influence, yet it is a mistake to suppose that the mere chewing of the nut gives to the mouth an offensive appearance; unless the other ingredients are added, the saliva hardly changes its natural colour. Betel-nuts contain a large quantity of tannin, which has caused them to be employed in some parts of India for dyeing cotton-cloths.

The exact country of the betel-nut is unknown, but is supposed to be the Sunda Islands; the tree, from time immemorial, has been extensively cultivated in all parts of the East Indies, so that we are unable to trace it back to the spot whence it originally may be supposed to have come. It grows freely in all the eastern islands, from Sumatra to the Philippines, and seems to have as many distinct names as there are languages. Thus, in Malay it is called *Pinang* (giving its name to the island in the Straits); in Jamaica, *Jambi;* in Bali, *Banda;* in Bugis, *Rapo;* and in Tagala and Bisaya, *Bongo;* in Achin, *Penu;* in Sanscrit, *Goorvaka;* in Bengalee, *Gooa;* in Arabic, *Foolful;* in Persian and Hindustani, *Soopara;* and in Telingee, *Poka Chilloo.* Judging by this, the probability is that the tree is indigeneous in each country.

In the fresh or green state, the betel-nut is an object of general domestic consumption; and in the dry state, of large exportation to China and India. Fifteen tons of these nuts were shipped from Singapore in 1858 to the single port of Ningpo. The most productive countries in this article are Ceylon and the northern and southern coasts of Sumatra, towards its western extremity.

The quantity of Areca nuts exported from Ceylon in ten years has been as follows:

	Quantity.	Value.
1850	66,343 cwts.	£42,948
1851	78,037	54,806
1852	71,793	52,230
1853	59,465	46,448
1854	46,208	32,173
1855	47,329	42,192
1856	66,428	50,200
1857	47,594	45,438
1858	69,088	51,816
1859	66,630	49,973

With a tolerably attentive culture, and in a suitable soil, the betel palm bears fruit in the fifth or sixth year, and lives for about twenty-five years. It flowers during the greater part of the year. In Ceylon, this palm is cultivated chiefly in the Western and Kandian provinces. It bears twice in the year, each tree, on an average, producing 300 nuts. Thus, prolific and easily reared, the produce is cheap. The price they realise to the grower is about 2s. the hundredweight. The wood is used for reepers, arches, and temporary buildings.

In his interesting work on the narcotics ('The Seven Sisters of Sleep'), Mr. M. C. Cooke has collected some useful details respecting the betel-nut. At Travancore, where the betel-nut is a staple product, a quarter of a century ago there were ten and a quarter million of trees growing, which at the average yield would produce about 63,000 tons of nuts. In Pinang, there are half a million or more betel palms, producing upwards of 3,000 tons, and the island takes its name from this tree. The Pedes coast of Sumatra produces annually about 4,700 tons, of which half is exported. The Chinese receive from thence 3,000 tons, besides as much more from Cochin China. When there is not an immediate demand for the nuts, they are stored in the husk, but insects attack them freely. Of the nuts produced in Travancore, 300 tons of prepared nuts are annually sent to Tinnevelly and other parts of the Peninsula, and about 3,000,000 ripe nuts, in the husk, to Bombay and other places by sea. The local modes of preparing the nut for use in Travancore are as follows :—Those used by families of rank are collected while the fruit is tender, the husk or outer pod is removed, the kernel, a round fleshy mass, is boiled in water. In the first boiling of the nut, when properly done, the water becomes red, thick, and starchlike, and this is afterwards evaporated into a substance like gambier or catechu. The boiled nuts being now removed, sliced, and dried, the catechu-like substance is rubbed thereto, and dried again in the sun, when they become of a shining black colour, and are ready for use. Whole nuts without being sliced, are also prepared in the same way for use. Ripe nuts as well as young nuts in the raw state are used by all classes of people, and ripe nuts which have been steeped or kept in water, are also used by the higher classes.

Various Asiatics have recourse to different other species of Areca ; for instance, the convicts confined on the Andaman Islands use the nuts of *Areca laxa*, Hamilt. ; the Nagas and Abors of Eastern Bengal use those of *A. Negensis*, Griff. ; and the natives of the mountainous districts of Malabar those of *A. Dicksoni*, Roxb., instead of those of *A. Catechu*, Linn. The poorer classes in Silhet use the seeds of *Calamus erectus*, Roxb., as a substitute for betel-nut. The bark of *Callicarpa lanata*, Linn., which is sub-aromatic, and slightly bitter to the taste, is chewed by the Cingalese instead of betel leaves.

At Pedir, Acheen, and other parts of the East, betel-nuts are sold by the loxa or laxar, which weighs about 168 lbs., and consists of 10,000 nuts, with from ten to twenty-five per cent. added, according to the bargain previously made, for nuts which may be worm-eaten or otherwise damaged.

Betel-nuts are but little used in this country. They are occasionally sold to stable-keepers, who grate them and mix them with horse-food as a preventive of diarrhœa. They are burnt into charcoal for tooth-powder, but this has no superior merit over other vegetable charcoal. They are occasionally worked by the turner, and wrought into different kinds of beads for bracelets, small rosary cases, and other little fancy ornaments, but they are too small to be applied to many uses. In the Museum of Economic Botany, at Kew, there is a walking-stick made of betel nuts, strung upon an iron centre.

The areca-nut fibre is worthy of notice, because of its capability of being turned to many useful purposes, especially as it has a soft and cotton-like feel, and is capable of being spun into twine. Moreover, immense quantities of the areca-nut husks are now thrown away, and should this fibre be found capable of being made into paper, or turned to other useful purposes, of which no doubt is entertained, it may be collected in large quantities, and at little cost.

ON MINERAL OILS AND THE MINJAK LANTOENG OF JAVA.

BY DR. BLEEKRODE.*

At the commencement of the year 1861, the papers were filled with marvellous accounts of springs and wells yielding immense quantities of mineral oil in North America. In March of the same year, purified mineral oils from America, limpid as water, could be obtained at the establishment of Mr. James Madden, of London, at 1f. 50c. the litre.

Mineral oils have, as yet, been little studied. Their chemical composition varies in the same degree as their origin, in the successive geological stages of the earth's crust. Mineral oils are not of the character of tar, but they much resemble in their composition, the paraffin oils prepared by Mr. James Young's system, by the slow distillation, at a low temperature, of Boghead or Cannel coal. A specimen of mineral oil brought from Banjermassen, in Java, scarcely differs from this. But this resemblance ought not, however, to lead one to the hypothesis of attributing the origin of mineral oils to the distillation of coal, bituminous schists, or lignites, and certainly not to the opinion of American geologists, ascribing them to the decomposition of animal substances in the Devonian and Silurian epochs. Pure mineral oil may be completely distilled at temperatures between 360 deg. and 400 deg. C., and it would, consequently, require a depth of from 10 to 12 kilomètres to attain this intensity of terrestrial heat.

The mineral oil of Rangoon, obtained from wells in the vicinity of the river Irawaddy in the Burman Empire (Burmese naphtha, or Rangoon tar), has become an article of regular importation to England, amounting in 1857 to 29,811 litres, and in 1858 to 17,118 litres. Mr. Warren De la Rue and Dr. Hugo Müller have studied its chemical composition, and they have described it as a mixture of hydrocarbons, without any combination of oxygen. Rangoon oil contains 10 to 11 per cent. of paraffin; it has a density of 0.880 at a temperature of 40 deg., and then consists of a liquid

* The Author, Professor at the Royal Academy at Delft, and one of the most distinguished scientific men in Holland, died at Delft on January 3 last. The present article, communicated to the 'Repertoire de Chimie Appliquée,' was one of the last published by him.

as limpid as water. Mr. Gregory was the first to point out the identity of this substance, formerly designated by M. Christison under the name of petrolene, with the paraffin of Reichenbach.

This paraffin has received the name of *Belmontine*, from the name of the locality in which the manufactory is situated. It is the well-known ingredient of the stearic candles of Price's Candle Company. In that establishment the oil is distilled by steam ; a mixture of hydrocarbons, having a density of 0·827 to 0·861, and boiling between 211 deg. and 270 deg., separates without a trace of paraffin. This has been called *Sherwoodole*, and was recommended by the late Dr. Snow as an anæsthetic ; it is also a solvent for caoutchouc, and can replace benzole for removing grease stains. The heavier oils are called Belmontine oils ; they can be purified with sulphuric acid, a substance resembling asphalte separating. Distillation above 221 deg. C. yields paraffin oils, which crystallise on cooling.

The pure paraffin has received the name of Belmontine. It is very remarkable that its fusing point is 60 deg. C., whilst paraffin prepared from Boghead fuses between 42 deg. and 48 deg. C., and that prepared from turf at 47 deg. C. We particularly notice this difference, since an error has arisen on this subject among recent writers who have noticed the account of M. Wagenmann, engineer at Neuwied (Dingler, 'Polytechn. Journal,' clii. 312) : this author published the notes of his visit to the manufactory of Price's Patent Candle Company. He commenced by calling the manufacturer "Belmont," and then proceeded to say that Belmontine fused at 28 deg. C. M. Wagner, the editor of the German edition of 'Muspratt's Chemistry,' has repeated this error.

M. Vohl has published the analysis of a mineral oil brought from the East Indies (probably from Rangoon). The density was 0·885 at the temperature of 14 deg. C. ('Dingler's Journal,' cxlvii. 394). Distillation and rectification produced—

40·705 per cent. of photogene, or oil of 0·830 sp. gr.
40·999 per cent. of gazogene oil for lubricating machinery.
6·071 per cent. of paraffin fusing at 60 deg. C.
4·600 per cent. of asphalte.
7·610 per cent. of loss.

The author includes among the substances constituting the *loss* the creosote and carbolic acid. There is reason to doubt the presence of these substances in true mineral oil. They have not been detected in the Java oils ; Messrs. Warren De la Rue and Müller have not found them ; also M. Haase, in decomposing the mineral oil of Carpathia, particularly notes their absence. It is therefore an especial characteristic of natural mineral oils, that they contain neither creosote nor carbolic acid.

The mineral oil of Gallicia, or Carpathia, was investigated by M. Haase in 1859 ; its density was 0·875. After a light, limpid oil, of a density of 0·74, was separated, the residue had a density of 0·83. Distillation produced—

50.0 per cent. of photogene, or oil of 0·815.
33·3 per cent. of solar oil of 0·850.

13·5 per cent. of red brown paraffin oil.

By rectification with sulphuric acid and potash, there were produced—

14·7 per cent. of loss.

33·7 per cent. of photogene of 0·810.

38·8 per cent. of solar oil of 0·845.

13·6 per cent. of paraffin oil of 0·875.

The mineral oils of Sehnde, near Hildesheim, in the kingdom of Hanover, have been studied by MM. Bussenius, Eisenstuck, and Helsmann, from the year 1858 to 1860.

We know of one analysis only (incomplete) of the natural mineral oils of North America, published by Mr. Dugald Campbell in the TECHNOLOGIST for March, 1861, (vol. i. p. 249). The density of American oil from Boston was 0·840 at a temperature of 16 deg. Fractional distillation produced four sorts of oils, of specific gravities 0·826, 0·838, 0·833, and 0·846; the boiling point of the first was found to be 182 deg. C. Mr. Campbell mentioned another specimen, of a density of 0·900; but that was impure, by containing water and earthy substances. Distillation produced equal quantities of oils of 0 867 and 0·872, with a loss of 7½ per cent.

Mineral oils are found in many islands of the Indian Archipelago. They are there known under the name of Minjak Lantoeng at Java, or Minjak Linji at Sumatra. As they are much used by the natives, they are regularly collected and sold in the markets of the towns and principal villages.

The localities where these oils rise spontaneously in natural fissures or artificial excavations, are ordinarily surrounded by warm or saline mineral springs; the earth belongs to the tertiary formation, at least the upper deposits below the alluvial strata. Volcanoes and volcanic rocks form the true geological constitution of the country.

A specimen of oil from Palantoengan, in the Residency of Samarang, has the consistency of tar, its colour resembles wood-tar; its density is 0·955 at 16 deg. C.

A specimen of Tjiakijana, in the district of Pourbolingo, in the Residency of Banjermassen, is as liquid as water, with a deep green colour by reflection; its density is 0·804 at 16 deg. C.

It is very remarkable that the deep green colour is only produced by reflection; a thick layer, half a centimètre thick, is of a reddish brown, and a very liquid layer is of a clear yellow both by reflected and refracted light. Concentrated sulphuric acid precipitates from it a black asphalte-like mass, the supernatant liquid then reflecting a beautiful apple-green colour, while the refracted light is yellow. This oil, without a particular or disagreeable odour, may be considered as a solution of paraffin in liquid hydro-carbons. At a few degrees above zero it acquires the consistency of butter, the paraffin crystallising. Young's paraffin oil, prepared from Boghead coal, has the same properties. The mineral oil from Palantoengan of 0·955 specific gravity, contains only 3·8 per cent. of mineral substances, no chlorides, a little sulphate of lime, and the rest silicates. On treating it with one-tenth of sulphuric acid, according to Saussure, 15 to 18 per cent. of a black, asphalte-like mass, containing paraffin, is precipitated. Distillation at 320 deg. C. produces a reddish-brown paraffin oil, and upon heating the residue above this temperature paraffin distils over almost pure.

It is very difficult to separate hydro-carbons of a constant boiling point so as to isolate them. At temperatures between 190 deg. and 230 deg. nearly one-third separates as a slightly reddish yellow oil, having a density of 0·845 at a temperature of 16 deg., retaining, however, an oil boiling at 250 deg.—260 deg. On raising the temperature to 350 deg., C., one-fourth more oil distils over, forming a liquid of 0·918, containing much paraffin. The lightest oil distils at 80 to 90 deg., beginning to volatilise at 60 deg. ; its density is 0.786 ; it is very clear, and has the characteristic odour of fetid lime-stone, or the lime-stone of the Belgian coal formation. The quantity of this oil amounts to 4 per cent. ; it dissolves iodine, phosphorus, caoutchouc, &c. Concentrated nitric acid changes it into a heavy, yellow, aromatic oil, smelling of cloves.

The other specimen from Tjiakijana consists of 40 per cent. of paraffin, and 60 per cent. of a clear oil of 0·780 specific gravity at the temperature of 60 deg. C. ; its boiling-point varies between 90 deg. and 170 deg. C. Spontaneous evaporation produces a mass of the consistency of yellow butter ; distillation gives a residue of paraffin. The distilled oil also dissolves iodine, phosphorus, &c., and is changed by concentrated nitric acid into a heavy yellow oil smelling of cloves.

For want of a sufficient quantity of this remarkable oil, it has not been possible to study it in detail. I must, however, repeat that it is the first example of a natural solution of paraffin in oily hydro-carbons.

THE AILANTHUS SILKWORM AND THE AILANTHUS TREE.

BY M. F.-E. GUERIN-MENEVILLE,

Secretary to the Council of the Imperial Society of Acclimatization.

(Abridged and Translated from the French by Lady Dorothy Nevill.)

The culture of the Ailanthus and the rearing of its Silkworms are subjects so utterly new, that principles yet remain to be discovered for their management analagous to those which guide the numerous cultivators of the Mulberry Silkworm. In the treatment of the tree, so justly called by Olivier de Serres the "blessed tree of God," I wish to give the little knowledge I have been able to gather on this subject, and to call the attention of the public to this new cultivation, which I believe, at no distant period, is destined to give a new source of pleasure and profit to many, and which in France, has been carried on with the greatest success. One circumstance which renders the cultivation of the Ailanthus and its Silkworm so easy, is the facility with which it can be reared in parts of the country that are little populated, and where labour is scarce and costly. To complete the success of this new agricultural industry, there must be a means found for disposing of the produce, for without that no one would know what to do with their cocoons, or dare to enter upon this undertaking on a large scale, even after experience has taught them that it will become really advantageous. At present no one, as mine has been the first trial of these worms in England, has been even consulted on the commercial value of these cocoons ; but Monsieur André Marchand, Rue des Petites Ecuries, No. 50, at Paris, not content with buying the cocoons, but to facilitate plantations of Ailanthus and the cultivation of its Silkworm, offers for sale all that is necessary for this purpose. Those in this country who are desirous of engaging in this pursuit can be supplied with plants and the eggs of the Silkworms by Mr. McGhee, Tyne Hall, Ilford, Essex. By this means I trust that this new branch of industry is destined to become, as in China, an object of real utility to the country ; and unless unforeseen and insurmountable difficulties arise to extinguish this already successful agricultural trial at Dangstein, the acclimatization of this domestic worm may prove a source of riches for Great Britain.

Europe is indebted for this species of Silkworm to the Abbé Fantoni, a Piedmontese missionary in the province of Hang Tung, who sent some living cocoons to friends in Turin in 1856 immediately after the first gathering. These cocoons began to yield moths towards the middle of June in 1857, and eggs were hatched in a few days after.

As Father Fantoni had told his friends that the Chinese fed them with the leaf of a tree something like an Acacia, they tried the worms with the *Ailanthus glandulosa* leaves, which they discovered were eaten greedily. These worms multiplied, and some eggs were transmitted to France, where they are now becoming a great source of profit.

The eggs of the *Bombyx cynthia* are twice as large as those of the common Silkworm, and the females lay about half as many. They are oval, equally long at both ends, white, and marked with black, caused by the particles of gum *inside them.* One gramme of eggs of the *Bombyx cynthia* contains about one hundred eggs.

The quantity of eggs laid by the females is very variable, and are according to the size of the moths. If they are in strong health one will give from two hundred to four hundred eggs; but the right portion would be about two hundred and fifty to each. When the eggs are near hatching, they flatten a little, and lose their weight, and assume a greyish tint which is produced by the caterpillar inside.

The caterpillars are hatched about eight or twelve days after the eggs are laid, according to the temperature. The most characteristic colour at this age is to appear black, but seen through a microscope they are yellow underneath. They have a transverse black mark all along their body. Like many other caterpillars, they change their skins four times, or go through four changes before they make their cocoons. Before each change they remain inactive from twenty-four to forty-eight hours, according to the temperature. Before this crisis arrives, they cover the under part of the leaf on which they are with an invisible gummy substance of threads of silk, and they fix so solidly their membranaceous feet that the old skin remains adhering whilst they pass on.

The existence of these caterpillars, like those of the Mulberry Silkworm, is divided into five stages. The first is the interval between their birth and the first change; the second is that between the first and second change; the third is between the second and third; the fourth, that from the third to the fourth; the fifth, that of the fourth change till the formation of the cocoon. The caterpillars have a different colour and shape in each of these stages. Thus, during the first, as I have before said, they are yellow-coloured with a black spot down the belly, independently of black tubercles. During the second change their body is about 4 or 5-tenths of an inch long. They are still yellow, with head tubercles and segments quite black. At the third crisis the caterpillar is from 6 to 8-tenths long, and soon becomes quite white. At this stage there comes all over their body a waxy secretion, forming a sort of white flour, destined to protect the worm against rain and dew, as water cannot fix on it. At the fourth stage it attains the length of ¾ to 1 inch. Its body is first white; then it becomes gradually green, with tubercles of the same colour; and soon the head, the feet, and the last segment become of a golden yellow. There are always black points upon the segments or rings of the body and the floury secretion. At the fifth stage the emerald green colouring is the same, but more intense, and the extremities of the tubercles become of a marine blue. The caterpillar is then from 1¼ to 1½ inch long, but it grows rapidly, and, according to the abundance and quantity of the food, it attains the length of from 2½ to 3 inches long.

Arrived at this stage, it begins to eat less and gradually becomes of a yellowish-green. It begins the cocoon by fixing two or three leaflets firmly to the main stem with its silk, so that it may be secure at the fall of the leaf in the beginning of the winter.

In weaving its cocoon this worm does not proceed like the Mulberry Silkworm, because it makes an elastic opening for the exit of the moth.

In working, the caterpillar takes from time to time a little repose, but this only lasts a few seconds. From time to time also, after having placed a number of zigzags of thread, it stops and puffs itself out, as if to push out the sides and make the necessary room. When it works from the side of the opening it makes much longer movements, and places the thread in a longitudinal way, advancing it to the extremity of the opening, cementing one thread to another, and returning parallel to the first thread. During all this while its antenæ are at work, as well as its mandibles. These seem to serve as polishers, for they neither bite nor cut any part of the work. The threads that form the opening of these cocoons are not cut but simply turned and laid one over another. The cocoons of the Ailanthus worm are of an elongated form, of more or less pale and grey colour, of very close tissue, $1\frac{1}{2}$ to $1\frac{3}{4}$ inches long, and about $\frac{3}{4}$ broad. They vary much in size and weight according to the conditions in which they were obtained.

These cocoons naturally open like those of the Mulberry Silkworm after the exit of the moth, but up to the present time they cannot be spun off in a continuous thread ; therefore, they have as yet only yielded floss, and, consequently, the fibre is more or less short, so that they have only been spun like wool or cotton. The difficulty does not arise because the thread is cut at the opening made for the exit of the moth, as some people have imagined, because the threads are not cut but only laid one over another. It results only from the circumstance that the cocoon being open at one end, fills with water (when placed in the basin) ; and being so heavy breaks the thread ; but we have no doubt a remedy for this will soon be found.

There certainly does seem some manner of manufacturing the silk in skeins, because amongst the many fabrics made from the Ailanthus silk and sent over by Father Fantoni from China, there were some made with silk in one continuous thread, and which had preserved the grey colour of the Ailanthus cocoons. In the meantime, whilst this is being discovered, these cocoons are treated like the Mulberry cocoons. They are carded, and then the material is obtained, analogous to what is obtained from the Mulberry Silkworm. This material of a brownish-grey colour carded, yields filoselle or floss silk, " only more glossy," which is manufactured in France under the name of galette or fantaisie, and of which there is an immense consumption. Mixing it with thread and wool, it is largely employed in manufacturing fancy stuffs. This is manufactured in great quantities at Roubaix, Nîsmes, and Lyons, and such an immense quantity of this substance is consumed in France, that every year 1,200,000 kilogrammes are exported from abroad.

The qualities of this new textile fabric have been studied and appreciated by people well calculated to know its worth. Amongst others, by Messrs. Henry Schlumberger and Charles de Jongh, great manufacturers, A. Guebuiller and Dr. Sacc, the eminent Professor of Chemistry at Wesserling. As there have not yet been enough Ailanthus cocoons to permit an industrial trial, these gentlemen tried their machines with the cocoons of the Castor Oil worm ; but they admit, that if there is any difference between the two it is all in favour of the Ailanthus silk, because they have ascertained it will bleach well.

Thus Dr. Sacc, in speaking of the Castor Oil silk, says :—" One fact which diminishes the value of this silk is its brownish colour, which prevents its being used for clear colours. The fact disappears completely with the silk of the Ailanthus worm, with which I will engage myself to produce white silk. That clever chemist and weaver, Monsieur de Jongh, finds that the gloss of the Ailanthus silk far surpasses any of the other known kinds of Bourre de soi."

The late Monsieur Geoffroy de Saint Hilaire, President of the Imperial

Society of Acclimatization, when lecturing at the Academy of Sciences in 1857, said :—"Here is the report from the Weavers at Alsace, who have made use of Monsieur Schlumberger's experiments on the Ailanthus silk. Mons. H. Schlumberger has found the cocoons very easy to card and spin. The thread obtained is less brilliant, strong, and rough, it left no residue, not more than in combing the thread. It is a most excellent stuff for use in all manufactures where bourre is required. The cocoons are easily cleaned, and they will take a good dye. This culture made on a great scale will furnish in abundance a stronger and a finer gloss than the Mulberry Silkworm."

The strength of this silk is immense, and to this is attributable the great durability of the Indian foulards, which are composed exclusively of this silk. In speaking of this silk, Father Incarville said :—"The silk produced by the Ailanthus lasts double the time of the Mulberry worm, and does not spot so easily, and washes like linen."

These remarks will be enough to prove the immense utility of this cultivation in France and England.

The Ailanthus Silkworm may have in the south and in Algeria three generations ; but with us in England it is better content with two. Unlike the Mulberry Silkworm, the eggs do not keep during the winter, but some of the cocoons remain with their live chrysalis inactive during the dull months, ready to become butterflies in the spring. The moths ought to appear between the 5th and 10th of June at latest, and as about from forty to forty-five days must elapse between the laying of the eggs, their becoming moths, and the formation of the cocoons, the first gathering ought to be from the 25th to the 30th July. The cocoons will remain inactive about twenty-six days, at the temperature of 70 deg. to 80 deg. Fahrenheit, not becoming moths till August 26th at latest. The eggs will be laid immediately, and these worms will have finished their cocoons at latest by September 30th or 5th October. The cocoons ought to be kept during the winter strung up like beads in a place where the temperature ranges from 60 deg. to 70 deg. (Fahrenheit). The moths will begin to appear about the 5th or 10th June.

Every evening the moths must be placed on a tray with a cloth over it, and air must be admitted. The females will lay against the sides of these trays, and the eggs must be detached either by a wooden knife or by the nail, and put either in a room heated 70 deg. or 80 deg. (Fahrenheit), or else in sunshine where they will hatch. About ten or twelve days after their having been laid you had better put Ailanthus leaves on the eggs, when the young worms will immediately climb on them and commence feeding. These leaves ought then to be placed in a bottle of water, the ends well stuffed into the bottles, as the young worms might descend the stems and then into the neck of the bottle, where they would get drowned immediately.

If unforeseen circumstances—bad weather for instance—prevented you putting the young worms on the trees in the open air, you must place fresh bunches in bottles close to the faded leaves, when the worms will go on to them. To save the few that may possibly fall down, you would do well to place a few leaves where the bottles stand, upon which the worms will creep immediately. You must guard against giving these worms old leaves gathered from a large tree, because they could not be so easily devoured by them, and they would kill a great many. This inconvenience would not arise where the plantations are made expressly for the worms, because the frequent cutting of the trees makes them put forth new shoots and tender leaves.

In placing the young worms on the Ailanthus trees, they must be strewed as it were on the plants. You must bring them on the old leaves in large baskets lined with paper, and you must fix these leaves on the trees. They might be fixed with pins or tied on till the worms have hold of the new leaves. Experience can alone teach the number of worms required on each tree. When once the worms are securely fixed on the leaves, there is no further trouble except to see that ants and wasps do not carry them off. The best manner of doing this would be to destroy the wasps in the spring time before the nests are made.

When the worms have come to their fourth change, they begin to spin their cocoons on the leaves of the Ailanthus (or even on any other ones in the vicinity), and the cocoons may be gathered eight or ten days after the beginning of the spinning.

About a month after the cocoons are finished the moths will appear. They will lay as in the spring time, and soon after the eggs will be hatched. The same process must be gone through as I have described, if you are able to hatch the eggs about the 30th August.

This second cultivation would end the first days of October—that is, if it were a torable season. The best manner of preserving the reproductive cocoons during the winter has not been fully ascertained ; but every day brings forth new methods of doing so. Meanwhile, we advise our readers to thread the cocoons in rows of one hundred each, and hang them up in different temperatures, so that we may find out which suits them best. They must not be kept together in baskets or boxes, as they will more or less, ferment ; and then if the moth does not come forth prematurely, they may contract maladies, which will be transmitted to the eggs, and most probably to forthcoming generations. The fear of birds seems to strike people who hear of this open-air cultivation, and I have given great attention to this subject. This fear has almost totally disappeared under the experiences of Messrs. Hébert and Lamotte-Baracé, especially since they have begun on a larger scale the cultivation of this worm ; and if ants, wasps, or birds, do carry off a small quantity, it is not missed in a large plantation where these worms feed. The same reasoning applies to fields where cereals are grown, and which birds and insects attack, and of which one does not count the ravages because of the enormous quantity of the crop.

Culture of Ailanthus Glandulosa.—This is not the place to enter into the etymology of the name of this tree ; suffice it to say, that its name of Vernis du Japon, or Japan Varnish Tree, was given to it by Abbé Incarville, who introduced it into Europe in 1751, thinking it was really the tree which produces that precious varnish which is so much employed in Japan and China. A few years ago the true tree was introduced, so that the ailanthus has since that period borne the name of the False Varnish tree.

We all know that the ailanthus is one of the easiest shrubs to grow, and there is no soil, however bad, in which it will not thrive. Calcareous, ferrugineous, sandy, clay, arid, and strong soils all suit it equally. In towns, or by the seaside, it does admirably. Like the Sumac, to which it is allied, it throws out suckers from its roots. It is by these means that it is multiplied, but since it has seeded in France, they propagate it in this manner at present. The seeds which are numerous ripen in autumn; they may be gathered from the month of November till January. They must be carefully dried for fear of fermentation. The seeds may be sown from the months of February till May, broadcast or in rows, and ought to be covered with from 1 to 2 centimetres of earth, and they will appear from three weeks to a month after they are sown. With the exception of a few cereal grains, there are hardly any other shrubs where the seed germinates so quickly, and it is not uncommon to see some of the shoots from these seeds 30 and 50 inches high the first year. Quantities of ailanthus trees have been planted on the Appenines, because they resist the bite of animals, and no ground game will touch them on account of the smell they exude when a leaf is gathered, or a branch broken off. Those trees destined for the reception of the worms ought to be planted about a yard from each other; the chief stem cut down every year, so that the young shoots spring up and afford young tender leaves for the worms; and, by planting them not too great a distance one from another, the shoots join each other, and thus enable the worms to go from one plant to another. As I mentioned before, this tree may be multiplied by its roots, which can be cut off and planted as we do potatoes. Where the plants are yearly cut down they naturally will not flower or seed. Experience has taught me, that if trees are planted from 12 to 15 feet high, they may be cut down immediately to within 2 or 3 feet of the soil, so that they will immediately throw out fresh shoots. This tree is so hardy and so easy to propagate, that in a plantation of 15,000 to 20,000 plants made in France, not one died. In England it is equally hardy. I planted three dozen standard plants on a sloping bank exposed to the sun; the heads were cut off, and the leaves began to sprout about the middle of May. My worms were hatched (according to the method already laid down), and put on the trees the 17th of June. They were then left without further care, except for a few days to watch the ants, which seemed inclined to carry off a few, till July the 21st, when they began their cocoons. Having had no previous experience, too many worms were placed on the trees: consequently, they ate up all the leaves, and descended the trees in search of more; so many perished in this way. The rest made their cocoons in the ailanthus, and some in cabbage plants planted near these shrubs.

These cocoons have been pronounced by Monsieur Marchand, of Paris, quite magnificent for size and colour; and I have no doubt that another year, I shall be able to carry on this cultivation with the greatest success.

The worms did not appear to mind the great wind or rain they had to experience during the time they were on the trees. I hatched the second crop the 31st August, and they did well until the second week in September, when three fine days brought out wasps to a great extent; and the fruit having all gathered, they seized upon the worms, and, as it were, sucked them till nothing was left but the skin. As I had not been troubled with these pests during the first cultivation, I did not take precautions this time. Another year this might be remedied, but my worms were hatched too late, as the nights were often of the temperature of 42°, and I doubt the worms being able to stand this degree of cold. Another year I should propose hatching the eggs about the 20th of May. They would have finished their cocoons about the end of June, allowing the trees a month to rest, and push forth fresh leaves. And here I beg to remark that, although every vestige of a sprout or leaf was eaten off my trees by the worms, no sooner were they removed than the trees burst forth twice as strong as before.

The second cultivation of worms might commence the beginning of August and ending the middle of September, which would avoid the colder part of the autumn.

If any persons wish for further information, I shall be happy to render it; and if, by publishing this little account of my own experience, I may have helped towards establishing a new source of employment and profit for both poor and rich, my object will be gained.

Dangstern, near Petersfield, 1862.

NOTES ON KUNDOO OR TALLICOONAH OIL.

BY ROBERT CLARKE.

As specimens of this oil, and the seeds from which it is obtained, have been sent from Western Africa to the International Exhibition, it may be useful and interesting to publish some notes upon it, which appeared a few years ago in the 'Pharmaceutical Journal.' We have received, under the name of Mote-nuts, the same seeds, and they are also called Kundoo-nuts. They are the product of *Carapa Touloucouna.* In commerce, this oil has been imported into London under the name of Mote grease. The crab oil, as it is termed, obtained from *Carapa guianensis*, is much esteemed in Demerara and Trinidad as an unguent for the hair. The seeds differ from those of the African species, in being less dense, more triangular in shape, and of a lighter colour.

The tree which furnishes the seed from which Tallicoonah or Kundah oil is procured, is found growing abundantly in the Timneh country, and near the colony of Sierra Leone. It is a Meliaceous plant, the Carapa Touloucouna of the *Flore de Senegambie*, and is figured in "Sweet's British Flower Garden," p. 72. The fruit is a large somewhat globular five-celled capsule. The seeds (of which there are from eighteen to thirty in each capsule), vary in size from that of a chestnut to a hen's egg; they are three-cornered, convex on the dorsal surface, and of a brownish or blackish red colour, and rugous.

At the village of Kent, near Cape Schilling, the oil is manufactured as follows :—The seeds are dried in the sun, and then hung up in wicker racks or hurdles, and exposed to the smoke of the huts. When exposed for a sufficient time, the seeds are roasted, and subjected to trituration in large wooden mortars until reduced to a pulp. The mass is then boiled, when the supernatant oil is removed by skimming. The natives principally manufacture the oil to afford light; this oil is both good and pleasant to burn. The leaves are used by the Kroomen as thatch. The tree grows to the height of upwards of twenty feet. I believe the medicinal properties of Tallicoonah or Kundah oil are yet but little known in Europe. Among the liberated Africans, the Sherbros and Soosoos, the oil is held in high estimation as an anthelmintic, the negroes and all classes of the colonists being very subject to worms. The sort of worms for which this oil proves efficacious are the tape, lumbrecus, and ascarides, more especially the two former, administered, however, in the form of enemeta; the oil is successful in bringing away great numbers of the latter. When employed as an enema, one or two ounces may be thrown into the bowels, dissolved in warm water, of a temperature sufficient to retain it in the liquid state. I have used it in large doses (as much as ℥iss.), in Lethargus, a disease of the brain, in which it is most desirable to act upon the bowels with the most powerful drastic purgatives.

Some of the colonists are in the habit of mixing with the palm and nut oils, used to afford light, a portion of Tallicoonah oil, to prevent their servants from mixing the oil with their food. I have employed it in cases of worms, or when I suspected their existence, in doses proportionate to the age and strength of the patient. In such cases, the dose has ranged from one ounce to one drachm, fluid measure. It is here necessary to observe that its purgative effects were by no means always uniform. In persons of weak habit of body, and in whom there existed any liability to bowel complaints, the Tallicoonah oil, from its acrid bitter properties, would prove injurious; but for persons in the opposite condition of body, I can confidently recommend this medicine as a safe and powerful anthelmintic. The usual way I have administered the oil is precisely similar to the modes in which castor or the other fixed oils are given. If given in proper doses,

* The oil obtained from an allied species, *Xylocarpus granatum*, has also an equal repute in the Eastern Archipelago.—EDITOR.

its purgative effects bear a close resemblance to those of castor oil, both in the length of time that elapses before its operation, and in the bulk of the stools produced.

When over-doses are taken, it produces most violent hypercartharsis, cold sweats, and vomiting, succeeded by collapse, and if remedial means are not promptly employed, even death. I have observed that the negroes also use it as an expectorant and rubifacient. The best specimens are liquid, but it is more generally found concrete, and could be procured in abundance from the coast, as an article of commerce. Mr. Redwood found this oil to be entirely soluble in ether, and that alcohol separated it into two parts, a concrete substance which was dissolved, and an oil fluid, at ordinary temperatures, in which the alcohol took no effect. The former contained the bitter principle and the nauseous odour of the oil, the latter was nearly colourless and tasteless. The oil owes its bitterness to an alkaloid principle, which MM. Petroz and Robinet ('Journ. de Pharmacie, t. vii., p. 48), found also in the bark of the tree.

Reviews.

THE CANADIAN NATURALIST AND GEOLOGIST for February has three or four papers of economic interest—viz., "On the Primitive Formations in Norway and in Canada, and their Mineral Wealth," by Thomas Macfarlane; "On the Shore-Zones and Limits of Marine Plants on the North-east Coast of the United States," by the Rev. A. Kemp; and "On the Mammals and Birds of the District of Montreal," by Dr. Hall.

HAITI AS IT IS: BEING NOTES OF FIVE MONTHS' SOJOURN IN THE NORTH AND NORTH-WEST OF HAITI. BY ROBERT S. E. HEPBURN. De Cordova, Jamaica.

This is a work which might be read with interest by those visiting the Haitian Court at the International Exhibition. The accounts here given, and the productions and manufactures shown at South Kensington, proves that there are resources and industries of importance yet to be developed, in what Washington Irving has termed "one of the most beautiful islands in the world, and doomed to be one of the most unfortunate." Mr. Hepburn, who was geologist to the republic, speaks of large mining resources in the island, and especially of its vast fields of lignites, although the deposits have not yet been worked. He remarks:

"The relative commercial value of mineral fuel is determined according to the percentage of combustible matter which each variety contains. There are several varieties of mineral fuel, known respectively as peat, lignite, anthracite and bituminous coal. The last named variety is found only in the old geological formations, the former varieties chiefly within the tertiaries and human period. The deposits of mineral fuel in Haïti, fall chiefly under the head of Lignite and Anthracite. Judging from the fossils, principally conchifers and bivalves, similar but not the same with extant shells, which accompany these deposits, I conclude that they belong to the *Eocene* or early Tertiary formation.

"Lignite, sometimes called brown coal, is usually distinguished as bituminous and non-bituminous. In bituminous lignite the quantity of bitumen and other volatile matter vary from 40 to 60 per cent., the proportion of carbon within the same limits ; and the ashes from 4 to 10 per cent. There is a variety of bituminous lignite, commonly known as steam-coal, containing from 11 to 15 per cent. of bitumen and other volatile mtater, and from 80 to 85 per cent. of carbon. A specimen of this coal was found in Maine, one of the States of North America, which yielded, upon analysis, 72 per cent. of bitumen, 21 of carbon, and 7 of ashes. In non-bituminous lignite, the quantity of carbon varies from 50 to 70 per cent.

"The specimens of lignite which were submitted to me by the Haïtien government for analysis, fall respectively under the head of bituminous and non-bituminous. Of the bituminous specimens, that from *l'Azile sur la riviere Dorge* yielded, upon analysis, of

Bitumen and other volatile matter	50.0	= 75.0 of combustible matter.
Carbon - - - - -	25.0	
Ashes, consisting of Iron, Lime, Alumina, and Silica -	25.0	
	100.0	

"That from Lasgoiamos *section de Morange commune de Hinche*, yielded of

Bitumen and other volatile matter	60.0	= 92.5 of combustible matter.
Carbon - - - - -	32.5	
Ashes, consisting of Iron, Lime, Alumina and Sand - -	7.5	
	100.0	

"These two specimens are all that fall properly under the head of bituminous Lignite. It will be seen that they do not, by any means, compare badly with Lignite, found in other parts of the world. The other specimens of lignite submitted to analysis, are non-bituminous, of which two are from Anse à Veau.

	No. 1	No. 2
Carbon - - - - - -	50.0	75.0
Ashes, consisting of Iron, Alumina and Silica - - -	50.0	25.0
	100.0	100.0

"The next is from Banica, and consists of

Carbon - - - - - - -	66.7
Ashes, = Silica, with a trace of Iron -	33.3
	100.0

"Two specimens, taken respectively from Hinche, and from a locality not named, yielded, of

	No. 1	No. 2
Carbon - - - - - -	92.5	90.0
Ashes, = Iron, Lime, Alumina, and Silica	7.5	10.0
	100.0	100.0

"By comparing these results with the statistics given above, it will be observed, that the two first specimens are lignite of very good quality; and that the two last contain a per centage of carbon equal to that yielded by the best Anthracite; indeed, but for their minerological characteristics, they might be designated Anthracites. Anthracite, we must remark in passing, contains on an average from 80 to 95 per cent. of carbon. A specimen of anthracite, submitted to me by Mr. Simon Spencer, which this gentleman assured me was obtained at Anse à Veau, yielded upon analysis, of

Carbon - - - - - - - -	76.0
Ashes - - - - - - - -	24.0
	100.0

"This specimen, although falling below the average quantity of carbon usually found in Anthracite of the best quality, is nevertheless, from its minerological characteristics, a true Anthracite."

The following relates to tropical products:

"In the past the staples of Haïti were identical with those of Jamaica—sugar, coffee and indigo. Of these only coffee remains to them. In this respect, very nearly the reverse has happened to Jamaica. We have continued to be a sugar and rum producing country; and although we continue to send a little coffee into the market, we are far below mediocrity in this respect, when we contrast the present with bygone days. The coffee which is now being exported from Haïti is not the product of present industry, but the remains of the industry of the past. It is obtained from trees, the greater portion of which were planted during the old French régime. In Haïti the coffee trees are not pruned as they are in Jamaica; they are suffered to grow luxuriantly, and to attain to a considerable height; and the trees in consequence reach a much greater age than they do in this country, and continue to bear for a much longer time. These trees have fallen into the hands of the small settlers, who care them, and, by planting from time to time, replace the older trees as they die out.

"Although sugar has ceased to be an article of trade, the cultivation of the sugar cane is still partially kept up, but only to an extent sufficient for home consumption, in the form of '*sirop*' and '*tafia*.' President Geffrard, with his wonted anxiety for the good of his country, is directing his energies to the restoration of the cultivation of sugar cane, and the manufacture of granulated sugar. With a free influx of immigrants from America, and an ample supply of agricultural implements, little difficulty could be experienced on this head, considering the facilities which the government is willing to afford in respect of this matter. So far as I have been able to learn, the government has undertaken to import improved implements of husbandry, and machinery for the manufacture of sugar, and to supply them to persons engaged in the cultivation of the soil, and the resuscitation of the manufacture of sugar, on the condition that those to whom implements and machinery are supplied, pay a tenth part of the original cost annually, with six per cent. interest, and a commission of five per cent. on the purchase, until the government is reimbursed.

"The cultivation of cotton is also a subject to which the government of Haïti is directing the attention of the people almost daily; urging the prosecution of it on them in every possible way. As we have already seen, they have taken some steps in this direction, and although they have not accomplished as much as it is desirable that they should, yet, the fact that something has already been accomplished in this way is an earnest for the future, not only in regard to cotton, but also in regard to sugar and indigo.

We cannot for the present, reasonably hope to see the cultivation of these staples carried to the same height, as in the days of the old régime; at least many years must elapse ere it arrive at this point of success."

Manual of Botanic Terms. By M. C. Cooke. R. Hardwicke.

We had occasion to notice recently a work from the pen of Mr. Cooke, and the present cheap volume, with numerous illustrations, promises to be equally useful. The special features it presents are: that the terms are written in their Anglicised forms, under which they are commonly employed, and the derivations are recovered from the mysticism of a Greek alphabet, so as to adapt the work to general use, as a plain and ready reference for botanical students.

The West India Quarterly, No. III. A. De Cordova, Kingston, Jamaica.

There are some very excellent papers in this number of the 'West India Quarterly,' and we would especially enumerate Mr. Hill's "Jottings by the Sea-side," a paper "On the Importance of the Study of Physiology," and a curious article "On the Advantages of smoking Pimento with Tobacco," a subject which we had before seen adverted to in Jamaica. Many lighter articles come in to relieve the heavy scientific papers, making an interesting variety for tropical reading.

"As it would be as easy to arrest the torrent of Niagara, as to put a stop to the universal habit of smoking, it might, nevertheless, be practicable to adopt a middle course, or modification of the present vicious and filthy system of smoking tobacco, and, thereby, diminish the deleterious influence of the drug *per se.* With this view, an admixture of *pimento with tobacco* has been recommended, nearly in equal proportions. This mode is decidedly less deleterious—the stimulating effects of the pimento counterbalancing the sedative effects of the tobacco—and, while forming an agreeable fragrant and exhilirating compound, which, so far as it has been used, is generally preferred to tobacco smoking, it, moreover, possesses the advantage of being agreeable to those who are sometimes involuntarily compelled to endure the *reek* of an empyreumatic pipe.

"To the inhabitants of some of our towns and villages—hemmed in by the swamp, and to those exposed to malaria in any of its forms, whether the miasms be almost imperceptible to the senses, or produces nausea and vomiting, as happens to some, in passing such stagnant putrid lagoons, as those of the Ferry, on the Spanish Town Road, smoking pimento with tobacco, if not altogether a safeguard, is yet preferable to the tranquillising sedative tobacco, and, as such, should have the preference. If Dr. Reid, when planning the ventilating of ships fitting out for the unfortunate Niger exploration, had also enjoined smoking pimento with tobacco, he would have made a step in the right way; and if he could have persuaded the government that acclimated seamen, recruited at Port Royal, were preferable for such a dangerous enterprise to unseasoned sailors from the banks of the Thames, the result might not have ended in such a disastrous failure!" . . . . .

"In smoking pimento with tobacco, let me not be misunderstood. To say that any chemical change is effected, or that the fragrance of the fumes possess any disinfectant power over malaria, would be incorrect, and lead to error and disappointment. The first sanitary step to be taken, whether in town or country, whether in temperate or tropical climates—especially in tropical climates—is to remove all *excreta*, or anything capable of generating foul air to a safe distance. One of equal importance is, for those living in malarious districts, if possible, to leave the vicinity of the lagoons and stagnant river courses, during the drying process under an autumnal sun. Cutting down all rank succulant bushes in the immediate vicinity of dwelling houses, and cultivating the spot with flowers, is in accordance with sanitary rules, and esthetic propriety. A musty smell, clinging about a place, resembling that of bats, or cockroaches, indicates malaria, and is a source of fever, especially to infants and children, and should be immediately rectified. It is difficult to convince parents that a cause, apparently so trifling, will make fatal inroads upon their lovely flock through the much dreaded infantile fever. The free circulation of fresh air, and a copious supply of pure water for baths and cleansing purposes, and a respect for that maxim which inculcates cleanliness, as next to godliness, are indispensable for the preservation of health.

"These pre-requisites, with a just appreciation of letting our moderation be known to all men, being attended to, the smoker may then indulge with comparative confidence in the fragrant compound ; and, although the former may only perform the office of a deodorant, to cover any incidental odours, a very material point shall have been gained in sanitary progress.

"If smoking pimento with tobacco answered no better purpose to travellers by land and sea, to soldiers and sailors, and the inhabitants of countries abounding in Malaria, than to inspire a degree of confidence in the preventive power of the fragrant exhalations, a great step would be gained ; for who does not acknowledge the power of mind over matter, and the happy influence of a cheerful disposition in contributing to the preservation of health. The first to fall victims to grave epidemical diseases, are those whose minds succumb to the dread of the evil ; under all circumstances, therefore, it is of the highest importance to prevent alarm, or panic. It is in connection with such consideration, combined with any medicinal effect which smoking pimento with tobacco may possess, that we would feel more confidence, if not security, in passing along the banks of a swamp, or lagoon, with the dews of night falling. The benefits of moderately using tobacco, weakened by an admixture of pimento, so as to produce no noxious effects, is of vital consequence to young men, where the formative principle is busily at work, building up a stout frame. As every *paterfamilias* knows the impossibility of preventing smoking habits among his sons, is it better to 'mitigate the ills we cannot shun,' by acquiescing in the modified, fragrant, and elegant use of this compound, which, while not interfering with the physical development, will tend to educe the *mens sana in corpore sano.*"

The Pharmaceutical Journal for April contains a Process for Estimating Tannic Acid in Galls, in the place of the Gelatine Process, by Mr. J. H. Marriage. He employs a solution of ammonio-sulphate of copper, containing in each decem. 634 grains of crystallised sulphate of copper, and just sufficient liquid ammonio to redissolve the precipitate first occasioned. Two septems of this solution indicate one grain of tannic acid. It occasions an olive-green precipitate, and at the same time deepens the colour of the liquid operated on. As the experiment approaches completion, the colour again becomes fainter, and would probably vanish altogether. Mr. Fownes estimates the tannic acid in galls at from thirty to forty per cent., Royle puts sixty per cent. as the maximum, but Mr. Maurice is dissatisfied with less than sixty-five per cent. from blue galls. A sample of Chinese galls gave him fifty-two per cent.

The Chemist and Druggist for April contains two or three articles deserving special mention. One on Chemistry and Pharmacy at the International Exhibition, by Mr. Quin, the Superintendent of that class of products ; A Day at the Carrow Works, Norwich (Messrs. Colmans'), describing the Manufacture of Mustard and Starch by Mr. J. C. Brough ; and one on the Night-shade Order of Plants.

The Paris TECHNOLOGISTE for March and April have been received. Among the papers in these we may mention the Manufacture of Vinegar from the Juice of the Beetroot and its Residues, of well-flavoured Alcohol from the Saccharine Juice of the Sorgho and of Maize; the Manufacture of Dextrine and Glucose Products, on the Preparation of Pure Nickel, and on Red, Blue, and Green Colours Extracted from Creosote.

The two first numbers of the present volume of the ANNALS OF AGRICULTURE IN THE COLONIES, edited by Mr Paul Madinier, are also to hand. Considerable attention is being given in its pages to Cotton Cultivation; and it contains also a great variety of miscellaneous statistics and details on colonial affairs generally.

THE POPULAR SCIENCE REVIEW. No. 3. Hardwicke.

Every successive number of this review is marked by increased attraction. The papers in the present are of general interest, and fully bear out the title of popularising science. Mr. Robert Hunt contributes one of his admirably-written articles on the Subject of Light and Colour; Mr. W. Fairbairn treats of the Great Exhibition Buildings, Past and Present, and the Application of Iron in their Construction; Mr. Gore shows how Science is applied to Electro-plate manufactures; Mr. Hargrave tells us how Precious stones are Artificially imitated, and various other eminent and talented writers contribute to make this one of the most important periodicals of the day.

PUBLICATIONS RECEIVED.—Catalogue of the Victorian Exhibition, 1861, with prefatory essays indicating the progress, resources, and physical characteristics of the Colony, &c. Melbourne: Printed for the Commissioners. Descriptive Catalogue of a Collection of the Economic Minerals of Canada, and of its Crystalline Rocks sent to the International Exhibition of 1862, by Sir W. E. Logan. Montreal: John Lovell. Catalogue of Contributions to the International Exhibition from Natal, drawn up by Dr. Mann, F.R.A.S. The Exchange, No. 1 and 2.

Scientific Notes.

APPLICATION OF ASBESTOS.—Asbestos, which is so abundant in many localities, has hitherto been very little used commercially. On the Continent and in Corsica it is used for packing fragile and valuable articles. Some of the more flexible varieties have been woven into articles which are unaltered by fire. It is employed in some kinds of gas-stoves, and the Greenlanders twist the fibres into lamp-wicks. In America, this mineral may be procured at the rate of 1½d. per pound. It has been tried there for paper-making, and for the manufacture of steam-packing, in both of which applications it is said to be serviceable. Its property of resisting heat, and its bad conducting power, would render this material particularly valuable in connection with steam-machinery. Mr. Audesley, the proprietor of considerable deposits of asbestos, near Baltimore, has introduced asbestos paper into the States, with some success. It would seem well adapted for coarse purposes, owing to its very low price, but it is somewhat friable, although not more so than the commoner kinds of straw-paper. The mineral is present to the extent of about thirty per cent., and communicates to the paper a not unpleasant satin-like aspect. It burns with a flame, leaving a white incombustible residue, which, with careful management, retains the form of the original sheet. Characters, written on the paper with ordinary black ink are still legible after burning. Owing to the friability which the presence of this mineral communicates to paper, it would not probably be a useful ingredient to any except low-priced common paper, although it is not impossible that its peculiar property of resisting heat might be of use under some circumstances.

New Paint from Antimony.—About six months ago a patent was taken out by Messrs Hallett and Stenhouse, for the manufacture of a paint from native oxide of antimony—a mineral which is found in considerable quantities in Spain, Borneo, and other localities, where it is usually associated with the grey sulphide of antimony, from which it has been produced by the process of oxidation, which, as might be expected, is found to be more or less complete. This native oxide of antimony, whose colour varies from light-yellow to yellowish-red, occurs usually massive, and consists of antimony combined with oxygen in different proportions, and generally contains some sulphide of antimony, silica, &c. The oxide is first reduced to coarse powder, and is then roasted for three or four hours, at a low, red heat, with free access of air, in muffles or other suitable furnaces. During the process of roasting, the sulphur and other volatile matters are expelled, the colour of the substance becomes much paler, and the residuary metal is converted, for the most part, into antimonious acid. The calcined product is then reduced to an impalpable powder by being ground in flint mills, and, when dried and mixed with oil, constitutes the paint. The paint has a delicate stone colour, and is quite equal in body or capacity to the best white lead; while it possesses the great advantage of maintaining its colour in vitiated atmospheres—being not acted upon either by acids or sulphuretted hydrogen. This property renders it peculiarly adapted to interiors of ships, gas-works, and hospitals. It is devoid of anything hurtful to workmen, either in its manufacture or use; and as (weight for weight) it will go fully 25 per cent. further as a pigment, than the best white lead, and its price being considerably lower, the new antimony paint promises, ere long, to be very generally employed.

Purification and Extraction of Oils.—Bisulphide of carbon has lately been applied to the purification of oils with much success. It has a great affinity for fatty bodies, as may be shown from the fact that when the bones of which ivory black is made are treated in the usual manner, only 5 per cent. of fat is obtained; treated with sulphide of carbon, they yield 12 per cent. Immense quantities of soap are wasted in extracting grease from wool; treated with the sulphide, the operation is more efficacious, economical, and expeditious. Oily seeds treated with the sulphide yield 10 to 22 per cent. more oil than by the old processes; besides, the oil is purer, and entirely free from glutinous matters, and requires no purification; besides, the oil contains more stearin and margarin, and consequently yields a harder and a better soap. The mode of operating is very simple. The fatty matters and the sulphide are mixed together in a closed vessel, and after digestion the sulphide is allowed to filter off, carrying with it the oil. The receiver is then converted into a distilling apparatus; steam is introduced; the sulphide passes off and leaves the pure oil behind. The sulphide may be used as often as required.

LIME AND EGG CEMENT is frequently made by moistening the edges to be united with white of egg, dusting on some lime from a piece of muslin, and bringing the edges into contact. A much better mode is to slack some freshly-burned lime with a small quantity of *boiling* water; this occasions it to fall into a very fine, dry powder, if excess of water has not been added. The white of egg used should be intimately and thoroughly mixed, by beating, with an equal bulk of water, and the slacked lime added to the mixture, so as to form a thin paste, which should be used speedily, as it soon sets. This is a valuable cement, possessed of great strength, and capable of withstanding boiling water. Cements made with lime and blood, scraped cheese, or curd, may be regarded as inferior varieties of it. Cracked vessels of earthenware and glass may often be usefully, though not ornamentally, repaired by white lead spread on strips of calico, and secured with bands of twine. But, in point of strength, all ordinary cements yield the palm to Jeffrey's Patent Marine Glue, a compound of India-rubber, shell-lac, and coal-tar naphtha. Small quantities can be purchased at most of the tool-warehouses, at cheaper rates than it can be made. When applied to china and glass, the substances should be cautiously made hot enough to melt the glue, which should be then rubbed on the edges, so as to become fluid, and the parts brought into contact immediately. When well applied to the stem of a common tobacco-pipe it will break at any other part, in preference to the junction. The colour of the glue prevents its being used for china.

THE TECHNOLOGIST.

NOTES ON THE CULTIVATION OF THE POPPY.

BY T. A. M. GENNOE, OPIUM DEPARTMENT, BENARES.

Soil of a sandy loamy nature is best adapted for poppy cultivation, though clayed lands are also much used. Lands situated on the margin of rivers, but free from any collection of stagnant water, are also well suited for the poppy-plant; alluvial soils likewise, provided the deposits are sand and clay, afford good productive crops. There is a remarkable difference in the quality of the produce of these several kinds of soil; that obtained from the first-mentioned is characterised by its rich fawn, or dark-brown colour, whilst the consistency is high, and the texture unbroken, whereas the produce of alluvial ground is generally not only dark in colour, but less granular in texture, and somewhat in a liquid state. Poppy-fields should, if practicable, be selected near the vicinity of villages, not only on account of the facilities of irrigation they possess, and the better opportunities the cultivators have of watching the culture of the plant, but lands so situated are always accounted rich from the constant supply of human manure they receive. The peasantry are fond of making fires in the cold weather; care, therefore, should be taken not to allow smoke to choke up the breathing pores of the plant. Soil composed partly of saline earth, or where nitre is seen diffused in other earthy substances, should always be eschewed, so also lands abounding in siliceous and calcareous earths, where the latter is found in the hard form of Kunkur, are to be avoided. Usar lands, or sandy soils, are equally prejudicial to the free growth of the poppy, as these lands always yield an abundant efflorescence of soda. I have seen some excellent crops of poppy grown on the sites of jungle which have been brought under cultivation, and now possess a rich loamy soil.

From July, or when the rains set in and the ground is moist, the lands should commence to be prepared by being ploughed up, so that by the middle of October, according to their requirements, a liberal supply of manure might be used on them. Ploughing should, however, be suspended when the fields are covered with rain-water, as it impoverishes the soil. As the season for sowing advances, or about the month of November, flocks of goats, or sheep, if procurable, might be penned with very great advantage on the fields for one or more nights, as the manure thus obtained operates favourably on, and is peculiarly invigorating for the soil. The poppy, unlike many other plants, the soil of which requires what is agriculturally termed "a rotation of crops," may be sown on the same ground, year after year, with unerring regularity, as the quantity of decayed vegetable and animal manure put into the soil, imparts sufficient nourishment to the ground to sustain annual crops of poppy without in the least degree being deteriorated by these yearly sowings.

When the lands are ready, or about the middle of November, the early sowings may commence, and the 2nd and 3rd be concluded in December. The seed should be of the previous year free from damp; it should be moistened in water the evening previous to sowing, and the next morning, after being removed out of the water, it should be scattered over the fields mixed with fine earth at the rate of two seers per beegah of the large bazar weight: should the ground be dry, it might be irrigated with advantage prior to sowing. Another mode is adopted in some districts, of throwing the dry seed broad-cast. After sowing, the land should be irrigated the next day (if not previously done), and then on the succeeding day ploughed and harrowed.

After a week the beds should be made from 3½ to 4 cubits in length by 2 to 2½ cubits in breadth. All the beds should be placed in consecutive rows, according to the level of the ground, so that there may be no difficulty in irrigating the land. A drain or outlet should intervene between every two beds for the passage of water. In lands bordering on rivers and jheels, as they retain their moisture till December, the necessity of forming beds in them does not exist on that account, as they (the beds) are only useful to facilitate the watering of crops. Wells are essentially necessary for poppy-fields, and every facility and encouragement should be given to construct them wherever they are wanted. Kucha-wells may be dug at a very trifling cost, which would be more than three-fold repaid by the productive returns of the crops. Well-water is preferred to water obtained from any other source, such as jheels and rivers; but the cultivators, from necessity, are frequently obliged, from the want of wells, or their great distance from the fields, to avail themselves of jheel irrigation.

When the plant attains to the size of two inches in height, the beds, after being well irrigated, should be carefully weeded and thinned, and the plants to be retained should be kept from 3 to 4 inches apart from each other. Two weeks after the same operations are to be practised, all the sickly and superfluous plants, together with all foreign and noxious herbs, should be removed, leaving the vigorous poppy plants at distances of 7 or 8 inches from each other. Then the process of gently digging up the soil with a hoe or spud should be diligently carried out, and the fields must continue to be dug and irrigated every two weeks;

the roots thus imbibe moisture, and the plant springs up large and luxuriant.

In the process of irrigation, care should be taken not to allow the water to exceed one inch in depth, or, in other words, the entire seedling should not be under water. It is very necessary that irrigation should be pursued at stated intervals of time until the collections begin.

When the plants have been in bloom for some time, the green capsules become slightly coated over with a fine, transparent, white-coloured surface, and the pods become less yielding to the touch when pressed; when this change presents itself, the cultivators at once perceive that the plant has arrived to maturity, and is fit for incision. Another means for recognising this is, when juice exudes on breaking off the series of stigmata formed on the apex of the pod.

When the incisions commence, the process should be carried on regularly every third day, and according to the time of collection, whether late or early in season, or the condition of the plant, whether sickly or healthy, from 2 to 7 incisions might be expected. It is to be noted that there is a wide difference between the produce of the earlier, compared with the later sowings; the former is of lower spissitude but more abundant in bulk, whilst the latter is just the reverse, poor in quantity, but of higher and more superior consistence.

Gentle westerly winds are most favourable for our opium collections, as also for inspissating the drug when collected. Opium gathered in during the prevalence of easterly winds is scanty, because the juice does not exude freely from the incisions, and the opium collected is somewhat darker in colour from the atmospheric humidity with which it gets impregnated. The incisions should invariably be made in the afternoon, and the operation of collection the next morning.

It will be necessary now to enumerate a few of the causes which contribute to the falling off of produce, or tend to the entire destruction of the plant. "Bhur Bhar," a prickly plant, is very destructive to the poppy, absorbing the nutritive qualities of the ground intended for the latter alone: these ought to be steadily rooted up wherever they make their appearance. Insects are apt very often to attack the crops. When this occurs among the early sowings, the best plan is to persevere and re-sow, but when they begin their ravages after the plants have germinated and attained to some size, the following bait may be used with very great success—viz., to cut gourds or castor-oil leaves into pieces and strew them over the fields. The next morning they will be covered over with the insects, as they readily forsake the poppy for the more palatable food offered to them; thus, they can easily be removed and destroyed in a collective mass. The process of irrigation, too, offers a good opportunity for the insects to be destroyed by birds. There is a parasitic shrub called by the natives "*Tokra*," which is very detrimental to the growth of the poppy; it completely entwines itself round the root of the poppy, and gradually injures and chokes up the absorbing pores of the little poppy spongelets;

being a much stronger plant, it easily overpowers the tender poppy, and so induces premature decay. The poppy plant is subject, in common with other crops, to certain vegetable diseases, the two most common and most fatal are called "*Murka* and *Khurka*" in the village vernacular, the former shows itself among the early sowings; its ravages are marked by the plant becoming shrunk and stunted in growth, the leaves become sere and yellow, and the plant eventually decays away, affording, if it has lingered awhile, very little (if any at all) of produce. The cultivators attribute this disease to a species of infusorial worm which corrode the tender roots, and not to any agency of the soil, for side by side may be commonly observed two beds, one teeming with luxuriant plants full of rich foliage, whilst the other may have only a few lank diminutive plants, possessing not the slightest shadow of verdure. The "*Khurka*" occurs late in season, and attacks the plant in its healthiest state, this blight arises from excessive damp produced by a sudden change of atmosphere, attended with rain and damp wind, especially affecting fields which have just before been already seasonably irrigated. There is no mistaking the effect of such a transition; the bright green colour yields to a dark and sombre tint, which transfuses itself alike over the leaves, the stalk, and the capsule: a sensible decrease is at once observable in the produce, which before long ceases altogether, for the malady completely saps the vitality of the plant. The other causes which prove injurious to the plant, and materially affect its productive powers, are either natural visitation, such as a fall of hail, a severe frost, inopportune showers of rain, or excessively strong winds during collections, or the causes may be, as in too many instances they truly are, from a defective system of tillage.

For preparing the opium from its crude state to the consistency at which it ought to be delivered, the following simple treatment should be attended to; the drug, as soon as it is collected, should be temporarily kept, as it is usually done, in a shallow brass vessel placed in a slanting position, so that the sediment called *Pussewah* (got from dew uniting with the juice which exudes from the incisions) might be detached from the pure drug; the next day the opium may be transferred to shallow earthen vessels, and the same process repeated on each day the collection is pursued. The drug should be manipulated at least once a week. The *Pussewah* which accrues ought to be kept separate in another vessel. By a careful observance of these rules, the opium will be of good colour and quality. Everything (we would lay stress on this) depends on the early handling of the opium, and the speedy separation of the *Pussewah* before it deteriorates the drug, for it gets so closely combined with it as to become part of the mass, and almost impossible to be disunited. If the Opium be kept in its crude state without being seasonably manipulated, it is apt, especially if the wind has been easterly, to become dull in colour and aroma, and muggy to the touch. Care should be taken to preserve the drug from places where there is much smoke. It should not on any account be exposed to the sun, as the oxygen to be absorbed from it would discolour the drug, but a free current of air is very beneficial. Cultivators should be strictly guarded against stowing away their opium in *Kotlas,* or grain receptacles attached to their houses, as these places from their peculiar construction are almost perfectly destitute of ventilation.

The following hints will be found useful for the manufacture of what is departmentally termed "flower leaves" used as a cover for the opium cakes. The flowers are to be gently broken off from the plant and gathered into baskets ; thirty or forty of them may be taken each time, and baked on a shallow iron-pan or other earthern vessel over a moderate fire, and the mass, when heated, should be gradually rubbed down with a piece of rolled-up cloth, so that it may be pressed down to a circular form of the shape of a *Chupatty,* from six to twelve inches in diameter, clean in colour, with all the rugged patches smoothed down to an even texture. Care must be taken that the leaves are not burnt in the process of baking ; after being baked they should be dried out in the sun, generally on the tops of houses or on charpoys. Flowers broken off by the wind and strewn on the ground should not be mixed up with those gathered by the hand, as the former become black when prepared for use, so also flowers collected during a shower of rain invariably become discoloured. One great precaution is necessary to be remembered, which ignorant cultivators are apt to forget that flowers which have not attained to their full bloom should, on no account, be plucked, as this process would diminish in a marked degree the produce of the plant. Spoilt and discoloured leaves are never unserviceable, for they form excellent manure, and the cultivators, in using them as such, virtually restore back to the soil much of the nutritive principles which it had expended in the production of the plant.

I think I have touched, though very cursorily, upon some of the salient points relating to the cultivation of poppy. The culture of this plant is more of a "horticultural" than an "agricultural" undertaking ; every kind of land could not possibly be grown with poppy, plots of ground here and there in the immediate vicinity of villages, accessible for irrigating purposes and possessing facilities for constant watchfulness are generally chosen. The amount of labour and agricultural skill devoted on the crops from the early tillage of the fields to the gathering in of the produce can only best be explained by the remunerative profits realised by the growers. If sufficient care has been expended in the preparation of the land, and persevering industry exercised in the subsequent treatment of the crops, the harvest to the cultivator cannot but be rich and pleasing, a beegah of land giving him, in a good season, from 8 to 10 seers of opium, the same quantity almost, or perhaps 2 seers less, of flower leaves, and about 2 to 2½ maunds of poppy seed, for which latter he finds a paying market in his own native bazaar near his village.

THE COTTON TRADE.

It is not our purpose to trace the history of cotton-spinning back to the heroic ages, nor to cite Herodotus as witness to the quality of the cotton fabrics of India. Those of our readers who explore classic authors, or who are given to historical research, may read how the cotemporaries of Strabo practiced the art of printing calicoes ; and Pliny will describe to them the *Gossypium** plant, from whose "woolly down was made the beautiful robes which the priests of Egypt delighted to wear." Marco Polo will tell in quaint phrases what progress the manufacture of cotton goods had made in his day, in the far off Empire of Cathay; and in the "precepts of Eben el Awan" may be read all that was known to the Arabs of the culture and use of the plant whose products now figure so largely in our commercial statistics.

Our business shall be with the cotton trade of the present generation ; to relate in brief terms the steps by which it has grown to its present gigantic proportions—to nearly a third of the commercial enterprise of that great empire whose commerce envelopes the globe.

Among the many wonderful developments of industrial enterprise, the growth of the cotton manufacture in Britain is, beyond comparison, the most remarkable. In the first year of the present century, the cotton goods exported from the United Kingdom were valued at 355,000*l.* In 1860, their value was declared to be 52,013,482*l.* ; and those taken for home consumption were estimated to be worth 40,000,000*l.*

But great as is the contrast between the cotton exports of the first year of the present century, and the value of the cotton fabrics exported and taken for home consumption in 1860, the figures fail to convey anything like an adequate idea of the wonderful strides that have been made in the productive powers of British industry, skill, and enterprise. Valued at the prices obtained prior to 1815, the cotton goods now annually produced in Britain would be worth upwards of four hundred and fifty million pounds sterling. At the former period, the average value of a yard of manufactured cotton was 17¼d., now it is only 3½d.—nor is this all,—the article produced at the latter price is greatly superior in texture, appearance, and in durability, to the more costly fabrics manufactured prior to the inventions of Hargreaves, Crompton, Arkwright, and others, to whose ingenuity England is indebted for one of the most important of her commercial interests, and the world for putting within reach of the poorest labourer, luxuries that a century earlier could hardly be obtained by the wealthiest noble.

If such figures inadequately represent the annual productive value of the factories of Great Britain, at what capital sum shall we rate the brain labour of those men who have perfected the machinery wherewith such

* Gossypium—Cotton, a genus of plants, of the class Monodelphia, order Polyandria, Linn. The American species is termed *G. hirsutum,* the short staple, or upland cotton.

results have been achieved? If England's commercial supremacy is the chief element of her greatness and glory; if commerce is the best missionary of civilization, certain it is that the inventors of those wonderfully-productive agents are entitled to a conspicuous niche among the benefactors of the human race, and contributors to their country's greatness.

Having in mind the essential maxim of that excellent matron, Mrs. Glass, we shall grow our cotton before we spin it. To this end—as an acre of land, with the best management, will only yield 100 lbs. of the cleaned wool, we must have annually under crop, to meet the current consumption of Europe and America, not less than 19,000,000 acres; and, to ensure a proper rotation, not less than fifty-seven millions of acres of land are required for the production of the 1,871 millions of lbs. of cotton wool that feed the spindles of the European and American manufactories. It is probable that an equal quantity is necessary for the Asiatic and African looms; therefore, it is fortunate that the "*Gossypium*" is indigenous to so large a portion of the earth's surface, and that it has been found capable of naturalisation in latitudes extending thirty-five degrees on each side of the equator. It has been cultivated in Italy, in Sicily, and in the south of France. Egypt and Brazil supply large quantities of a superior quality, and recently it has been cultivated in Australia, and at the Cape.

Notwithstanding the wide range over which the cultivation of this plant may be extended, embracing the most important colonies of Britain, it is a singular fact that the attention of British capitalists has not until recently been directed to the promotion of its cultivation, and the vast interests involved in the manufacture of its products have been almost entirely dependent on the American plantations:—so much so that, in 1856, it was boasted by a writer in a New Orleans periodical, that "of the four millions of bales annually consumed, three and a half millions were produced in the Southern States of the Union."

Since, and indeed for some time previous to the "secession" of the Cotton States, the attention of the British manufacturers has been thoroughly aroused to the danger of their position, and it is almost certain that the efforts now being made will stimulate the production of cotton to an extent that will give as wide a range of markets for the purchase of raw materials as there now is for the sale of manufactured goods. There is no valid reason why they should stop short of this desirable result, for it has been abundantly demonstrated that labour is abundant in those countries where the soil and climate is most suitable for the culture of cotton, and only requires the enterprise and organisation of the Anglo-Saxon to train it to the work.

The first impulse has been towards India. When the Russian war seriously interfered with the supply of hemp, India supplied its place with "jute" and "sunn."* When British forests were found insufficient to supply the dockyards with timber, India gave them "teak," and now, when

* See an article on this subject in the present volume, ante p. 49.

the folly and presumption of man threatens to interfere with the accustomed supply of cotton, India is looked to for the means to fill the threatened gap. Nor will she fail. In that vast region, embraced by the Indus and the Himalaya mountains, and bounded by the Indian ocean, and the Bay of Bengal, there exists a population closely approximating upon 200,000,000, fully two-thirds of whom are subjects of the British Crown ; these, from a period anterior to historic record, have been clothed in cotton. The total quantity of cotton grown in India, according to Dr. Watson, amounts to upwards of 2,400,000,000 lbs. per annum. and demand for its culture certainly not less than 24,000,000 acres.

Great as is the acreage above indicated—nearly three times that of the American cotton fields—it is but small in comparison with the vast extent of British India. The cotton tract in the valley of the Godavery alone is said to be of greater extent than the whole American cotton field. Guzerat, under the present demand, is expected to send forward, during the current year, not less than three hundred millions of lbs., and this district is not one-hundredth part of India. It has been said, on what may be deemed good authority, that more cotton is annually wasted in India than is grown in America ; and there is no doubt but that, by stimulating the production, not only will the culture be extended over a greater area, but the productive power of the land will be materially increased. If to the completion of the works of irrigation already in progress, and the construction of railways, is added the stimulus of high prices in Liverpool, it seems reasonable to conclude that the supply of cotton from India will rapidly increase.

A recent writer justly observes that, "up to the present, the supply from India has been entirely influenced and over-awed by that from America. Omitting years like 1855, when New Orleans cotton was selling at 10¼d., and Surats (or East India) at 7¼d. : and coming down to later days, when American cotton was selling in Liverpool nearly as low as 4d. and Surats at 3d., we shall see reason to conclude that the development of the power of India to compete with America is, in one respect, a question of price."

Indian cotton is often delayed for months at the place of its growth by want of transport, during which period it is subject to a deterioration of, at least, ½d. per lb. The cost of growing it is estimated at 1½d. per lb., it costs another 1½d. to carry it to Bombay (or other port of export), and the freight to Liverpool adds another 1d. per lb. ; hence it cannot be sold in England at less than 4d. per lb.

In 1845, the largest crop ever produced (up to that date) in America was brought to market, and the price of the superior grades fell to a point which compelled the holder of Indian cotton to sell at 3d. per lb. This inflicted an actual loss of 1d. per lb., and purchasers for the European market withdrew their agents from India. As a consequence, the exports during the following year fell to about one-half their previous quantity. On the other hand, when, in 1856, the price of American cotton in Liverpool had risen to 6d. per lb., and Indian to 4⅝d., there was imported in the succeeding year the large quantity of 250,000,000 lbs., and last year this quantity was increased nearly 50 per cent.

In 1788, the efforts of the East India Company were first directed to the promotion of the growth of cotton, and to the improvement of its quality. In the same year was made the first shipment of Indian cotton to England. In 1814, the exports to England amounted to 4,000,000 of pounds, and they have since increased in the following ratio:

1831	25,805,153 lbs.
1838	40,217,734 „
1845	58,437,426 „
1851	84,923,022 „
1861	369,040,448 „

Next after India we may refer to the gradually increasing production of cotton in Egypt. Its cultivation was first promoted by Mahmoud Pacha, who no sooner became convinced of the fitness of the soil and climate, than he set about the prosecution of the enterprise with such vigour and sagacity, than within two years he exported nearly six thousand bales of a superior quality to England. In 1858, this quantity had been advanced to 38,248,112 lbs., and in the same year France obtained 7,434,300 lbs. from the same source. In 1855, the total quantity exported was 55,874,300 lbs., and the home consumption was estimated at from five to six millions of pounds.

England also receives large quantities of cotton wool from Brazil. In 1849, the quantity approximated closely upon 31,000,000 lbs., and though it hardly reached 17,000,000 in 1860-61, this falling off is attributed to competition with American supplies, and to the fact that in Brazil, cotton cannot be successfully cultivated near the coast ; the difficulty of transporting it from the interior adds so much to its cost as to render it unprofitable. The Brazilian government has offered encouragement for the construction of railways, by guaranteeing interest on the outlay, and lines are in process of construction by British capitalists. Their completion will remove the main difficulty to the increase of the cotton culture, and the exports will unquestionably be largely increased.

India, Egypt, and Brazil are not the only sources to which the British manufacturer can resort for his raw cotton. At the present moment importations of cotton arrive in Liverpool from five distinct regions of the earth, the United States, India, Egypt, Brazil, and the West Indies. Samples have also been produced from the western parts of Africa, as well as from Australia and Natal, of excellent staple and general good quality. Indeed, samples from Queensland and New South Wales, shown at the International Exhibition, are valued at 3s. 6d. to 4s. per pound! The quantity as yet obtained is small. But let us call to mind the rapidity with which the American supply has reached its present importance : less than seventy years ago the exports of cotton from the United States were *nil*; in 1794, they exported but 5,340 bales of 300 lbs. each, which embraced the entire crop. If such small amounts have expanded to the present enormous production, who shall say that Africa, with its teeming population and genial climate, will not speedily increase its modest contribution of twenty-one bales in 1859, to an amount which, if not equal to that sent from America, may yet startle us by rapidity of increase. It appears from the narratives of Clapperton and Landers, that cotton is grown very extensively in all parts of Africa. Dr. Livingstone tells us of vast ranges of country suitable for the cultivation of the plant. In one place, he says, "The markets are well supplied with provisions by great numbers of women, everyone of whom is seen spinning cotton with a spindle and distaff, exactly like those which were in use among the ancient Egyptians. . . . . . The cotton was brought to the market for sale, and I bought a pound for a penny. This was the price demanded, and probably double what they ask from each other. We saw the cotton growing luxuriantly all around the market-place from seeds dropped accidentally. It is seen also about the native huts. . . . . . We met on the road natives passing with bundles of cops or spindles full of cotton thread, and these they were carrying to other parts to be woven into cloth." In a country so congenial to the production of the staple, with a population naturally docile, though fond of display, there requires but the opportunity and the knowledge that they can at once exchange the raw material, so easily obtained, for the fabric they so highly prize, to induce them to apply themselves to cultivating and collecting it at such points as may be selected by the European traders for making the exchange.

Summing up the supplies obtained from all quarters we find that England, in 1859, received 1,226 millions of pounds of cotton wool, of which 962 millions went from the United States, and the remaining 264 millions from all other countries. In 1860, this enormous quantity had increased to 1,391 millions of pounds, but in 1861 it fell back again to 1,257 millions of pounds.

Such facts, showing as they do the vast preponderance of the supply obtained from one source over that obtained from all others, have not failed to produce their effect on the public mind here. We find Mr. J. B. Smith holding the following language in a paper read before the Society of Arts, in 1857: "It is much to be desired that our supplies of the raw material for so great a manufacture should be derived from a variety of sources, that we may, as far as possible, be thus protected from the fluctuations in prices incident to good or bad seasons; but, unfortunately, they are chiefly derived from one source. . . . . But not only are we exposed to the danger of being limited chiefly to one source of supply, but to a still greater hazard—namely, that this supply is the production of slave labour. It may be that the institution of slavery, although condemned by all civilised nations, may yet exist for ages in the United States; or it may happen that occurrences may any day endanger its continuance. The alarm created by recent symptoms of discontent among the slaves in that country, is evidence that their owners themselves are not without apprehensions of danger; and it is impossible for those interested in the cotton manufactures of this country to contemplate with unconcern the insecurity on which this vast manufacture rests. This is not a local question—it has become a great national question—and must be forced upon the attention of statesmen of all parties. To me it appears the importance of the subject can scarcely be over-rated."

With such motives to action, so forcibly expressed by one who had the ear of those most interested five years ago, it is not likely that our manufacturers are so unprepared as the Americans imagine,—with the necessity of dealing promptly with this great question, so prominently brought home to them by the present disturbances in the United States, and the blockade of the cotton ports of the Southern Confederacy,—with so wide a field for action before them,—we may be sure that the commercial enterprise of Britain will not sleep.

It will not be long ere the absurdity of that rooted idea of the Southern planter—we may almost add, of the Northern merchant—that "cotton is king," will be fully demonstrated; and they will then awake to the conviction that they are but as the flies on the rim of the wheel, and must struggle for dear life to find customers for their bales in the over-stocked markets of the world. The quarrel which was arrogantly assumed to be the precursor of the downfall of the commercial supremacy of Great Britain, bids fair to be the immediate cause of largely increasing and cheapening the world's supply of the raw material, and of giving a greater impulse to the productive powers of the British looms than anything that has happened since the inventions of Hargreaves, Arkwright, and Watt.

As with many other branches of manufacture, that of cotton was driven into England by the tyranny of continental rulers. It first took root in Manchester about the beginning of the seventeenth century, where it was encouraged by the municipal authorities granting to the political and religious refugees (who brought the art with them) valuable privileges for a nominal consideration, such as the privilege of cutting timber for their looms in the extensive forests owned by the Warden and Fellows of Manchester College. The industrious immigrant was also encouraged by privileges from the Crown. "The Provident Elizabeth," says l'Abbe de Smet, "did not confine her views to the relief of her religious partisans, but sought to transfer into her kingdom those prosperous trades of the low countries which adjoining states had looked upon with invidious eyes."

At this time the operative weaver had usually his residence in the country, where, in his garden plot, he eked out his earnings by the cultivation of his small holding. This was a necessity. The uncertainty of procuring a regular supply of material for his loom rendering his legitimate work exceedingly precarious.

The fly shuttle was invented by Kaye of Bury in 1750, and, in 1760, James Hargreaves had perfected important improvements in the carding processes. In 1762, the father of the late Sir Robert Peel erected one of his improved machines at Blackburn, which did not materially differ from those now in use. In 1757, the same James Hargreaves invented the spinning jenny, and after several unsuccessful attempts, succeeded in producing a machine with which he could spin eight threads at once. He speedily improved on his first attempt, and constructed a jenny to run eighty spindles. This may be considered as the leading step in that march of discovery which has improved every branch of the manufacture.

Like other benefactors of the human race, Mr. Hargreaves was not destined to reap much advantage from his discoveries. He was hunted from his native place, and settled in Nottingham, where he shortly after died—if not in great poverty, as has been asserted—certainly in very indifferent circumstances.

About the same time, Mr. Arkwright, of Preston, in Lancashire, gave his attention to the improvement of spinning machinery. He was brought up to the humble occupation of a barber, but seems to have been endowed with a rare combination of inventive talent, and a capacity for business. His want of mechanical skill was compensated by ardour and perseverance, and he succeeded, after many struggles with adverse circumstances, in perfecting that rare piece of mechanism called at first the "Water Frame," and, subsequently, the "Throstle," which performs of itself the whole process of spinning, leaving to the workman only the duty of supplying it with material and of piecing such threads as are accidentally broken.

In partnership with Mr. Strutt, a man of great mechanical ability, Mr. Arkwright erected a mill at Nottingham for spinning yarn with his machinery. In 1771, he removed to Cromford, where he erected another mill, and where he continued to follow up his first great invention, with many important though subordinate improvements. He was not, however, to enjoy the fruits of his invention without dispute. Like Hargreaves, he was first persecuted as an innovator; then, when the value of his inventions was demonstrated by the work they produced, his patents were contested, and, had it not been for his business tact, his inventions would have been pirated by the very men who had ridiculed them, and persecuted him.

It is commonly believed—and often appealed to as a fact by the advocates of protection to home manufactures—that the factory system of Great Britain was fostered into existence by protective duties. So far as this branch of the system is concerned, nothing can be more erroneous. It fought its way in the face of adverse laws. No sooner had Arkwright and his partners surmounted the mechanical difficulties that lay in their path than they discovered that they were doomed to ruin, unless they could command sufficient wealth and influence to obtain the repeal of preposterous legislative enactments. It was not until 1774 that Parliament was pleased to recognise the propriety of permitting genuine cotton fabrics to be made and sold, and then only under vexatious excise restrictions. The sapient lawgivers had previously considered it a necessary stroke of policy to ensure the consumption of home-grown material by requiring that a certain proportion of every fabric should be composed of *linen yarn.* It required no small degree of energy, and involved very great expenditure of time, to beat down the influence wielded by the defenders of home productions.

About 1792, Samuel Crompton learned to spin with one of Hargreave's jennys, and, being dissatisfied with the quality of the yarn produced, he set about improving it. His efforts resulted in the mule. With his machine —which, not being a mechanic, he had elaborated under great difficulties— he produced a superior article, which excited the public mind, and he was so beset by the prying curiosity of the country people, that in order to get rid of the vexation he exhibited his invention to those who choose to subscribe a guinea each. In this way he raised about fifty pounds, with which he constructed a superior and larger machine. He took out no patent, but subsequently received 500*l.* from Parliament.

When Arkwright's patents were cancelled and the use of the nice preparatory processes became general, the full value of Crompton's inventions became known, and the use of the mule jenny marked an important era in the history of the cotton manufacture.

The enormous productiveness of the spinning machinery could never have been utilised, had the conversion of the yarn into the woven fabric depended on the hand loom weaver. It needed another important element to complete the series of automatic machinery, and this was supplied by Cartwright, who, in 1784, invented the germ of the power loom. In 1787, he completed his invention and erected a "factory," which, probably by reason of his want of business habits, was not successful as a pecuniary investment. Numerous subsequent improvements were made by Bell, Monteith, Horrocks, Sharp, and Roberts, and a host of other inventors, who have improved this machine until it may be said to be perfectly self-acting in all its operations.

Having thus briefly glanced at the successive steps by which the inventive genius of the last century supplied the mechanism, we will now, with similar brevity, examine the industrial structure which capital has raised with the tools thus placed within its reach.

About the time Crompton completed his invention, he received 14s. sterling per lb. for spinning and preparing No. 40 yarn, and shortly afterwards he was paid 25s. sterling for No. 60. To show how fine a grist he could spin, he produced yarns as fine as No. 80, for which he obtained 42s. per lb. More perfect mechanism and improved skill enabled the spinners to work still finer grists for lower prices, and, in 1793, only 8d. sterling per lb. was paid for No. 100. Notwithstanding, however, this extraordinary diminution of price, by aid of the improved machinery, superior judgment in the selection of suitable cotton wool, and greater skill in working, the spinners can with less labour earn more money than they did when the prices were high.

Nor is the saving effected by the power loom in weaving of much less importance than that due to the spinning machinery. The invention of the fly shuttle by John Kaye, doubled the productive power of the hand loom;

but even as compared with the loom in this improved state, the mechanism wherewith a girl is enabled to produce from three to four hundred yards of four-fifths cloth per week is as great an economical triumph as is the invention of the spinning frames that produce the yarn.

Applying the great saving in the details of the cost of production to the quantities annually worked up, we have the key to the wonderful expansion of this branch of industry, and we are enabled to understand the means whereby the manufacturer is enabled to place within reach of the multitude those fabrics that contribute so much to the civilisation with which we are surrounded.

We have alluded to the probable increase in the supply of raw material from regions which hitherto have not contributed at all, or only in a small degree, supplies of cotton to the manufacturer. It is well that these regions are so widely spread, and that they have a capacity to yield bountifully, for manufacturing power has increased, and, indeed, is still increasing at a rate which has no parallel in the records of industrial enterprise. The quantity of cotton annually consumed by each spindle in the United Kingdom is $31\frac{3}{4}$ lbs.; and it is estimated by those best acquainted with the case, that in 1860 the rate of increase in the number of spindles was not less than 45,000 per week, representing an increase in the consumption of cotton, of upwards of 74,000,000 lbs. per annum. As the average consumption of cotton per hand employed has been 2,351 lbs., this increase indicates an annual increase of 31,600 in the factory population of Britain. It is noteworthy that, notwithstanding this extraordinary increase in production, the supply of the manufactured article does not keep pace with the expansion of the markets, the scarcely perceptible reduction in price being entirely due to the steady improvement in the machinery used.

The following table will give some idea of the periodical increase of this branch of business and of the enormous values involved :—

	lbs. of Cotton Wool Consumed	Quantity and Value of Cotton Goods Exported from Great Britain.				Estimated Total Value of Cotton Goods Manufactured in Great Britain.	Average price per yard.	Average price of Yarn, per lb.	Average price of bowed Cotton per lb.
		No. of lbs. of Cotton Yarn Exported.	No. of Yards of Wove Fabric Exported.	Value of Hosiery, Lace, &c. Exported.	Tot. Value of Cottn. Goods Exptd. from U. Kingdom.				
				£	£	£	d.	d.	d.
1815	....	9,241,548	252,884,029	....	19,822,193	....	$17\frac{1}{4}$	$43\frac{3}{8}$	$21\frac{1}{2}$
1820	....	23,032,325	350,956,501	....	16,035,643	....	9	$29\frac{3}{8}$	$11\frac{1}{2}$
1827	....	44,878,774	365,492,804	1,144,552	17,638,165	....	$8\frac{1}{2}$	$18\frac{7}{8}$	$6\frac{1}{2}$
1830	250,695,000	64,645,342	444,578,498	1,175,153	19,428,664	47,000,000	$7\frac{5}{8}$	$15\frac{1}{4}$	6
1840	457,723,000	118,470,223	390,631,997	1,265,090	24,668,618	49,616,655	$4\frac{15}{16}$	$14\frac{3}{8}$	6
1850	613,204,800	131,370,368	1,358,182,941	1,343,262	28,257,401	45,826,992	$3\frac{13}{16}$	$12\frac{1}{4}$	$7\frac{1}{4}$
1860	1,140,510,168	197,364,947	2,775,450,905	1,795,590	52,013,482	92,013,482	$3\frac{1}{2}$	12	$7\frac{1}{4}$

We may add, that at the present time the total number of spindles employed in the cotton manufactures of Britain is estimated at 34,000,000, and that the cotton industry of the rest of the world is estimated to be, collectively, equal to that of the United Kingdom.

The space at our disposal scarcely permits us to glance at the manufactures of the New England States. They have been stimulated into existence by the protective duties levied by the Federal Government, which in some cases are almost equivalent to a prohibition against foreign goods. Under the protection thus afforded, the number of spindles at work rose from 8,000 in 1804, to 2,754,078 in 1850; while in 1854 their products were valued at about 12,000,000*l.* sterling.

We have the history of the rise and progress of the various branches of manufacture in the manufacturing districts of Britain to warrant us in the conclusion that priority of selection—others things being equal—exercises an enduring influence in permanently locating a particular branch of industry. We have noticed how Manchester early became the seat of the manufacture of textile fabrics, by reason of the encouragement given by the municipal authorities, and we have seen how that branch of industry has clung to the place of its birth through succeeding generations. Other instances might be cited. Glasgow was the genial birth-place of successful power-loom weaving, and still retains a pre-eminence in that branch. Nottingham was the refuge of the first promoters of the stocking-frame, and of the subsequent inventors of bobbin-net lace manufacture, and with the adjacent county of Derby, is still the chief seat of those industries. Undoubtedly there were important considerations which influenced selection, and which could not be over-ruled by favours within the gift of localities. When power spinning and weaving were first successfully introduced, sites otherwise inconvenient were selected which offered considerable water power. Watt relieved the cotton spinners from the necessity of seeking power at the expense of other advantages. Then the extensive employment of steam induced the establishment of factories where coal is abundant. The improvements that have been made in the steam engine, and the consequent economy of fuel has rendered this consideration even of minor consequence: one ton of coal can now do as much work as three tons did some years ago. Notwithstanding, however, the opposing circumstances here mentioned, the early establishment of any branch of industry in a locality has exercised an important influence. How else shall we account for the eminence of Sheffield in cutlery, Birmingham in hardware, Bradford in worsted, and Leeds in the cloth trade?

ON THE PRODUCTS OF THE PEA FAMILY (*LEGUMINOSEÆ*).

BY JOHN R. JACKSON.

PART III.—MIMOSEÆ.

The Ordeal, or Red Water tree of Sierra Leone,—so called on account of its bark being used in trial by ordeal by the natives,—is the *Erythrophlœum Guineense*, Don. A red juice flows from the tree, which is drank by the culprit; and, according to the effects, whether fatal or otherwise, so is he considered guilty or innocent of the crime imputed to him. The bark is very thick, and appears to contain an abundant quantity of resin. In Soudan the seeds of *Parkia Africana*, R. Br., are wasted, bruised, and then fermented in water. When they become putrid, they are thoroughly washed and pounded, and afterwards made up into cakes in much the same manner as some of our forms of chocolate. The pulpy matter enclosing the seeds is made into an agreeable beverage, and is also employed in confectionary. The seeds themselves are said to "form an excellent sauce for all kinds of food." The seeds of *Parkia speciosa*, R. Br., are eaten with rice by the Javanese. From *Entada pursœtha*, D.C.—climbing Indian shrub—a fibre is obtained called "Poospatta," which is used in Ceylon for making ropes. The seeds are employed for making snuff-boxes, spoons, &c., and are also used as an anti-febrile medicine by the Ghauts. In Java and Sumatra, they are roasted and eaten like chesnuts and are likewise employed as an emetic. The seeds of *E. gigalobium*, D.C., are used like the former for making boxes, &c. The pods of both species are of an immense size, sometimes four or five feet long. *Stryphnodendron Barbatemas*, Mart., and *S. Juvema*, are said to contain astringent properties similar to Catechu.

Adenanthera pavonina, L., is one of the largest and most common trees of the Indian forests; the wood called "Ruktachundun" is in great estimation on account of its solidity. The heart wood of the larger trees is of a deep red colour, which the Brahmins extract for the purpose of staining their foreheads after bathing. The seeds, powdered and mixed with borax and water, are employed by the jewellers as an adhesive substance, they also use them for weights, each seed weighing uniformly four grains. From the very showy appearance of the bright scarlet testa, they are frequently made up into necklaces, &c. The natives of Travancore consider them poisonous if taken internally.

The pulp surrounding the seeds of *Tetrapleura Thoningii*, Bth., is used by the natives of the Zambezi for washing. The pods of this plant are very curiously formed, from four to six inches long, of a dark-brown colour, and having a strong ridge down the back of each valve. *Prosopis juliflora*, D.C., a native of the West Indies, produces a wood used for knees of boats, and for ship-building generally. It is said that the pods furnish a black dye, and that an intense permanent ink is made from them; a resin flows from the trunk resembling gum Arabic. *P. spicigera*, L., a large East Indian tree, is valuable for the strength and durability of its timber, which has the advantage of being easily worked ; the sweet mealy pulp surrounding the seeds is eaten by the natives, as is also the pulp of several other species of this genus. The brown, shining seeds of *Desmanthus virgatus*, Willd., are, from their ornamental appearance, occasionally made up into fancy articles here and in the West Indies. Gum Arabic of commerce is produced by several species of Acacia, as *A. vera*, Willd., *A. Arabica* Willd., and *A. verek*, G. et P. It is obtained by spontaneous exudation from the trunk and branches, or by incisions made in the bark, from whence it flows in a liquid state, but soon hardens by exposure to the air. The largest quantity of gum is yielded in Barbary during the hottest part of the season—July and August. A wet winter and a cool or mild summer are unfavourable to the production of gum. Our imports now are principally derived from Senegal, Western Africa. We also receive it from Barbary, the East Indies, Cape of Good Hope, the Levant, and other parts of the Mediterranean, packed in either bags, casks, or chests. Gum Arabic is largely used as an adhesive agent, and also in medicine as an emollien. and demulcent, likewise in various forms of confectionary, as lozenges, &c, The source of true Gum Arabic is supposed to be *A. vera*, Willd., a native of Arabia and Africa. Gum Senegal is also said to be produced by this tree. The pods have been used in tanning and dyeing, under the name of "Senegal bablah." The gum of *A. Arabica*, Willd., a native also of Arabia, Egypt, Senegal, and India, forms part of the Gum Arabic of the shops. In India, it is mixed with the seeds of *Sesamum orientale*, after the expression of the oil, and used as food by the natives. An infusion of the bark is used as a tonic medicine, and a decoction of the same considered efficacious in the cure of ulcers ; it is also employed as a substitute for soap, and is said to be used in the distillation of Arrack. The bark, powdered and mixed with Gingelley oil, is applied in cases of cancer. The wood is used for wheels, tent-pegs, and various other purposes, and in some parts of India is reduced to charcoal for the manufacture of gunpowder. The pods and seeds are eaten by sheep in the hot season during the scarcity of grass. The bark, known as "Babool bark," is said to be powerfully astringent, and is used in the East Indies for tanning ; it has been employed in this country, but with little success. By some this tree has been thought to be identical with the Shittim tree of Scripture. The highly astringent resinous substance known as Catechu, or Cutch, is the inspissated juice obtained from *Acacia Catechu*, Willd. The terms Cutch, Catechu, and Terra japonica, were formerly used synonymously, the latter name being given when the substance was erroneously supposed to be a sort of astringent earth from Japan.* The term Catechu is now most generally used, and is derived from *Cate*, a tree, and *chu*, juice. The tree is a native of the East Indies, where it is found widely distributed ; it also grows in Jamaica,

* The term Terra Japonica is now usually restricted to Gambier, the product of *Uncaria Gambir.*—EDITOR.

attaining a height of from thirty to forty feet, and is covered with spines or thorns, as are many of the Acacias. The sap-wood is yellow, and the heart-wood dark-red; it is from this part of the plant the Catechu is obtained. The wood, after being cut into small chips, is boiled, and the liquid evaporated, and when of sufficient consistence, poured into earthern moulds. The wood is most productive during the month of January, and useless in June. Catechu is largely employed by tanners, and also as an astringent in medicine; it arrives in this country either in baskets or bales, and sometimes in large balls enveloped in leaves, that in greatest esteem is said to be derived from Pegu, which fetches a much higher price than the other sorts. In India, Catechu is used by the natives, mixed with oils, to preserve the woodwork of their houses against the ravages of the white ants. From the flowers of *Acacia farnesiana*, Willd., a choice and delicious perfume is obtained, the chief ingredient in one of the most valued handkerchief-scents. The tree grows in all parts of India, where a gum exudes from the stem in large quantities. The wood is hard and durable, and much used where strength is required.

The pods of *A. concinna*, D.C., are largely employed in India by the natives for washing, in the same manner that they use soap-nuts. The leaves are used for culinary purposes, having an agreeable acid taste, somewhat resembling the tamarind. *A. sundra*, D.C., furnishes an astringent extract similar to that yielded by *A. Catechu*. The tree produces a durable timber, in great estimation among the natives for house-building purposes. Several other species of this genus, as *A. stipulata*, D.C., *A. speciosa*, Willd., *A. odoratissima*, Willd., produce woods more or less valued in India, for furniture and house-work. From the bark of *Acacia leucophæa*, Willd., the natives procure a coarse fibre, which they convert into cordage, fishing-nets, &c.; this bark also yields, by distillation, a kind of spirit resembling arrack; the same may be said of *A. ferruginea*, D.C., and *A. myriophylea*, Grah., an intoxicating liquor being procured from the bark of both these species. In Tasmania, the seeds of *A. Sophera* are eaten by the natives, who cook them by roasting the pods while the seeds are still in them. The pods of *A. nilotica* are astringent, and are employed in Egypt for tanning, under the name of "Neb-Neb;" they have been seen in the English markets, but have not found a great demand. *A. arborea*, Willd., produces a strong and durable wood in Jamaica, it much resembles mahogany in appearance, and takes a good polish. From the seeds of *A. niopo*, Humb., the Guahibo Indians at the Maypures, in Colombia, prepare a snuff, which they call Niope snuff. The mode of preparation is by roasting the seeds, and pounding them in a platter with a wooden pestle. The box or mull for containing this snuff, is composed of the bone of a tiger, closed at one end with pitch; this is worn hung round the neck. The snuff is taken into the nostrils with the aid of two small hollow bones (the bones of a bird), united into one tube below, while at the upper ends are fixed two palm seeds with holes bored through them, corresponding with the size of the tubes; these ends are applied to the nostrils, the single end slipped into the mull, and the snuff so drawn from it.

Acacia melanoxylon, R. Br., furnishes the Myall wood of New South Wales ; this wood is also called violet wood, on account of the strong odour it has of that favourite flower. Articles made from it are shown in the Queensland Court of the International Exhibition. The tree grows to a height of from 20 to 40 feet, with a diameter of from 10 to 18 inches ; it is a rich, dark coloured wood, and is much used for carving and ornamental work. The bark of the Black wattle of New South Wales, is much prized in that colony for tanning. Many species of Acacia growing in New South Wales, produce valuable wood, which require to be more known to be appreciated. The wood of the *Acacia mollissima*, Willd., of Tasmania, is much prized for its durability, and is used for tree-nails, and, when split, for making hats and baskets. Many of the species of this genus furnish gums more or less. valuable. Sabicu wood, of which the stairs in the Exhibition building of 1851 were made, as are those in the Crystal Palace at Sydenham, and which is so valued for its excessive hardness, has been attributed to a species of *Lysiloma*, perhaps a new species, *L. Sabicu*; it grows in the Island of Cuba. Some species of *Albizzia* furnish woods which are used in India for various purposes. In Brazil, a gum is procured from *Pithecolobium gummiferum*, Mart., resembling gum Senegal. From the leaves of *Inga bigemina*, Willd., a decoction is made by the natives in India, used for encouraging the growth of the hair, and for curing leprosy. The wood of *I. xylocarpa*, D.C., is much esteemed for its strength, and is used for plough-heads, &c. The pods of *I. fœculifera*, Desv., contain a sweet yellow pulp, which is eaten by the natives of St. Domingo, who call it Pois-doux ; it is said to be a purgative.

Kew, W., May, 1862.

SOME REMARKS ON THE SANDAL WOOD OF THE SOUTH SEA ISLANDS.

BY JOHN MACGILLIVRAY.

The wood under consideration is the product of various trees, belonging to the genus *Santalum* of botanists, and that species called *Santalum album*, for a long time furnished the principal supply. Being a hard, close-grained, and ornamental wood, it is used for some descriptions of cabinet work, and various carved, ornamental, and useful articles—as writing-desks, work-boxes, card-cases, &c., are made of it. But its chief characteristic consists in the remarkable smell of the wood, which it owes to the presence of a peculiar volatile oil, extensively used by the natives of India as a perfume, and also on account of certain reputed medicinal properties.

This also has caused it to be largely used to burn as incense in the temples of China. In course of time, sandal-wood was discovered to be abundant in some of the South Sea Islands, where it is the product of several species of *Santalum*, all of which are different from the long known

Indian one. Thus two kinds have been described as inhabiting the Sandwich Islands (*S. Freycinetiaum* and *S. paniculanum*), and are not met with elsewhere, and to my own certain knowledge, the sandal-wood trees of Feejee, Aneiteum, and the Isle of Pines, constitute three distinct species, which I believe are yet undescribed, rendering it probable that there are several other kinds in the South Sea Islands quite as distinct, but yet to be botanically described. It must be borne in mind, that samples of the wood alone are not sufficient to enable one to decide specific differences; for this purpose it is necessary to examine the leaves, flowers, fruit, &c.

The sandal-wood tree is not found on all the islands of the Pacific, its head quarters would appear to be among those of the south-western portion, including New Caledonia, the Loyalty Islands, New Hebrides, Espirito Santo, and some others. In the Feejee Islands, which have produced several thousand tons within the last thirty years, the tree has become very scarce. For instance, at Ovaiau, all the natives and white residents whom I spoke to on this subject, agreed that it was no longer to be found there, so that I considered myself fortunate in one day stumbling on a small sandal wood sapling, growing in the interior of that island, which still more fortunately was in a condition to furnish flowering specimens for my collection. Precisely the same thing happened at Aneiteum, where the only growing sandal-wood tree I ever saw during numerous excursions, was one so small as not to have been deemed worth cutting down.

And at the Isle of Pines so exhausted had the supply of sandal wood become, that the natives had actually taken to grubbing up the roots of trees cut down in the earlier days of the trade, and all my efforts to obtain a section of the wood might have been ineffectual had not accident led me to the tree which furnished me with a specimen. Even then, owing to its increased value, I had difficulty in obtaining permission to cut it down, owing to the absence of the chief, to whom it was requisite to make suitable compensation. It is only the central portion of the tree which produces the scented yellow wood, constituting the sandal wood of commerce. The trunk and larger branches cut into lengths of from three to six feet, and the whole of the bark and outer white wood is removed with the axe, an operation technically called cleaning.

Thus, a log a foot in diameter is reduced to a billet, only from four to six inches thick. The quality of the wood depends on the quantity of oil contained in it, as indicated by the smell when freshly cut or burned. The old trees produce the best, and in them, that part of the wood near the root is the most prized. From want of data, I have no means of estimating the amount of capital sunk in the sandal wood trade; the profits, however, I have reason to believe, are sometimes enormous. But while this trade is a lucrative one, the risks are very great, both to lives and property embarked in it. Probably about twenty-five small vessels connected with Sydney, are engaged in the sandal wood trade, with which is combined the collection of tortoiseshell, cocoa-nut oil, bêche-de-mer, yams, pigs, &c. It is also the means of introducing among the islands, large quantities of what is technically termed "*trade*," consisting of iron instruments, arms and ammunition, calico, &c.

Formerly the sandal wood trade was carried on under much greater difficulties than now, on account of the fierce and treacherous disposition of the islanders, who have repeatedly attacked, sometimes successfully, the vessels employed in it, and more frequently boats' crews and shore parties were cut off. That many of those attacks were provoked by the white traders is a matter of notoriety, but in most cases the reverse is attempted to be made out, and many murders and other atrocities committed by the sandal wood traders have been carefully concealed by those who, it may be inferred, could not justify them.

On the other hand, it is positively certain, that in several instances the natives have been the unprovoked aggressors. The sandal wood is either brought off by the natives to vessels or boats about the coast, or is collected and stored up at various stations, left in charge of a white man or two, when such can be done with safety. Some of these stations are of considerable importance, as those at Tana and the Isle of Pines, belonging to Mr. Paddon, where there are extensive stores containing articles suitable for conducting the sandal wood trade, and supplying and refitting the small vessels which rendezvous there from time to time.

The sandal wood collected in the South Sea Islands is intended to reach its ultimate destination in China, where I believe the quantity now stored up is very great, the unsettled state of that country at present having greatly affected the trade, and rendered it prudent for the owners to hold on until the market takes a favourable turn. In China, sandal wood is usually worth from 20*l.* to 30*l.* a ton. In such of the South Sea Islands as produce it, the sandal wood is often employed to scent the cocoa-nut oil used to anoint the body and smear the hair. For this purpose, the wood is rasped down with a piece of shark's or other rough fish skin, and introduced into the oil which in course of time becomes strongly scented. As a perfume, however, it does not seem to suit the taste of the Europeans. A handful of the shavings of the wood will prevent moths from attacking clothes of any description, and I have successfully used the same means to keep away insects from preserved specimens of Natural History. Sandal wood is also an Australian product.

Some few years ago, a considerable quantity was collected in Western Australia and sent to China, but on account of its very inferior quality, it did little more than pay expenses, and the speculation was abandoned as being an unprofitable one. About six years ago, a small vessel, the 'Will o' the Wisp,' was despatched from Sydney, to procure sandal wood on the north-east coast of this colony, but various disastrous occurrences caused the early abandonment of the voyage. A little of the supposed sandal wood procured on this occasion, and which I saw was commercially valueless, being the product not of a *Santalum* (of which genus there are several Australian species), but of *Exocarpus latifolia*, a tree belonging to a different natural order of plants.

ON THE CULTIVATION OF RAPE OR COLZA FOR SEED, AS PRACTISED IN NORMANDY.

BY THE HON. R. J. WANT.

The seed is sown broad cast, in the month of July, upon well-manured ground, and if possible during wet weather. This is the seed-bed for the future plant. It should be sown as turnip or cabbage seed is sown, when it is intended to transplant the young plants. In the months of September, October, and November, the plants are taken from the seed-bed, and transplanted for the future crop. The field is richly manured with farm-yard dung, spread broad cast on the land, and ploughed in. The previous crop is usually wheat.

The plant is then planted out in rows about two feet distance from each other, and each plant, eighteen inches apart. In good soil, as for instance, land partly broken up from old pasture, or from wood, the crop will be much heavier and ripen more equally if planted at a greater distance. It is usually planted in every alternate furrow, but the manure plough is expressly constructed for breadth of furrow. The plant is exceedingly robust and soon recovers itself after transplanting. It thus remains permanently planted out until the month of February, when the horse hoe is set to work to pulverise the soil after the frosts. Good careful farmers then add some artificial manure to encourage the growth of the plant. The articial manure generally employed is guano or the rape dust, and rape cake, which proceeds from the manufacture of the oil. Rape cake, indeed, is one of the very best stimulants that the plant can receive. After this Spring manuring, the double mould board plough passes between the drills so as to throw the earth well up to the stalks of the plants.

Nothing more is done till harvest, which occurs towards the middle of July. The chief enemy of the rape seed crop is the hail, the heavy rains of July are also often prejudicial. As soon as the straw and seed pod become yellow, the crop is ready to cut. This is done by the sickle, and the reapers place the crop as it is cut, across the ridges, so as to leave the air to circulate as much as possible. In from six to ten days the crop is ready for the flail. It is a seed that sheds itself with great ease, and must be handled tenderly or much will be lost. The crop is thrashed in the field. A large space is cleared, and a sail-cloth spread on the ground. A light species of hand-barrow, or cradle is constructed, and lined with canvas. It is carried by two persons across the field, and they gather up the sheaves, which, as lightly as possible, they deposit in the cradle or hand-crib. When they arrive at the threshing place, they simply overturn the cradle and leave the sheaves on the floor.

The least possible strike of the flail suffices to dislodge the grain. After threshing, the grain requires to be constantly turned in the store, or it will speedily heat, and consume the strength of the oil. The produce of *an excellent crop* is half a French bushel, or 25 French quarts (litres), to every perch of twenty-four square feet. In round numbers, the yield of the crop may be estimated at twenty-five bushels to the acre—and I believe it often exceeds this. The profit is so very considerable that, for some years past, it is estimated that the Norman farmers pay rent and expenses from the rape seed crop alone. The land rent may be averaged at one franc the perch, or 70 francs the acre, which includes all taxes and rates. There is another method which I would strongly recommend, and that is, to sow as the Scotch farmers sow turnips. Sow in drills (manure in the drills), apply guano or bone dust, or rape dust in spring, and in damp weather.

Do not transplant at all, but thin out, and cultivate as for Swede turnip seed. I believe the crop would be as heavy, and the expense diminished one half, especially when labour is dear or scarce. The after-management of the colza seed is not difficult, but requires attention. The seed, when fresh harvested, is apt to sweat and heat. For this reason, careful farmers who wish to preserve the colour and strength of the sample, generally stow the seed away with a sufficient quantity of the seed-pod or husk. These substances mixed through the heap, prevent its taking heat. The bulk must, nevertheless, be repeatedly turned over, and the granary kept aired. The yield of oil, which is the ultimate and real test of the value of the crop, varies exceedingly. This variation is not so much to be attributed to the variety of grain as to the nature of the soil, the geniality of the season, and the care bestowed on the culture of the plant.

If the plant be cultivated too often upon the same soil, without adequate change of rotation, it will, as is often the case with clover, degenerate rapidly, and produce an inadequate return. A crop which stands well and thick on the land will not always turn out to be the best *oil-bearing crop.* I have tried the estimate in various houses, and the average is this, that it requires four hectolitres, or 400 French quarts of grain, to give 200 lbs. of oil in the rough. The process of rectifying the oil, facilities for purchase of steam fuel, of water power, and the chemical processes connected with rectification, are all elements of the expenditure. It is generally believed that the English market can be more readily and cheaply supplied by purchasing the grain in France, crushing and refining in England, than by purchasing the article ready-made for use in France.

French colza oil is constantly sold cheaper by retail in London, than its wholesale value is quoted in the Caen or Rouen colza markets. It has been repeatedly asserted that English oil-crushers have purchased "rape cake" in France in order to recrush it in superior machines, and then dispose of the oil cake. I have heard it stated that ten per cent. on the value has been gained by this species of speculation ; this is now probably at an end. First, because the French crushing mills are vastly improved in economy and power ; and, secondly, because the value of the rape cake is so greatly increased, in consequence of the demand for it as a manure for the colza crop. It appears to me that for the fresh "virgin" soils of the colonies, where the climate is suitable, and the labour is to be had, that the rape or colza cultivation will be a most valuable element of commerce as well as of farming.

ON THE MANUFACTURE OF COD-LIVER OIL, AND A NEW METHOD OF PREPARING IT FOR MEDICINAL PURPOSES.

BY PETER MOLLER.

Although it might be supposed that the manufacture of cod-liver oil was a matter of general experience, yet, not only on the Continent, but also amongst ourselves in a great measure, uncertainty and erroneous ideas are very prevalent both as to the method in which it is manufactured, and also as to the different sorts which are met with in trade. It is not, therefore, surprising that on both these points the most opposite statements are to be found in foreign newspapers, gathered chiefly by merchants or travellers, who, during their stay here in the country, have managed to extract very imperfect information about the matter, and have subsequently published accounts of their travels. But, as cod-liver oil has of late assumed a very important position in medical practice (where it will for the future be indispensable), and can no longer be looked on merely as a fashionable remedy, I have considered that my own experience of its manufacture in general, and of a better method for its preparation discovered by me, may not prove uninteresting.

Originally, cod-liver oil was only used for burning in lamps, and as grease; it was prepared, therefore, solely with this view; and it was considered unnecessary to attempt or devise any better method for its manufacture than that which had been in general use, since the days of Arild to the present time.

Properly, there are only two sorts of cod-liver oil, the light, or so-called clear sort (of which there are many varieties essentially the same, and differing only in shades of colour from a light to a somewhat deeper brown), and the dark brown, or so-called tanner's oil. Owing to the various shades of colour to be found in the former sort, it has been conceived that this circumstance was owing to the several methods employed in its preparation, and thus, in consequence, each different shade was supposed to possess different medicinal qualities and different component parts. Oesterlen,* p. 481, mentions sixteen different sorts; and it has been believed that the light brown contained more phosphorus, whilst in the darker shades iodine was the more active ingredient. In Sweden, and especially in Stockholm, preference has been given to the dark brown sort, or tanner's oil, as being the most efficient. The following

*Dr. Fr. Oesterlen: Handbuch der Heilmittellehre, 6te Aufl. 1856.

statements will prove that all the light oils have, in the main, the same component parts, and are consequently of equal efficiency. The clear, or colourless-transparent oil, as it is termed in the trade to distinguish it from the brown and tanner's oil, is obtained by throwing the liver, directly it is brought ashore by the fishermen, into large wooden vessels or reservoirs containing about eight to twelve hogsheads or more apiece, where, after having been subjected to a uniform stirring, it remains till decomposition has commenced. Under this process, the cells of the liver burst, and the oil therein contained floats on the surface. By degrees as the oil separates, it is tapped off, and conveyed into larger reservoirs where it is clarified, after which it is run off into casks, and is then ready, for trade.

The oil first drawn off from the vessel in which the liver becomes decomposed is generally of a light yellow colour, whereas that which is subsequently drawn off gets gradually darker as decomposition goes on, and probably absorbs some of the component parts of the blood, and acid properties of the air.

A continuous bubbling in the mass announces an important evolution of gases, which are partly absorbed by the oil, and impart to it an exceedingly unpleasant smell, which may be perceived at a great distance.

The method of preparing the burnt, brown, or so-named tanner's oil is as follows :—the solid remains, from which no more oil can be extracted, are taken out of the vessel and placed in iron kettles, and boiled till all the water contained in the liver is evaporated ; the remainder of the oil is then expelled, and the solid component parts *Grax*, *Grug*, or *Korg** as it is termed, float up and swim as a hard resinous mass on the surface, which is a sign that the operation of boiling is completed.

If during this melting process the heat has been so managed that the oil has been browned only to that degree that a small test dripped from a spade shows a bluish tint, the operation is considered to have succeeded, and the oil to be of a remarkably good quality. It is then, like the first, transferred into large reservoirs, strained, and clarified, after which it is drawn off into casks, and is then perfectly ready for merchandise.

The two sorts of oil which occur in trade are principally obtained in this manner.

The liver which the fishermen do not dispose of to the oilburners, they place in casks and take with them to their homes to manufacture oil for themselves. The liver is exposed to the same chance of becoming decomposed while the fishing is going on, as was the case above named in the large reservoirs ; and the shaking occasioned by the motion of the boat contributes to partly bruise the liver, and thus to separate the oil from it.

The oil thus obtained is poured off, and is often purer and freeer from

**Korg*, *Grug*, or *Grax* is used as a manure. It must be mixed with earth, or else it will destroy vegetation. Two years ago at Hammerfest and Tromso, it cost from 2s. 6d. to 4s. the comb.

a bad smell than the common perfectly clear sort, for which reason it has not unfrequently been preferred for medicinal purposes.

Undoubtedly some of the clear oil is prepared by exposing the liver to a gentle warmth over an open fire-place, in iron kettles, whereby a great portion of the oil flows out; but this method is only adopted in a small way by peasants after their return home, and could not be done on a large scale.

From the above it will be seen that there are only two principal sorts of cod-liver oil, the so-called clear and light brown, and the dark brown or tanner's oil. The first is prepared *without*, and the other *exclusively by*, the application of heat; and it is from this cause that they differ both essentially and apparently. The oil which is prepared by steam, or after decomposition without warmth, contains more or less stearin, which it deposits under a temperature of 5 deg. C. That which is manufactured under such a temperature that the oil will boil contains no stearin, as this is destroyed by the heat.

The different shades of colour observed in the light coloured oil (and there is an infinite variety) are caused, in some degree, by the colouring properties of the blood, which, as was mentioned above, is absorbed by the oil during the process of decomposition, but principally by the casks, which, under the chemical action of the oil, impart a brownish colour to it.

This is chiefly the case when the casks are new, and the colour is found to increase in intensity the longer the oil is kept in them, especially when they are placed in a cellar, or in any damp place. In order, therefore, to preserve the original colour, especially when the oil is intended for medicinal purposes, it is best to draw it off into large glass bottles.

The first-named sort of cod-liver oil employed for medicinal purposes, has, hitherto been manufactured without any radical improvement having been adopted in its preparation.

It is a patent fact that the kinds of cod liver oil described above possess a nauseous smell and taste, so that the patient can with difficulty be brought to take them ; a feeling which would be considerably augmented if the cause of its disgusting odour (which is produced by putrid portions of fish) were known.

As long as the oil was confined to it original purposes, there was no inducement to advise a better method for its manufacture.

Different means have indeed been had recourse to, *e. g.*—lime and caustic kali, to make it better adapted for use in lamps ; but it is easy to see that such treatment would not answer the purpose ; for the alkalies, as is the case in other fatty oils, produce decomposition and form soap, from which glycerine is extracted. Fatty acids cannot be separated from these alkalies without having recourse to a stronger acid. By such treatment, therefore, instead of obtaining a more purified sort, the oil will be in a much more decomposed state. Some of these fatty acids are notorious for their unpleasant smell and rancid flavour. It is, therefore, quite clear that oil prepared in this manner must be totally unfit for medical use.

In my younger days, and also after I was grown up, I lived many years on the sea coast, principally at Christiansund, where I had many opportunities of joining in the fishing, and of making myself acquainted with everything connected with the cod and herring fisheries, and as a consequence with the manufacture of cod-liver oil. The experience I then learnt, forty years ago, suggested to me the idea whether it was not possible to prepare more carefully an article, which, in a commercial point of view, is of such importance to Norway ; but so long as the oil was employed only as in olden times, there was no special encouragement to carry out my views.

It was not till it had been used for many years as a medicine, and that I had heard endless complaints as to its unplesant taste and smell, so much so as to render it almost an impossibility for many patients to take it, that I again began to think of the realisation of my views. But as I at this time resided in Christiania at a long distance from the coast, it was a matter of extreme difficulty to organisite the requisite establishments for its manufacture, at convenient places on the western coast. And it is more than probable that I should not have stirred in the matter to this very day, had not the Newfoundland cod-liver oil been imported from England into this country, but at such enormous prices, that a bottle weighing 2 lbs. cost, with charges, nearly seven shillings. If Englishmen at that great distance were able to manufacture a satisfactory article, surely the same thing could be accomplished here by us? Before, however, further entering into the matter, I received a letter from Mr. Krog, Apothecary in Hammerfest, dated Dec. 31, 1852, requesting me to impart to him a better method for preparing Cod-liver oil. Accordingly I wrote to him March 18th, 1853, and communicated the main points of my discovery, requesting him at the same time to manufacture cod-liver in this manner, and offering to purchase all he might be able to produce, by which he might in all probility realise a considerable sum. Not only did I receive no answer from Krog, but he actually published this new method in the newspapers, without mentioning my name, and even sent specimens on a small scale prepared in this manner, to the Exhibition of Industry and Art in Christiania, and later to Paris, as his own invention !

Thus deceived, I resolved to take a journey in the month of August, 1853, along the western coast, in order to enquire whether any improved method for the manufacture of this article had been discovered. I visited in this manner, Molde, Aalesund, Christiansund, Bodo, Lofoten, Tromso, and Hammerfest ; but in all of these places the old method was still in vogue. Whilst on this journey, I organised the requisite arrangements for boiling the oil, according to my method, in Lofoten, Christiansund, and Aalesund. On my return home, I had three sets of apparatus prepared at Aker's Mechanical Factory, and sent them to the above places, where they are still at work.

The result of the first experiment was perfectly satisfactory ; for I obtained, in a large quantity and of an excellent quality, what I had before only been able to produce in very small quantities.

The reader must pardon me for this digression with reference to the method of preparing the oil. I have done it in order to vindicate my right as being the inventor. And, indeed, I am in possession of written documents to prove, that I am the man who first carried out this method in our fishery districts, and therefore in the country.

The purifying of rancid and bad smelling oil, by the means hitherto adopted, will rather deteriorate it, and render it unfit for medical use, as the acids, which have not as yet been liberated, are separated under the process of decomposition.

It has by no means been fully ascertained in what component part of the oil its beneficial effects reside; some holding that they proceed from iodine, others from phosphorus, and others again from fatty acids, or from its fat. Both Professor Strecker's experiments and my own have shown, that iodine exists only in such a small degree, that it is difficult to assign to it any quantitative distinction. In my opinion, the idea that these two component parts are the effective agents must be relinquished, and the more so, as they have been employed in cases, in which, under similar circumstances, the oil has been used most successfully, without any traces of the same effects being apparent. How far it is to be attributed to the agency of the peculiar fatty acids contained in the oil I do not know, and it must remain an open question.

I must, therefore, give it as my opinion that cod-liver oil acts in its entirety as a fatty substance, and the reason that vegetable oils cannot be used with equal advantage is owing to the circumstance, that cod-liver oil, as an animal-fat, is easier of digestion, probably owing to its elementary composition; for when influenced by alkalies, it gives very different decomposing products than is the case with the fatty vegetable oils.

If this view then be the correct one—viz., that cod-liver oil acts as fat, the principal object in its manufacture must be to get it as pure, and as similar as possible to that which is found in the liver.

The liver, as is well known, has a mild fatty flavour, and a smell with scarcely any traces of oil; and further, the oil which floats on the surface of the water, when fish and liver are boiled in large quantities, has as pure flavoured a taste as the finest Florentine oil; and, even the oil, which is separated, on boiling the fat summer herring, is totally devoid of an oily flavour. The fishermen skim it off, and use it as butter, or as other fat in their households. From the practical knowledge I have gained about this matter, I may say that the principle of my method is very similar; and it only remains to institute some experiments with liver on a small scale in order to carry out and confirm my views; and then to construct suitable apparatus, and thus decide the process of obtaining the oil in a perfectly purified state. The apparatus, in which the manufacture of the oil is performed, is perhaps difficult to describe without illustrated plates;

I will, therefore, only mention its chief parts, and the manner of using them. They consist, then, of a melting kettle, a water-kettle, and a fire-place, constructed of thick iron plates, and so arranged, that the one can be placed on the other, and with the joints are perfectly close.

The fire-place, which stands on the ground, consists of two parts, a cinder-hole, grate and doors, and also a pipe to increase the draught, and carry off the smoke. It should be constructed within of brickwork. The water-kettle must be provided with a funnel above, and with cocks on the side to ascertain the quantity of water. On this again is placed the melting kettle, which, on being filled up, descends into the water-kettle, yet without touching the surface of the water.

The operation is performed as follows:—the liver is taken as fresh as possible, that is, as soon as it is taken out of the fish, and is then washed and cleaned with water, and the gall-bladders removed; it is then cut up into small pieces, and thrown into the kettle. When this is nearly two-thirds full, the fire is lighted underneath, and the water in the kettle is brought to a boiling state, which must be kept up as long as the process of melting lasts. The whole mass must be constantly stirred and pressed with a large wooden spoon, in order to promote the separation of the oil, which is gradually poured into a cask through a strainer as it melts.

The process must be continued in this manner till all the oil is extracted from the liver.

The remaining portion of the liver is then taken out of the kettle, and laid on one side in order to yield the brown or tanner's oil, after the manufacture of the best and purest oil is completed.

The apparatus must be set up as near the fishing ground as possible; for it is expedient to get the liver as fresh as possible from the fish, as it soon becomes decomposed; and absorbs the acid properties of the air, and becomes rancid. The oil is then placed in casks, secured with a tight-fitting bung for transport to Christiania, where it undergoes a further purifying process by means of filtration, which, however, has no influence on its composition; it is then bottled off, and has a flavour and appearance like the accompanying samples. To prevent imposition, my oil is sold in glass bottles stamped with my name, and sealed.

As Norway is nearly the principal country for the production of cod-liver oil (in good years from 12,000 to 16,000 hogsheads of both sorts are exported, a large portion of which is employed for medicinal purposes*), it appears to me to be unreasonable, that we should require to import this drug from England, and that, too, at a price of 4s. per pint, or about 100*l*. the hogshead.

Cod-liver oil manufactured according to my method may be sold profitably at half the above price, and has, moreover, the advantage of being a genuine article, while that which is imported into the country from abroad passes through many different hands, and is exposed to the risk of being

* Thus in 1852 a single firm exported about 600 hogsheads for this purpose.

mixed with sperm, or with other sorts of oil, which is not so easy for the consumer to detect.

The cod-liver oil here treated of is manufactured from the liver of the cod (*Gadus Morrhua*) found along the coasts of Nordmore, Sondmore, and in the Lofoten islands. This is considered to be the best, the purest-flavoured, and the most effective. Whether the oil prepared from the codfish, which is caught later in the year off Finmarken, is equally effectual, has not been ascertained ; but it is certain that it has a totally different flavour, far from agreeable, which is said to proceed from the "Lodden" (*Osmerus arcticus* v *Mellotus grœnlandicus*) on which it feeds, and which is moreover used as bait in the codfisheries in these districts. The flavour of this fish is disagreeable, and is considered to impregnate both the flesh and liver of the codfish, and consequently the oil obtained therefrom.

The oil prepared from the liver of the coalfish (*Gadus carbonarius*) does not possess the pure flavour and peculiar properties of the cod-liver oil. This fish is caught simultaneously with the codfish, and its liver is frequently mixed up with the other, so that it is necessary to be on the spot and to purchase the liver oneself to ensure having genuine cod-liver oil.

Thus it happens that the light yellow cod-liver oil sold in casks for medical use, and of which so much is written in foreign newspapers, is far from being the genuine cod-liver oil it is supposed to be, but is frequently a mixture of cod and coalfish-oil.

Christiania, March, 1862.

THE USEFUL WOODS OF THE ISLAND OF DOMINICA.

BY JOHN IMRAY, M.D.

I regret much that I am unable from limited time, and other occupations, to send a detailed report on the various articles forming our small collection sent to the International Exhibition. I have, however, drawn up a catalogue of the woods of this country, with numbers corresponding to the specimens. Their uses are detailed from such information as I was able to collect. The catalogue is of course imperfect, but may be of some service notwithstanding. The great staple of this island, as of all our West India Colonies, is the produce of the cane,—sugar, rum, and molasses. Formerly coffee was exported in quantity so great, as to be considered almost its chief staple. Unfortunately a blight appeared on the coffee-trees about thirty years ago, which has so completely ruined the plantations, that scarcely more coffee is now produced, than suffices for the consumption of its inhabitants. Our small contribution of the various productions of the island, shows that this Colony is capable of producing many other articles beside sugar and rum. The collection, however, is far from being complete, in consequence of the late period at which the Colonial legislature determined on rendering assistance, by a pecuniary grant.

The number and variety of woods produced by so small a country, may possibly be considered a point of some interest. Our lofty mountains indeed, afford different climates according to the elevation. The deep ravines and sheltered vallies, the low-lying lands on the windward and leeward exposures of the island, and the high mountain sides and ridges, furnish different varieties of trees and plants.

Our best land-wood trees are chiefly found on the leeward side of the island, where the heat is greatest, and less rain falls. Such as the Courbaril, satin-wood, mastic, bully tree, &c., but hard-wood trees are found growing in all parts of the island, both near the coast, high upon the mountain sides, and in the vallies of the interior. The most valuable of our hard-wood trees, are probably furnished by the N. O. Sapotaceæ. In this order are the Bully tree, Mastic, (?) varieties of "Bris" Balate, &c. But the timber most generally used in this country for all ordinary purposes, comes from "Lauracæ," in which order are found many different kinds of valuable timber trees. For the most part the timber of this family is easily worked; the trees are of moderate size, and growing in all parts of the island. They are cut down and sawn into boards, &c., on the spot, or split up into shingles and staves.

The vallies and ravines in the interior of the country, are covered with extensive forests of valuable timber trees. The difficulty in the way of these forests being made useful to the country, is the want of roads to open up the interior. Many of the specimens sent are imperfect, from the wood being green at the time it was worked. I regret there was no time for preparing specimens of all the fibrous substances this island produces, as in that respect I do not suppose we are much behind any part of the West Indies.

1. Coubaril, or Locust-tree, (*Hymenœa Courbaril*). Valuable timber tree of large size; wood dense and close-grained; used for making all kinds of furniture; formerly employed in house-building; now too valuable for that purpose; resembles mahogany, but is much harder; not durable in the ground.

2. Satin-wood or Yellow Sanders. Noyer, Fr. Large tree; beautiful and valuable wood; becoming scarce in the country; now chiefly used as a furniture wood; formerly in house-building and mill work; very durable in the ground.

4. Mastic. Acouma, Fr. Very large tree; reaches to 6 feet in diameter; used for mill work and in house-building; available for almost every kind of work; one of the most valuable woods of the island.

4. Bully tree. Balata, Fr. Very large and valuable timber tree; attains a diameter of 6 or 7 feet; used for all kinds of mill work, rollers, beams, water and balance wheels, sills, cogs, plates, &c.; also applied to housework.

5. Cedar, (*Cedrela odorata*). Large tree; an excellent furniture wood; the odour repels insects; used for house and ship-building.

6. Galba, (*Calophylum Calaba*). Lofty tree; 4 or 5 feet in diameter; timber valuable for mill rollers, frames, and other mill-work; pretty cabinet making wood; very durable; lasts well in the ground; bears exposure to moisture.

7. Resinier grande feuille, (*Coccoloba sp.*) Large tree; nearly 4 feet in diameter; dense, close-grained wood; valuable timber; employed in all kinds of house and mill-work; one of the most durable woods of the island; becomes hardened by age, so that tools can scarcely work it; almost indestructible in the ground.

8. Resinier petit feuille, (*Coccoloba sp.*) Tree 2 to 3 feet in diameter; very durable in the ground; used for posts, &c.

9. Black cinnamon. Bois d'Inde, Fr., (*Pimenta acris*). Large tree; about 4 feet in diameter; one of the hardest and heaviest woods the island produces; very durable; good for rollers and other mill-work, especially cogs, posts in the ground, sills, &c.

10. Bois Lezar. Large and lofty tree; one of the best and most lasting woods for house building; used for making shingles, posts in the ground, mill posts, &c.; durable in water.

11. Adegon, (*Ardisia* sp.) Large tree 4 or 5 feet in diameter; useful for all purposes; boards, planks, mill work, house work, ship-building, shingles; lasts well in water.

12. Angelin, (*Andira inermis*). Large tree; employed for all kinds of house work, inside and out, mill work, rollers, &c.; valuable timber; lasts well in water.

13. Iron-wood. Bois de fer noir, Fr. Tree, 12 to 18 inches in diameter; very durable wood; used for posts; cabinetmaker's wood.

14. White Iron wood. Bois de fer blanc, Fr. Tree same as above; uses also the same, but the wood is not so lasting as the black species.

15. Amandier, (*Cerasus occidentalis*). Large tree, 3 or 4 feet in diameter; sawn into boards and planks; used for mill-work, and inside house-work; furniture wood; the seeds are used for making the liqueur "Noyau;" the bark is sometimes put into rum, to give it a flavour.

16. Caconnier, (*Ormosia dysacarpa*). Large tree 3 or 4 feet in diameter; useful wood for all kinds of house work, inside and out; rafters, posts, &c.

17. Epineux rouge, (*Xanthoxylon ochroxylum*). Small tree; good for posts; lasting in the ground; available for fancy cabinet work.

18. Epineux blanc. Large tree; sawn into boards and planks; employed in house work, inside and out; rafters, posts, &c.; cabinet wood.

19. Epineux petit feuille, (*Xanthoxylon*). Small tree; durable wood for posts.

20. Tendre Acailloux. Small tree; pretty cabinet wood; very durable in the ground as posts.

21. Rosewood, (*Cordia Gerascanthus*). Tree 2 feet in diameter; employed for all kinds of house-work, ship-building, and in furniture.

22. Citronelle, (*Citronella sp.*). Tree, 1 foot in diameter ; used for house posts ; small work.

23. Petit citron. Chène du pay, (*Ilex cuniefolia*). Tree 18 inches in diameter ; very useful wood ; employed for house-work, rafters, sills, posts, cart felloes ; makes excellent oars.

24. Brisiette. Middling-sized tree ; sawn into boards and planks, and employed for inside house-work ; very good furniture wood ; chairs and tables are made of it.

25. Savonette. Good-sized tree, 2 to 3 feet in diameter; valuable timber; available for many purposes ; mill rollers and mill work in general, posts, beams, cart-naves and felloes ; blocks for pulleys ; ship and boat-building.

26. White cedar, (*Bignonia leucoxylon*). Large tree ; timber employed for inside and outside house-work ; also in ship-building ; lasts well in water.

27. Goyavier, (*Eugenia œrugenia*). Tree about 2 feet in diameter ; light wood ; used for inside house-work, rafters, posts, plates, &c.

28. Carapite. Large tree, 3 or 4 feet in diameter ; employed for mill work of all kinds and house-work.

29. Bois branda. Large hard-wood tree ; rollers for small cattle mills are made of this wood : all kinds of mill and house-work.

30. Bois mat. Middle-sized tree ; makes good masts for vessels; also oars, spars, and staves.

31. Bois Fourmi, (*Ilex sp.*). Large tree ; sawn into boards and planks ; employed for all inside house-work, posts, &c.

32. Bois Bris Chien, (*Chrysophyllum microphyllum.*) Timber tree; makes good boards, planks, posts ; used for all kinds of inside work ; made into shingles ; furniture wood.

33. Bris, (*Chrysophyllum glabrum.*) Large tree ; about 4 feet in diameter ; timber employed for mill-frames and rollers, house-work, posts, &c. ; wood not very hard, but durable.

34. Petit Bris. Tree about 1 foot in diameter ; very durable wood ; available for posts, rafters, beams, &c.

35. Gommier, (*Bursera gummifera.*) Probably the largest and loftiest tree the island produces ; nearly all the canoes of the island are made of this wood ; a whitish, resinous substance exudes copiously from the trunk of the tree; this resin is much used in making flambeaux, also in the Roman Catholic places of worship as incense.

36. Bois pain, (*Talauma plumieri.*) Large tree ; boards used for inside house-work.

37. Bois piquette, (*Ixora Ferrea.*) Wood hard and tough ; used for axe-handles, posts, and for making flambeaux ; lasting in the ground.

38. Bois d'Orme, (*Guazuma ulmifolia.*) Tree 2 to 3 feet in diameter ; sawn into boards ; useful for oars, posts, staves, &c.

39. Icacque, (*Hirtella triandria.*) Small tree; wood used for inside and outside work.

40. Icacque Montagne. Small tree; wood used for posts, plates, rafters, &c.

41. Café Maron, (*Faramea odoratissima.*) Small tree; used for posts, rafters, plates, &c., in house-building.

42. Pois Doux, (*Inga Laurina.*) Small tree; makes excellent charcoal; employed as posts for Megass (cane trash) houses, and other coarse work.

43. Pois Doux Maron, (*Inga Ingoides.*) Middle-sized tree; used for staves; sawn into boards and planks, and employed for in-door work only.

44. Pois Doux Maron Blanc. Tree 3 or 4 feet in diameter; cut into staves and shingles; difficult to saw into planks.

45. Bois tan, (*Byrsonima.*) Tree about 2 feet in diameter; wood tough and light; made into beams, rafters, posts, oars; bark used for tanning.

46. Carapate. Tree about 2 feet in diameter; used for rafters, beams, posts, &c.

47. Raisin Montagne. Tree 2 feet in diameter; used for light work in house building; not durable.

48. Logwood. Campèche, Fr. (*Hæmatoxylon campeachianum*) Dye-wood; used for posts; very durable cabinet wood.

49. Sapodilla (*Achras Sapota.*) Fruit tree; grows to a considerable size; furniture wood; employed for inside house-work; not lasting.

50. Acajou grande feuille, (*Guarea sp.*) Large tree; timber employed for all kinds of inside house-work.

51. Acajou blanc. Tree about 3 or 4 feet in diameter; makes excellent boards for inside house-work.

52. Acajou Montagne. Large tree 2 to 3 feet in diameter; employed for house-building; furniture wood, shingles: not very hard, but bears moisture well.

53. Bois Sept-ans. Tree 3 to 4 feet in diameter; useful timber for any purpose; shingles, posts, oars, house-building; mill-frames, rafters, &c.

54. Bois graine bleu, (*Symplocos Martinicencis.*) Tree about 2 feet in diameter; sawn into boards and planks and used for inside house-work.

55. Bois Rivière, (*Chymarris Cymosa.*) Large tree; timber used for in-door work; furniture wood.

56. Pommier. Large tree 4 or 5 feet in diameter; employed for staves, rafters, and inside house-work; not a durable wood.

57. Sureau Montagne, (*Turpinia occidentalis.*) Large tree; sawn into boards and planks; used for ordinary purposes.

58. Chatagnier grandefeuille, (*Sloanea Massoni.*) Large tree; 5 or 6 feet in diameter; timber used for mill-rollers; inside house-work; becomes hard when dry.

59. Chatagnier petit feuille, (*Sloanea sp.*) Uses same as the above species.

60. Chatagnier cocoa. Valuable timber; employed for mill-rollers, posts, &c.

61. Chatagnier Noir, (*Pholacidia diversifolia.*) Tree 2 to 3 feet in

diameter; sawn into boards and planks; used in house-building and for mill-rollers.

62. La Gluie, or Bois de Soie. Middle-sized tree; timber used only for inside work.

63. Bois Pistolet, (*Guarea Perottettii.*) Large tree 3 or 4 feet in diameter; valuable furniture wood; used in inside and outside work.

64. Mapou, (*Cordia reticulata.*) Wood employed for making staves; of little value.

65. Mapou grande feuille. Sawn into planks for house-building, staves.

66. Mapou petit feuille. Wood used for staves.

67. Bois Cicerou, or Pipirie, (*Pithecolobium Micradenium.*) Large timber tree; made into staves and shingles, boards, planks, &c.

68. Gueppois grande feuille. Small tree; used for posts and walking-sticks.

69. Mahaut Piment, (*Daphnopsis Carribea.*) Small tree; used for posts; wood of little value; bark employed for making rope.

70. Mahaut Cochon. Large tree, 3 to 4 feet in diameter; used for staves and boards; wood splits very easily.

71. Bois Dubarre. Hard-wood tree; used for posts, rafters, beams. &c.; also for mill-work.

72. Coumentin, (*Myrcia divaricata.*) Hard-wood tree; employed for beams, rafters, posts, &c.; the Charibs mix the expressed juice of the bark with Roucou for the purpose of colouring and polishing other woods.

73. Moricypre, (*Byrsonima spicata.*) Tree 2 feet in diameter; useful timber for house-building; cabinet wood.

74. Kaklin. Hard-wood tree; 12 to 18 inches in diameter: durable wood for house-work, posts, &c.; lasts well in water; makes excellent charcoal.

75. Acouma blanc. Tree 3 or 4 feet in diameter; employed for house work, posts, rafters, &c.; only used for inside work.

76. Mille branches. Large hard wood tree; employed for mill rollers and other mill work.

77. Bois affie, (*Freziera undulata*). Large tree; sawn into planks and boards for general use; gun stocks are made of this wood.

78. Bois violon, (*Guatteria* sp). Tree about 2 feet in diameter; the boards and planks are available for inside house-work; wood does not last in the ground; used for spars, oars, staves; wood light.

79. Bois bambarra. Large tree 4 to 5 feet in diameter; wood tough and strong; employed for oars, mortar pestles, &.c; the seeds are sometimes used for killing fish in the rivers; timber available for inside house-work.

80. Bois dorée, (*Morisonia Imrayi*). Large tree; timber useful for ordinary purposes; cabinet wood.

81. Bois diable, (*Licania hypoleuca*). Very hard tough wood; useful in house-building; makes the best charcoal; used for making flambeaux; does not stand moisture.

82. Bois cote. Large tree ; very good timber ; employed for all kinds of house-work, posts, &c.

83. Figuier petit feuille, (*Ficus lentiginosa*). Timber used in house-building ; the wood is soft and not durable.

84. Bois sophie, (*Acacia* sp). Small tree ; durable for posts ; fancy cabinet wood.

85. Tamarind (*Tamarindus Indicus*). The wood of the Tamarind tree is tough and elastic, and is applicable for handles of axes, hoes, and other tools ; the preserved fruit is an article of commerce.

86. Guava, (*Psidium Guava*). The wood of the Guava is very tough, and is employed as handles for hoes, axes, &c. ; as the Tamarind wood ; the fruit makes an excellent jelly.

87. Sweet orange, and sour orange, (*Citrus aurantium, Citrus Decumana*). The wood of the orange tribe is very tough, and is employed as handles for axes, hatchet and other tools.

88. Bois periqué. Small tree ; wood tough and used as handles for hoes, axes, and other tools ; pretty cabinet wood.

89. Petit baume. Small tree ; used for posts, wattles, &c. ; and for making flambeaux.

90. Bois vinette. Small tree ; used for posts and making flambeaux.

91. Bois chandelle, (*Amyris* sp). Small tree ; used for posts and making flambeaux.

92. Bois charaibe, (*Sabinea carinalis*). Gr : N. S. Small tree used for posts ; fancy cabinet wood.

93. Poirier montagne, (*Exostemma carribea*). Small tree ; used for posts and making flambeaux ; pretty cabinet wood ; durable.

94. Bois carré. Small tree ; adapted for fancy cabinet work.

95. Quina, (*Exostemma floribunda*). Small tree ; used for posts and rafters ; the bark of this tree is possesed of tonic and emetic properties, and is used in the country medicinally.

96. Bois masse. Tree 12 to 18 inches in diameter ; timber used for house-work and cabinet making ; also for mallets ; wood tough.

97. Bois sicah, or Abricot maron. Tree about 2 feet in diameter ; useful hard wood ; employed for inside and outside work, posts, sills, plates, beams, &c.

98. Bois hypolite. Tree 2 to 3 feet in diameter ; made into posts, shingles, rafters, &c.

99. Bois marbré, (*Ardisia* sp). Small tree ; pretty cabinet making wood.

100. Radigonde. Large tree ; timber used for inside house-work.

101. Acouquoi jaune. Tree from 2 to 2½ feet in diameter ; valuable wood ; used for all purposes ; inside and outside work ; furniture wood.

102. Bois contrevent. Valuable hard wood tree ; fully 4 feet in diameter ; employed for mill rollers, frames, &c. ; furniture wood, side-boards, beds, &c ; house-building generally.

103. Balate. Large hard wood tree ; 4 or 5 feet in diameter ; the wood

is dense and tough, and is valuable for mill rollers and frames, plates, beams, &c.; inside house-work; does not stand water well.

104. Pomme Rose. Tree about 18 inches in diameter; the young branches are employed for making hoops for sugar hogsheads; fruit tree.

105. Simarouba, (*Simaruba amara.*) Tree 3 or 4 feet in dameter; timber used for inside house work; heading for casks; used medicinally.

106. Bois Debasse. Tree about 18 inches in diameter; employed for house posts and rafters.

107. Bois blanc or Montagne. Tree 3 feet in diameter; used for inside and outside house work.

108. Bois Rassade rouge. Tree 2½ feet in diameter; used for posts and rafters; may be sawn into boards and planks.

109. Bois Rassade blanc. Used same as above species.

110. Gombo Montagne. Tree 3 feet in diameter; sawn into boards and used for house building.

111. Bois Sand rouge, Bois Sand blanc. Tree 2 to 3 feet in diameter; sawn into boards for inside and outside house work; shingles.

112. Arali (*Clusia sp.*) Tree, makes excellent posts; lasts long in the ground.

113. Bois long (*Freziera sp.*) Large tree 3 or 4 feet in diameter; employed for shingles and posts.

114. Bois petit feuille rouge, Bois petit feuille blanc. Large tree 3 or 4 feet in diameter; used for boards, posts, and shingles; durable wood; lasting in water.

115. Bois Canon (*Cecropia peltata.*) Tree 3 feet in diameter; sawn into boards; used in house building, pailings.

116. Grossier. Large tree 3 feet in diameter; making into posts, beams, rafters, &c.; may be sawn into planks and scantling.

117. Bois Mammie. Tree 2 to 3 feet in diameter; used for boards and fences, also in house building, inside and out; lasts well in water.

118. Tamarind montagne. Small tree; used for posts and pailings; also sawn into boards; lasts well in water.

119. Laurier jaune. Small tree; employed for boards, shingles, and ordinary purposes.

120. Laurier Isabelle, (*Oreodaphne* sp.) Small tree; wood hard; used for posts and shingles, and sawn into boards; cabinet wood.

121. Laurier Zabucah, (*Aydendron cyriceum.*) Small tree; light wood; employed for shingles, posts, rafters, &c.

122. Laurier noir. Small tree; makes good shingles, planks and boards.

123. Laurier marbré. Tree 2 to 3 feet in diameter; sawn into boards and planks; furniture-wood; tables, &c., made of it; shingles.

124. Laurier Cypre, (*Oreodaphne cernua.*) Tree 2 to 4 feet in diameter the timber is used for all kinds of work, inside and out.

125. Laurier blanc. Useful wood; made into boards, planks, rafters, &c.

126. Laurier canelle. Tree 2 to 3 feet in diameter; excellent timber; made into boards, planks, rafters, &c.; may be used for any purpose.

127. Laurier fetida. Tree 2 to 4 feet in diameter; used for the same purposes, and of equally good quality as the Laura canelle.

128. Laurier coulibrie. Tree 2 feet in diameter; made into shingles, planks, &c.

129. Laurier pian. Tree 2 to 3 feet in diameter; good timber; used for shingles, planks, and all kinds of house work.

130. Laurier Madame, (*Nectandra sanguinea.*) Large tree; good timber; used for planks, beams, posts, rafters; cabinet-wood.

131. Laurier glissé. Tree about 18 inches in diameter; used for posts rafters, plates, &c.

132. Laurier falaise. Tree 18 inches in diameter; timber used for inside house-work.

133. Laurier muscat. Tree about 3 feet in diameter; made into boards, shingles and rafters; used for inside and outside house-work; furniture wood.

134. Laurier riviere. Tree about 3 feet in diameter; grows large in water; timber used for all kinds of inside and outside house-work; also for shingles.

135. Laurier mangue. Tree 3 feet in diameter; used for inside and outside house-work.

136. Mangue blanc, (*Moronobea coccinea*). Large and lofty tree; valuable timber; may be sawn into planks and boards for ordinary uses; makes excellent staves.

137. Mangue rouge, (*Guttiferœ*). Tree about 12 to 18 inches in diameter; the best wood of the country for staves, for sugar hogsheads; almost equal to the red-oak stave.

138. Olivier, (*Bucida Buceras*). Very large tree; timber valuable; made into boards and planks; used for all work, inside and out; very durable in water; the wood is difficult to ignite, and does not flame; one of the best woods for shingles.

139. Sea-side grape, (*Coccoloba uvifera*). Tree about 2 feet in diameter; timber used chiefly for boat building.

140. Kréké, petit Kréké, (*Melastomacea* sp.) Small trees; wood soft and of little value; used for posts in house-building.

141. Orange montagne. Timber used in mill work, house-posts, beams, and rafters.

142. Bois graine rouge. Large tree; boards used for inside and outside work; heading for sugar hogsheads.

143. Acacia, (*Acacia farnesiana*). Wood employed for posts, being very durable in the ground; cabinet wood; the husks of the pods are pounded and boiled in water; this decoction is rubbed on leather to colour it black.

144. Guèppois. Small tree; used for making walking sticks and posts in the ground, being very durable.

145. Café Maron rouge. Employed for same purposes as Café Maron; good for posts in house-building.

146. Bois Lodat. Timber may be used for ordinary purposes.

147. Acouquoi gris. Large tree; timber durable; employed for house and garden posts; may be used for rafters, beams, &c.

148. Goyavier montagne. Middle-sized tree; timber used for mill work.

149. Goyavier Douce. Large tree; employed for mill work, house-posts, beams, &c.; used only for inside work; not lasting in the ground.

150. Sureau. Small tree; used for house-posts; not of value.

151. Greenheart (Nectandra Rodiæi). Valuable timber tree; employed for mill work; very pretty cabinet wood.

152. Acajou nouveau. Tree nearly 3 feet in diameter; sawn into boards and planks for general use; shingles; furniture-wood.

153. Bois Anglais. Large tree; timber used for ordinary purposes; shingles, posts, rafters, &c.

154. Bois Manioc. Tree 2 to 3 feet in diameter; timber used in house-building, inside and out; lasts well in water.

155. Cacao Maron. Tree about 2 feet in diameter; used in house-building and shingles.

156. Bois L'Ail, (*Cassipourea elliptica*). Tree about 2 feet in diameter; used for posts, rafters, &c.; in house-building; might be used in cabinet work.

157. Bois Carriere. Timber used for ordinary purposes.

158. Bois Gonne. Large tree; timber used in house-building.

159. Bois Lait. Tree about 2 feet in diameter; used for house-posts and rafters; may be sawn into boards for inside work.

160. Bois Boucle. Small tree; pretty cabinet wood; useful for house and garden posts, rafters, &c.

161. Reinette. Small tree; used for house and garden posts.

162. Pain de Pice. Large tree; employed for mill work, rollers, &c.; sawn into boards for inside work.

163. Acajou. Cabinet wood.

164. Bois fleur jaune, (*Bignonia Stans*). Small tree; employed for making posts.

165. Soap berry. Timber used for ordinary purposes.

166. Bois Vin. Large tree; timber employed for inside house work.

167. Bois Doux.

168. Bois Piante. Timber used for ordinary purposes.

169. Prune Chillie. Light wood of little value.

THE FURS AND FISHES OF NOVA SCOTIA.

FURS.—This attractive department gained for Nova Scotia the first place for furs in 1851, and gave a gold medal to the exhibitor for that year. Though in its nature diminishing as the province becomes settled, still the export for 1860 gave 20,000*l.* value, one half of which were furs produced in the province. The collection now shown at the International Exhibition is a very fine one.

The fur bearing animals represented, with one exception (the ermine), in the collection of skins and manufactured articles of the exhibitor, Mr. W. J. Coleman, are in their natural order as follows. The classification is that of the Smithsonian Institute at Washington. This, though differing in some respects from British authorities, bears such weight in America as to be the first authority, at least, on American mammals.

Three Lynx skins (*Lynx Canadensis*). Common, said by Temminck to be identical with the Lynx of Northern Europe, and is not diminishing in the province ; a beautiful rusty brown, hoary fur.

Five Wild Cat skins, (*Lynx rufus*). The Wild Cat, or Bay Lynx, differs from the last in shorter fur and longer pencils to the ears ; it is not so abundant as the last ; both are true Lynxes.

One Wolf skin, (*Canis Occidentalis*). This Wolf is exceeding scarce in the province ; it is distinct from the European Wolf.

Ten Red Fox skins, (*Vulpes Fulvus*), of exceeding beauty.

Six Silver or Black Fox skins, (*V. fulvus*, variety *argentus*). These are the celebrated silver or black foxes—the most valuable furs the world produces, of an incomparable lustre and beauty ; they have brought in some cases 40*l.* each. There are some fine black fox skins in the Newfoundland Court, and in Russia.

Six Cross Fox skins, (*V. fulvus*, variety, *decussatus*). Of great beauty, but of less value than the last. All these Foxes are of one species, and live and breed together, but owe their difference of colour to unknown causes.

Two Fisher skins, (*Mustela Pennantii*). Pennant's Weasel, or Fisher—a large and beautiful Weasel, but rapidly diminishing in numbers.

Ten Martin skins, (*M. Americana*). The American Martin differs from the Pine Martin of Europe ; it is rapidly diminishing in the province of Nova Scotia.

Putorius cicognanii and *P. Richardsonii*, two distinct species of Ermine, and both differing from the true Ermine, are found in Nova Scotia ; they differ chiefly in length of tail.

Twenty-five Mink skins, (*Putorius vison—P. nigrescens*). Mink—two species—perhaps varieties exist in Nova Scotia—differing in size ; the smaller, or *nigrescens*, has the more beautiful fur. Mink fur, of exceeding beauty and increasing value ; the animal does not diminish in numbers ; its value has increased tenfold.

Six Otter skins, (*Lutra canadensis*). The American Otter differs from the

European Otter; it affords a valuable, brilliant, and most durable fur; not rapidly diminishing.

Four Raccoon skins, (*Procyon lotor*). The Raccoons are increasing in number, and afford a rather handsome fur for robes; the skins are also used in the manufacture of felt hats.

Three Bear skins, (*Ursus Americanus*). American Bear; by no means diminishing in numbers; differs from Europeans species, and affords in season a thick and brilliant black fur.

Eight Beaver skins, (*Castor canadensis*). Differing from European Beaver; it became nearly extinct a few years ago, but now is increasing in numbers.

Twenty-five Musquash skins, (*Fiber zibethicus*). Abundant and rather increasing; the beauty of this fur in its natural state is well seen in Mr. Coleman's manufactured articles; when dyed and plucked its resemblance to the fur-seal is so great as to deceive any but dealers. It must rise in value and importance.

Rabbit skins, (*Lepus Americanus*). Hare, formerly confounded wth the varying Hare of the Old World.

It is found in enormous quantities, and is often a great boon to poor settlers; some families with wire snares have caught in one season between two and three thousand. Sixty thousand skins have been shipped by one dealer alone.

FISHES, &c.—The fisheries of Nova Scotia are an almost inexhaustible source of wealth. Though a large portion of the population is engaged in agricultural and other pursuits, the exports of fish in 1860 amounted in value to $2,956,788. The census table gives 396,427 quintals of dried fish, and 283,273 barrels of pickled fish.

The shipping owned in Nova Scotia and employed in the fisheries, &c., in 1860 amounted to 3,258 vessels, with a gross tonnage of 248,061 tons, being almost a ton to every man, woman, and child in the province. This amount of tonnage places Nova Scotia in the rank of one of the principal maritime countries in the world, and the first as to the proportion of tonnage to population.

The fish of Nova Scotia are represented by specimens preserved in alcohol in clear glass jars, by J. M. Jones, Esq., and also by specimens of pickled, smoked, and dried fish, purchased in the market, being samples of those preserved for ordinary use or export.

The exhibition of fish does not include the finest specimens, but must be considered as containing fair samples of such as can be procured between the months of October and January in the Halifax market.

The reason for the largest and best specimens not being exhibited arises from two causes:

1st. The jars used, though ordered at the kind suggestion of Professor Agassiz from the New England Glass Company by the Nova Scotian Commissioners, and being larger than any manufactured in England for a similar purpose, cannot be procured of such dimensions as to admit of the exhibition of hallibut or of the larger specimens of some other fish.

2nd. The season when the effort to procure specimens of fish was made was so far advanced that the best samples of many species could not be obtained.

Fish preserved in Glass Jars.—1. Salmon, (*Salmo Salar*). Attains the weight of 30 lbs.; abundant in the market of Halifax during the season; price, fresh, 4d. to 6d. per lb.; smoked, from 3s. to 4s. each; pickled from 2*l.* 8s. to 4*l.* per barrel; preserved in tins, 1s. per lb. Amount of catch in 1860, 2,481 barrels.

2. Cod, (*Morrhua vulgaris*). Attains the weight of 90 lbs.; abundant in the fish market of Halifax all the year round; price, fresh, same size as specimen preserved, 5d.; dried, per qtl. of 112 lbs., 10s. to 14s.; exports from the port of Halifax alone, in 1860, 281,111 qtls.

3. Haddock, (*M. æglefinus*). Attains the weight of 15 lbs.; abundant in market during the season; price, fresh, same size as specimen preserved, 5d.; dried per qtl. of 112 lbs., 6s. to 8s.; preserved in tins, 10d. per pound.

4. Hake, (*Phycis Americanus*). Attains the weight of 25 lbs.; price, fresh, same size as specimen preserved, 4d.; dried, per qtl. of 100 lbs., 5s. 6d. to 7s. 6d.

5. Pollock, (*Merlangus carbonarius*). Attains the weight of 40 lbs.; not abundant; affords serviceable oil; price, fresh, same size as specimen preserved, 5d.; dried, per qtl. of 112 lbs., 5s. 6d. to 7s. 6d.

6. Mackerel, (*Scomber vernalis*). No 1 variety; more abundant some seasons than others; price, fresh, in the Halifax market, 6d. each; salted, per bbl. of 200 lbs., 2*l.* 10s. to 3*l.* 10s.

7. Mackerel, *(S. vernalis,)* No. 2 variety. Abundant in Halifax market during the season; price, fresh, 3d. each; salted, per bbl. of 200 lbs., 1*l.* 10s. to 2*l.* 10s.; preserved in tins, 1s. per lb.

8. Mackerel, *(S. vernalis,)* No. 3 variety. Abundant during some seasons; price, fresh, in Halifax market, 2d. each; salted, per bbl. of 200 lbs., 15s. to 25s. The catch of mackerel in 1860 amounted to 66,108 bbls.

9. Trout *(Salmo fontinalis.)* Attains the weight of 4 lbs; price, fresh, in Halifax market, mixed sizes, 8d. per dzn.

10. Sea Trout, *(S. trutta.)* Attains the weight of 7 lbs; price, salted, per bbl. of 200 lbs., 20s. to 30s.

11. Whiting, *(Merlangus* ——?) Attains the weight of 3 lbs.; not very abundant; flesh very delicate; price, fresh, 1d. to 2½d. each.

12. Eel, *(Anguilla vulgaris.)* Attains the weight of 6 lbs.; abundant in Halifax market during winter months; price, fresh, 4d. to 6d. per bunch of 12; salted, 16s. per bbl. of 200 lbs; preserved in tins, 10d. per lb.

13. Gaspereau, *(Alosa tyrannus.)* In enormous quantities during the season; often used for manure; price, fresh, 4d. per dzn.; salted, per bbl. of 200 lbs., 12s. to 16s.

14. Herring, *(Clupea elongata.)* Abundant during the season price, fresh, 4d. per doz.; salted, per bbl. of 200 lbs., 13s. 6d. Catch in 1860, 194,170.

15. Tom-cod, *(Morrhua pruinosa.)* Abundant during the winter months; price, fresh, 3½d. per doz., mixed sizes.

16. Rock-cod, *(M. vulgaris.)* Attains the weight of 15 lbs; price, fresh, same size as specimen preserved, 4d.; dried, per qtl. of 112 lbs., 10 to 14s.

17. Sea Perch, *(Labrus ceruleus.)* Very abundant; of fine flavor.

18. Cat-fish, *(Pimelodus catus.)*

19. Norway Haddock, *(Sebastes Norvegicus.)* Not very abundant; delicate flavor; price, fresh, 2d. each.

20. Smelt, *(Osmerus viridescens.)* Extremely abundant during the winter months; delicious flavor. Is so abundant as to be often used for manure; price, fresh, in Halifax fish market, 2d. per doz.

21. Perch, (*Perca flavescens.*) Abundant in fresh waters; fine flavor; price, fresh, in bunches of 1 doz. each, 6d.

22. Dog-fish (*Spinax Acanthias.*) Fœtus taken from the mother October, 1861. Attains the weight of 16 lbs.; very abundant on the coasts of the province; affords a valuable oil; price, dried, 3s. per hundred. Used for fattening pigs, &c., and frequently for manure.

23. Flounder, (*Platessa plana.*) Price, fresh, per bunch of six, 2½d.

24. Dollar-fish. Not abundant; flesh white and of fine flavour; price, 3½d. per doz.

25. Lump-fish, (*Cyclopterus lumpus.*) Very rich flavor; price, 1½d. to 2d. each, averaging 1 lb. weight.

Pickled Fish, &c., collected under the superintendance of W. H. Townsend, Esq., late Inspector of Pickled Fish.—One case each of Codfish, Haddock, Hake, and Pollock; one and a half bbl. No. 1 Mackerel, one and a half bbl. No. 1 Round Herring, one bbl. No. 1 Split Herrings, one bbl. Trout, one tub of Salmon, one and a half bbl. of Alewives, one bbl. of Shad, by J. S. O'Brien Noel, one box Digby Herrings, by Benj. Hardy, Digby.

A collection of Fish preserved in tins consisting of Lobsters, Mackerel, Salmon, Eels, and Haddock.

Mollusca.—The most important species, and the only one used generally for food, is the Oyster, of which there are unlimited deposits along the shores washed by the Gulf of St. Lawrence. The whole coast from Cape Breton to New Brunswick being almost continuous Oyster-beds. If properly worked, they would form a source of very profitable employment for a large number of persons. The Oysters of Tatamagouche resemble in appearance, and are equal in flavour, to the best English "natives." The other species of mollusca, though found generally in profusion along the shores of the province, are but little sought after by the people of Nova Scotia.

This department is illustrated in the Nova Scotia Court by the following collection, contributed by J. R. Willis, Esq., Principal of the National School, Halifax,—nearly all are abundant and cheap:—

Oyster (Ostrea Borealis, and O. Virginiana,) Scallop (Pecten Magellanicus, P. Islandicus, and P. concentricus,) the latter is small and rare. Clam Mactra gigantea, M. solidissima, Venus mercenaria, Cyprina Islandica, Solen enses, Mya arenaria.) Mussel (Mytilus edulis, and Modiola Americana.) Whelk, Buccinum undatum, Fuses decemcostatus, and F. Islandicus.) Periwinkle, (Littorina littorea.)

Crustacea.—The most important species found in Nova Scotia, and the only one exhibited, is the Lobster *(Homarus Americanus.)* It is found in enormous quantities, on every part of the coast. It is stated that not less than a million dozen of Lobsters are annually disposed of, at or in the vicinity of Halifax, for exportation or domestic use. Along the Northern coast of Nova Scotia they are thrown up in such quantities by gales that they are used extensively for manure. Their price in the market in Halifax is generally about 1d. each. Occasionally, however, there has been so large a supply, that a wheelbarrow-full has been sold for 1s.

A case is exhibited by J. R. Willis, Esq., containing several specimens. The most interesting feature of the collection is an enormous claw, about 15 inches long, which belonged to a lobster 30 inches in length, and of almost the same dimensions from point to point of extended claws.

Pearls.—A large quantity of Pearls have recently been found in the fresh water Bivalve *Alasmod Margaritifera,* in streams and lakes of Annapolis, and King's County, and are apparently abundant. 15 selections are exhibited, from contributions by the following persons: Wm. McIntyre, Job Randall, E. J. McNeill, Thaddeus Walker, Wallace Kirkpatrick, Austin Woodberry, and Joseph Grogan. In the pearl case are animals with corresponding valves, preserved in alcohol, by J. R. Willis.

A VISIT TO THE GREAT EXHIBITION OF 1862.

BY THOMAS D. ROCK.

Amidst the bewilderment produced by multitude and variety, an occasional paper on some of the more prominent technological attractions at the Great Exhibition will, doubtless, prove acceptable, and more especially to those readers of the TECHNOLOGIST who, from unavoidable hindrances, are compelled to absent themselves from the great Industrial Museum. The notes which I propose to make, as opportunity occurs, will also serve as a register of many objects, and products of interest, which may possibly escape the notice of other periodicals less specially devoted to industrial science.

Class IV., where will be found the British collection of raw and manufactured products of two out of the three kingdoms of nature (Animal and Vegetable substances used in manufactures), unfortunately occupies, in common with Classes 1, 2, and 3, a very undesirable site, and the Eastern Annexe itself, in which these classes are placed, is a miserable structure, neither air nor water tight, and altogether unworthy of the many valuable specimens there exhibited. This class is, notwithstanding the drawbacks of situation and shelter, well deserving of a visit from the public, and I feel quite persuaded that no intelligent mind will fail to derive great satisfaction and advantage from a careful inspection of its contents; which are arranged upon a central and two side avenues; and I would caution the visitor against the prevailing notion that all the best things are necessarily in the front and foremost spot; for it so happens that many of the most beautiful objects in this class are behind, and secluded in position.

Wax-flowers are well represented in Class IV., and the evidence of patient and successful industry is quite apparent. One case, in particular, deserves high commendation, a Kentish Ditch scene (No. 925 of catalogue), by Miss E. B. Lambert, of Tunbridge, which is one of the most natural groups of botanical wax-work that was perhaps ever manipulated. The ferns "Scolopendrium" and "Blechnum," with the wild foxglove or "Digitalis," in full bloom, defy almost the closest inspection, whilst the bunch of blackberries, (prospectively tempting) together with the wild honeysuckle, (so natural as to suggest the very perfume it exhales), contribute to enhance the general effect, which is quite an exception to wax groups in general, where the profusion of gaudy blossoms and scarcity of green leaf, usually fail to produce the delusion desired. The ivy leaves of this case are the only serious drawback to its perfection, and appear to have been executed with less care than usual.

Beautiful as is the Ditch scene, however, the chief merit in wax-flower work, belongs to Miss M. Allen, of Percy street, for having rescued the art from a purely superfluous application, and annexed it to the daily increasing number of those industries, which are useful as well as ornamental. This lady's group of useful plants in wax-work, including a cotton and tea shrub, as well as some flax in full bloom, will, I feel sure, inaugurate a new era in wax-work, since for educational purposes it is quite evident that wax models of plants, *well executed*, must be more desirable than either dried specimens, or coloured illustrations. I should be sorry to criticise too closely the forms of the models in question, as much would depend upon the original designs, but I think Miss M. Allen may well count upon receiving from those best able to render assistance in such matters, every encouragement and help, to bring the happy suggestion of her mind to good effect.

The work in vegetable ivory, exhibited by Mr. B. Taylor, of St. John street road (No. 1,137), will well repay a careful and minute examination. The Temple of Art, executed by his own hands, consists of no less than 2,000 separate nuts or portions of nuts, and the delicacy of the turning in some parts is perfectly astonishing. In 1851, Mr. Taylor obtained the medal for his vegetable ivory turning, on which occasion, the chief feature of his display consisted of three Chinese pagodas, which are, nevertheless, greatly eclipsed by the Temple of 1862. Many minor articles, some coloured to represent fruit, surround this temple, all testifying to the beauty and utility of that interesting and nominal paradox, the vegetable ivory nut.

A model of the west front of the Royal Exchange, of which Messrs. Robert Fauntleroy and Co., of 100 Bunhill row, London, are the exhibitors, is likely to attract attention, from the large number and splendid variety of woods employed in its construction; no less than 500 specimens, embracing. the most choice and ornamental woods from each quarter of the globe.

The great richness and brilliancy of colour of many of these woods, almost provokes the suspicion that dye has been used to enhance the effect, yet every single specimen is perfectly natural and unexaggerated. These woods have not been grouped for the purpose of displaying architectural beauty, but the model in question was selected as one best calculated to illustrate the character of those hard and fancy woods, so extensively worked in the lathe. A catalogue and plan of this model is promised shortly, and will doubtless prove acceptable to the public. Close behind this model is a beautiful display of furniture woods, by Messrs. Oliver, also of Bunhill row. A magnificent specimen of Sabicu wood, such as is rarely seen, and some very fine Hungarian ash, are the chief attractions, but most of the woods shewn by this firm are of exceedingly fine quality.

Messrs. Langton, Bicknell, and Sons, of Newington Butts, display an instructive series, illustrating the manufacture of sperm candles (No. 926.) The raw sperm, or head matter of the whale, "Physeter Macrocephalus," is placed in juxtaposition with the preparatory processes. Slack pressed sperm, tight pressed sperm, hot pressed sperm, and rectified sperm, which latter material is the solid portion of the oleaginous mass, purified and ready for candlemaking. The oil itself is largely used as a lubricator for machinery.

All who take an interest in paper and papermaking, will rejoice to find in a case exhibited by Messrs. Routledge and Co., (No. 1,120) of Oxford, that rags are no longer essential to the production of a useful paper material. The Esparto fibre, "Spartium junceum," which Messrs. Routledge appear to have utilised most successfully, is a wild grass which grows abundantly in Spain and Portugal, and is converted by the peasants into shoes or sandals, baskets, brooms, cordage, and a variety of other useful articles. The "lament o'er rags" may fairly cease, for if the coarse and tough grass thus reduced to pulp, by Messrs. Routledge can be utilised, there are other and even more eligible fibres, which can certainly supply us with all that is necessary or desirable.

A small and modest case, the property of G. Mason, Esq., of Yately, Hants, proves by its contents, that a very fair quality of silk, may be procured from the true moth, even in this cold and ungenial climate of ours, if the food be but the best of its kind. The cocoons and skeins of silk, which Mr. Mason has sent up to interest and instruct us, are the produce of worms fed upon the white mulberry (*Morus alba),* which is the proper food of the silkworm. English silk from worms fed on the common garden or black mulberry, (*Morus nigra*) has certainly failed as an experiment, but this silk appears, from the superficial and distant inspection I was able to afford, considerably superior to any of English production before seen. And if the theory be correct that the silk fibre exists primarily in the leaves, (in those of the white mulberry pre-eminently,) and that the functions of the caterpillar in producing the silk are somewhat akin to our

* An account of Esparto for papermaking will be found in the TECHNOLOGIST, vol. II, ante page 13.

spinning operations, whereby a mass of short fibres are spun into a long and continous thread, there certainly appears reasonable ground for making further experiments in this direction.

The invaluable cocoa-nut palm is rightly held in universal estimation, for the uses to which its various parts and products can be applied, are scarcely to be enumerated ; and very recently a novel application of the only portion of the tree that has hitherto been a waste substance, has been added to the thousand and one practical benefits previously derived from this chief of palm trees. In separating and cleaning the fibres which surround the shell of the nut, a large quantity of fine and fibrous pulp, almost as small as dust, has hitherto been a waste product ; but gardeners have now discovered that this rubbish is an excellent substitute for peat, and is also specially suited to invalid plants, as many hopelessly diseased, have recovered their vigour completely by a free use of the material in question. That it is peculiarly adapted to the growth of ferns, E. Hyde, Esq., of Kingston-on-Thames, seeks to prove by planting a variety of those interesting plants (at the bottom of his case of cocoa-nut fibre brushes,) entirely in the refuse, which he is selling freely at a most moderate price, and all lovers of flowers should at anyrate supply themselves with some of this elixir vitæ, ere this heap of many years accumulation disappears, and scarcity begets dearness.

Leaving Class IV., for the present, I would draw attention to the extensive and valuable display of raw products, which our Colonies have contributed at a very heavy expense, and no trifling amount of labour, and, I feel sure I only echo the sentiments of my countrymen in general, when I express the hope that such efforts may be fully rewarded, and that it may be found desirable to add many of the Colonial products to our list of commercial necessities.

Canada displays her wonderful resources most abundantly, but I have only space sufficient on this occasion to allude to a very few of her treasures. In minerals, there is much to delight the geologist and practical mineralogist. The talc is very good, and might doubtless be profitably shipped to this market. The plumbago also, is flaky in character, and as I presume suitable to the manufacture of crucibles. Woods form a very prominent portion of the Canadian products, and some few of the specimens are really very beautiful in figure, particularly the Curled ash, ("*Fraxinus excelsior*") which has a pattern very similar to the renowned Hungarian ash, a wood which has been much in favour with the English public, and has realised a very heavy price per ton ; but the difficulty of obtaining large planks, has dwarfed and smothered a trade, which might otherwise have been considerable. If Canada can send Curled ash, fully equal to the specimens referred to, and of large size, I think our timber merchants will prove their appreciation of its beauty. Some samples of walnut wood are also noticeable for their figure.

British Guiana likewise exhibits sections of the valuable woods from her territory, and illustrates their quality and character, by a few articles of furniture entirely composed of them. Two table-tops in curious mosaic are exceedingly attractive, in which the splendid Purple-wood throws out its conspicuous charms ; but the *bijou* of the court, is a little cabinet, also constructed of the woods of the Colony, shown by Sir W. H. Holmes. The doors are inlaid and quite flat, and yet they represent in striking perspective an elegant apartment with window and door in the distance ; the perspective effect being produced simply by a judicious grouping of the woods, the darker varieties forming shade to the light-coloured specimens, and I do not think such an elegant and successful piece of wood-work, is to be found elsewhere in the Exhibition. The artist deserves great credit for his design, and the woods of British Guiana, already celebrated as containing the mottled serpent, or Letter wood, and the brilliant "Purple heart," will certainly not lose in public estimation, by the tasty employment of them in this cabinet. Specimens of India-rubber from Demerara, in round balls, will be certain to engage the attention of those commercially interested in an article the utility of which appears unbounded.

The cotton of colonial growth in the New South Wales and Queensland collections, valued at 3s. 6d. and 4s. a pound, ought surely to rejoice the hearts of many whose future prosperity may very possibly depend upon the quantity and quality of this invaluable raw material which our own possessions can supply. America as an exclusively cotton growing country, appears on the eve of expiring, and with much pleasure, therefore every Englishman must hail this happy omen of future stores, in a new field of production. A sideboard top of Australian cedar root, or Burr, is an object also in the New South Wales court, of rare beauty, and in passing I may just observe that the entire collection from this colony is of a very practical character.

Before closing this brief notice, I would allude to some agricultural produce shewn by the Russian Government. My attention was first arrested at this spot by the sight of some nuts (*Corylus Avellana*) from the Crimea, of extraordinary size, so large as quite to eclipse the English cob nuts and filberts ; and in a cask adjoining these are some tempting walnuts from the same province—not large and hollow as walnuts frequently are, but of a size, and external appearance, that indicates quality within. The collection of seeds includes some very fine buckwheat, with a series of grits prepared from it ; green peas, dried young, for making soups, &c., which possess a most promising and natural flavour, very superior to preserved vegetables in general. We can never hope to receive green peas fresh from Russia ; but when carefully dried, it is evident that we might advantageous import them for winter supplies. Two samples of sunflower seed from the western provinces of Russia, where this seed is largely pressed for oil, at once suggest and offer us another source, or supply of oil, whichever might be found most suitable for us to receive.

THE TECHNOLOGIST.

AILANTICULTURE—ITS HISTORY AND COMMERCIAL RELATIONS.

BY JAMES MORRIS.

In the May number of the TECHNOLOGIST there was published a condensed report of the translation made by Lady Dorothy Nevill of the work of M. Guérin-Meneville, Secretary to the Council of the Imperial Society of Acclimatisation, Paris, on the 'Ailanthus Silk Worm.' As this culture is now beginning to form an important branch of industry in France, and as it could, under many aspects, be made to fill up the fearful void in cotton production, the source at present of so much want and misery in the north of England; and as the Ailanthus tree could be planted advantageously on the barren lands of the United Kingdom, where hardly anything else could be profitably cultivated, it seems worth while to occupy a short space in the TECHNOLOGIST in stating what M. Guérin-Meneville, so well known for his other scientific works, has already done in Ailanticulture, and what are its prospects of useful introduction into England.

It was in 1845 that M. Guérin-Meneville, in an article in the 'Annales de la Société Séricécole de France' (IX., p. 269), proposed to introduce and to acclimatise the silkworms of the Castor-oil plant (*Ricinus*) and the oak. At his request, one of his pupils of the experimental silkworm breeding establishment of St. Tulle, near Calcutta, was preparing to forward him the Ricinus silkworm, when the Society received some from another source, and which it has been able successfully to acclimatise. ('Bullet Soc. d'Acclimat.,' Sept., 1854, p. 307, et 'Rev. Zool.,' 1854, p. 573 et 636.) Since that time, M. Guérin-Meneville has largely distributed this species in the name of the Society.

At present, M. Guérin-Meneville distinguishes three species of the oak silkworm:

1. That from the North of China, which he has named *Bombyx Pernyi;* 2. That from Bengal, which produces the Tussah silk, *B. Mylitta;* 3. That from Japan, which he has named *Bombyx Antherœa* (Yama-Mäi). M.

Guérin-Meneville made many attempts, since the year 1855, to introduce and acclimatise these three fine species of worms, the cocoons of which are so firm, and so easily operated upon by the usual process. His labours give the best founded hopes, almost the absolute certainty that he has succeeded in enriching Europe with these three valuable species of silkworms, the productions of which furnish the clothing material for the entire population of the extreme East. A very interesting account of the experiments of M. Guérin-Meneville on the *B. Antherœa* (Yama-Mäi), as well as some excellent coloured plates of this beautiful species, will be found in the 'Rev. et Mag. de Zoolog.,' Mai, 1861, *et seq.* The Jury of the French Exhibition, in 1855, appreciating the difficulties and the numerous essays of M. Guérin-Meneville on this subject, granted him a medal as an encouragement to continue in a work so difficult, though at the same time so rich in useful results.

In 1857-58, M. Guérin-Meneville at length received living cocoons and butterflies of the *Bombyx Cynthia*, the Ailanthus silkworm domesticated in China, and from that time to the present he devoted all his care and all his leisure to realise this difficult acclimatisation, which he has now done in a definite manner, and by his scientific efforts he has introduced this new domestic insect into European agriculture. His efforts have been seconded by the scientific men of Europe, by the Emperor of the French, by the Queen of England, by the King of Holland, &c., and even by the poor agriculturalists of France. Ladies of rank have also co-operated with him in this scientific idea of creating a new industry in Europe ; among these it will be sufficient to mention the names of Madame la Comtesse Drouyn de Lhuys in France, and Lady Dorothy Nevill in England. In speaking of this lady in one of his works, M. Guérin-Meneville says : "Le nom de cette dame se rattachera à l'histoire des débuts de l'ailanticulture comme un gracieux souvenir."

This scientific undertaking is besides most disinterested on the part of M. Guérin-Meneville, as he gives his new silkworms to all those who are desirous of endeavouring to cultivate them. In a learned and interesting Report, addressed to the Minister of Agriculture and Commerce, 'Sur les Progrès de la Culture de l'Ailante, &c.,' and published at the beginning of the present year, he thus speaks of his own zealous efforts in this respect: "No novelty has ever been introduced, no useful project has ever been inaugurated without a stimulus more noble than the mere desire of making a fortune. In a question like the present one, no possibility exists of obtaining riches, except it be those of honour, and the desire of doing something useful to one's country." The scientific and agricultural societies of the whole of France have not disregarded this zealous perseverance in a work, the object of which is to benefit the public at large, for they have honoured M. Guérin-Meneville and his fellow-labourers in this useful endeavour, by granting them various medals and prizes. Those who are interested in such a labour as the foundation in England of so important a branch of commerce as that of Ailanticulture, can judge for themselves by visiting the department which M. Guérin-Meneville has fitted up in the French Court (No. 837) at the side of that of the Société d'Acclimatisation de Paris. This new textile material, superior to cotton, and almost at the same price, can be there examined ; and certainly, though M. Guérin-Meneville has but a small, he has a most interesting portion, in the Great Exhibition of the Industry of Nations, valuable above all things as a point of comparison, as an aggregation of efforts to introduce the new, the best, and the most beautiful.

The Ailanthus silkworm may be bred in the open air, and at a very trifling cost. Its product, Ailantine, is a textile substance, more beautiful and much stronger than cotton, and may be regarded indeed as intermediate between silk and wool.

The *Ailanthus glandulosa* is a hardy tree, possessing great vitality, and may be grown anywhere, even in the most arid and unfruitful soil, where neither cereals, nor herbage, nor succulent plants can be made to grow.

The Ailante silkworm (*Bombyx Cynthia*) is as hardy as the plant it feeds upon. No severity of weather can detach it from the leaf to which it adheres, nor hinder it from spinning its cocoon.

Both the Ailanthus and the silkworm have been already extensively introduced with great success in various parts of Europe, Africa, America, and Australia. In very warm climates the *Bombyx Cynthia* gives two crops a year, but in colder regions only one.

In the temperate portions of Europe, where the climate, as in England, parts of France and Holland, will not admit of the growth of cotton, the Ailanthus may be cultivated so as to yield the following results. Taking a French hectare, equal to about 2½ English acres, as the basis of calculation, the outlay to be incurred would be :

	£
Purchase of 2½ acres of poor land	8
Total cost of planting the Ailante therein, and interest . .	12
Total	£20

While the annual produce commencing on the fourth year may be safely reckoned at from 12*l.* to 16*l.*, that is from 5*l.* to 6*l.* per year ; a plantation of Mulberry trees yielding the same ratio of produce usually sells in France at from 400*l.* to 480*l.* the hectare, equal to about 160*l.* to 190*l.* per acre.

It appears that cotton from Sig, in Algeria, was sold in March last at Liverpool, from 2s. to 2s. 2d. per lb. Now, although the present price of Ailantine is but a trifle higher than this quotation, the intrinsic value of the material is quadruple that of cotton, as regards strength, durability, and beauty. Moreover Ailantine can, as we have already stated, be cultivated anywhere, and in the poorest of land, whilst it is well known that the cotton plant can only be grown in warm climates and in well irrigated fertile soils.

More than a million of these trees were planted in France in 1861, and more than 100 millions of seed sown, sufficient to cover 20,000 hectares of land, or nearly 50,000 acres.

It may finally be observed that the method invented by Mme. de Cornelian and M. Forgemol for winding off the raw silk from the cocoons considerably enhances the value of Ailantine.

Along the barren sea-coasts of England, the *A. glandulosa* would flourish extremely well. The labour of children could also be advantageously directed to this new commercial project; and at a moment like the present, when a single unforeseen event, a single emergency, has arrested the prosperous career of a mighty industry, and plunged into distress those operatives dependent upon it, the readers of the TECHNOLOGIST will see at once how worthy an object of development in England is this Ailantine economy. If the Chinese can clothe themselves at such a minimum price with the products of this silkworm, it is certainly worth an effort to endeavour to give the suffering poor of England the opportunity of bettering their condition, when the result is so clear, and the manipulation so easy and inexpensive. The results of the experiments of G. Mason, Esq., of Hants, whose small collection of cocoons and silk from worms fed on the *Morus alba*, which is exhibited in the Eastern Annexe, prove that something might even be beneficially done in this direction. But the Ailanthus would grow in a soil in which the white mulberry could not flourish; and the worms which feed upon it, according to all the experiments of M. Guérin-Meneville, are so hardy, that they have nothing to fear from the sudden changes, and the ungeniality of our English climate.

AN ACCOUNT OF THE BOTANICAL AND MINERAL PRODUCTS USEFUL TO THE CHIPEWYAN TRIBES OF INDIANS INHABITING THE McKENZIE RIVER DISTRICT.

BY BERNARD R. ROSS.

Vegetable Products.—A nation of hunters, paying no attention whatever to agriculture, can enjoy but few of the numerous benefits afforded by the vegetable kingdom to the human race in general. Such is the condition of the Chipewyan tribes of Indians. Though the benefits derived from the mighty forests which fill the McKenzie valley, are but few to their denizens, they may be considered, notwithstanding their fewness, to be of essential, indeed of vital importance to the existence of the aboriginal dwellers in these wilds; since, without fuel to warm them, and without canoes to migrate, they would soon cease to exist.

From the vegetable kingdom are derived fuel, canoes, sleds, paddles, snow-shoes, baskets, dyes and food, besides other articles which will be noticed hereafter. Two trees, the canoe birch (*Betula papyracea*) and the white spruce (*Abies alba*) stand out, from their importance, in bold relief; but the larch and willow are used also, as well as several kinds of plants, which furnish medicines, dyes, and edible berries that are useful in periods of scarcity. Indeed, in summer a considerable portion of the ordinary food, as well as the luxuries of the natives, is drawn from this source.

According to the method adopted in my former paper on the zoological products,* I shall pass the various uses of each species briefly in review :—

The Canoe or Paper Birch (*Betula papyracea*).—The benefits which this valuable tree confers on the inhabitants of the McKenzie river district, are many and important. Its bark is used in the construction of canoes, and in the manufacture of various utensils for domestic use, such as drinking cups, dishes, and baskets. It also yields spunk or touchwood of the best quality. Of its wood, platters, axe-helves, paddles, snow-shoe-frames, dog-sleds and other articles are made, and as it is a strong and durable material, of close grain, and susceptible of receiving a tolerable polish, the white residents avail themselves of it for the construction of furniture. In spring, the sap forms a pleasant drink, from which a syrup can be manufactured by boiling, and which may be further transformed, by fermentation, into an agreeably flavoured wine of considerable potency. Beyond the arctic circle, the birch is rare and stunted, though it is found as high as 70° N. The largest and finest trees in the district grow on the banks of the Liards, or river of the Mountains. Since the advent of missionaries into these wilds, the natives who are christianised, use the bark for paper on which to engrave their syllabic literature, as well as for letter-writing.

The White Spruce (*Abies alba*).—This is pre-eminently the forest tree of McKenzie's river district, and grows a considerable distance within the arctic circle, as high as the 69th parallel. It is used for the thin hoops or *verrandis* and lining of bark canoes. With its tough roots split to a convenient thickness, and used under the Cree name of *wattape*, the pieces of canoe bark are sewed together. Tasteful baskets and dishes are also manufactured from it, as well as kettles capable of containing water. Before the arrival of traders the Indians used these for cooking their food, which was done by dropping heated stones into the water until it boiled. In districts where the birch is scarce, or for temporary use, a rude canoe is made from the spruce. For this purpose, a well-grown tree, with thirty feet or so clear of branches, is chosen ; an incision is made down to the wood along one side, and the bark being skilfully raised in one piece, receives the canoe shape by being skewered together, and having a few willows inserted for *verrandis* to add to its stiffness. It is serviceable for a short period only, heat and cold being alike destructive to this species of craft, by rendering the spruce bark dangerously brittle. Pieces of the bark are used for covering houses of the white residents, and also by the natives for roofing temporary sheds or cabins. The gum is used for paying the seams of canoes, and is chewed by the female aborigines, to the whiteness of whose teeth the habit contributes in no small degree.

* See ante, p. 257.

From the fibrous bark of the willow a species of twine is made which the natives manufacture into nets of great durability. Sleds are made of the larch and the Banksian pine. The Loucheux Indians use the black seed of the bear-berry for beads, to ornament their dresses with. Alder bark, the wild sorrel, and other shrubs and plants are used for dyes and medicines. While the strawberry, raspberry, gooseberry, mossberry, cranberry, crowberry, mooseberry, red bearberry, the fruit of the rose, and various roots contribute an important item to their summer larder.

Mineral Products.—The mineral kingdom affords but few and unimportant articles for the necessities of the Indians.

Sulphur is found in considerable quantities at the Sulphur Cove on Great Slave Lake. Here sulphur springs occupy a space of several hundred yards in length along the beach. They are very clear, and flow in small rivulets, whose banks are encrusted with a deposit of sulphur which becomes serviceable when thoroughly dried, and is used by the Chipewyan Indians who come to Fort Resolution, in the fabrication of matches.

Common Salt is procured from the salt plains lying about twenty miles up the Salt river, a tributary of the Slave. The springs issue from the base of a long ridge, some hundreds of feet in height, and spreading their waters over a clayey plain, deposit the salt by evaporation in cubical crystals of various degrees of fineness. The mother liquor flows into Salt river, giving a name as well as a most abominable taste to that stream, which is still sensibly brackish at its junction with the Slave. At present, the main supply of salt is confined to one large *jet d'eau* from which a strong brine, mingled with completely formed crystals, is perpetually thrown. Around this spring, evaporation has formed a hillock of dry salt many feet high; and a pole forty feet long was shoved into the spring without finding bottom. Sir John Richardson considers that these fountains belong to the Onondaga Salt group of the Upper Silurian Series of New York.

Numerous bands of buffalo, elk, and reindeer frequent these plains to lick the mineral, of which they are extremely fond. The salt is of excellent quality, strong and well-flavoured. It preserves meat, meal, and butter, fully as well as that imported from England, being far superior to the description manufactured in the plain country of the Swan River district. As the Salt river is very crooked, with generally too little water to float any craft larger than a small canoe, the transport of the salt from the springs to its mouth is by horses.

Ochres, red and blue, are procured at several points in the district, and are used for painting snow-shoes and sleds, by the natives. The Loucheux of the Youcon river paint their faces with these colours in the same way as the tribes of the Plain.

White earth or Pipe-clay is found associated with the coal beds at the mouth of Bear river. When newly dug, it is plastic, but soon dries. It is eaten in times of scarcity by the natives, and is also used as a soap for washing their clothes, and by the whites for white-washing their houses. At the request of Sir John Richardson it was analysed by Drs. Davy and Prout, but was not found to contain any nutritious matter.

Mineral Tar is procured at several spots along the Arthabaska or Clear Water river; it is also found on Great Slave Lake, at a short distance N.E. of Big Island, and also near to Fort Good Hope. It is little used by the natives, except to mix with and to soften gum for paying canoes with. It becomes, after being boiled and purified, an excellent tar for boat-building purposes, for which it is used.

Iron Pyrites is found in the mountain ranges. The Gens-des-Bois, a tribe living on the banks of the Pelly river, use it instead of flint to strike fire with.

Pieces of Agate are used occasionally as flints, and native copper has been made into knives, spear and arrow heads.

Lignite exists in large quantities near the mouth of Bear river, where it is seen in a state of combustion. It is of little value as fuel, and quite unserviceable for forge use. The legend told by the Slave and Dog Rib Indians, of the origin of the fire in these lignite beds is rather curious. The story relates that in the days of old, before Indians roamed the forest, or glided over the waters in their birchen canoes, a giant, tall as a pine tree, dwelt at the eastern end of Slave Lake, then a much larger sheet of water. The giant hungered and he went to hunt. His spear was a tall fir-tree, hardened in the fire, and tipped with native copper. The skin of gigantic elks served him for clothing. Travelling on, he found a beaver-house; the beavers in those days were of extraordinary size, and their houses of corresponding proportions. With great exertion and toil, the house was broken open: it contained two animals, a female and her young. The latter was killed, but the dam escaped, pursued by the giant, who bore the dead cub over his shoulder on the point of his spear On they sped, until the western end of the lake was reached, where a rocky barrier then stretched across, giving vent to the waters of the lake, and thus forming the Tesschi or McKenzie's river. Through this, the beaver pushed her way, the flood of which swept her downwards, far out of the pursuer's reach. The giant still continued the chase, until hungry and exhausted, he reached the mouth of Bear river, where he stopped to cook the cub, which was the size of a moose-deer; and thus lit the fire which continues burning to the present day.

With these I think I have completed this series of notes, in which I believe that nothing of importance to the comfort or welfare of the natives is omitted.

Among the Esquimaux, the arts and manufactures of savage life are in a much more advanced state than among the Indian tribes.

ON THE GLASS OF POMPEI.

M. G. Bontemps, at one of the late meetings of the *Académie des Sciences*, read a very interesting paper on this subject. The following are the most salient points of M. Bontemp's communication:—"The use of glass for window-glazing, an invention so useful to the Northern nations, does not seem to claim a high antiquity. Its use among the ancient Greeks and Romans is negatived by the silence of the Greek and Latin writers. The wonderful skill displayed in glass manufacture many centuries before the Christian era, would appear to imply that it was simply a question of climate that glass for window purposes was not made. Philo, the Jew, in the first century of the Christian era, while describing his embassy to the Emperor Caligula, alludes to the employment of window-glass; Seneca, however, says that it was in his own time that this invention came into use. These assertions have given rise to numberless contradictions in learned commentators; but the discoveries at Herculanum and Pompei have removed all uncertainty from the question. Mazois, the celebrated architect, in his work 'Les Ruines de Pompei,' (Paris, 1814-1835), in his chapter on the Public Baths (T. II., p. 77), thus writes:—'If the question of the employment of window-glass by the ancients were still a matter of doubt, we should find in this hall a testimony capable of solving it. Time has still preserved there a bronze window-frame, which shows not only the size and the glass employed, but also the manner of arranging it. The panes of glass were inserted in an incision in the bronze, and kept in their place by small turning buttons which pressed upon the glass; the size of the panes was about 20 inches broad by 28 inches long, and the thickness more than two lines (5 to 6 millimetres).'"

The certainty that glass was employed at a period anterior to the year 79 of our era, the date of the eruption of Vesuvius, in which Herculanum and Pompei perished being confirmed, it becomes an interesting question to know how these panes of glass were manufactured, which, as we have seen, were of considerable dimensions; whether they were blown in cylinders or in sheets, or whether they were run out like our looking-glass. M. Bontemps asserts that a mere inspection of the fragments is sufficient to determine the method. He says:—"These panes of glass which, according to their size, could not weigh less than five kilogrammes, had they been blown, could not have been the product of a single piece; the joinings then should be observable on the different cuttings. Were these panes the result of the blowing of a cylinder then opened and rolled, the bubbles of the glass should be lengthened and parallel with regard to the axis of the cylinder; they should be concentric were the panes the result of a globe afterwards flattened out; were they run out, the bubbles could not assume any uniform direction, and must generally be round and flat." By the kindness of the Minister of Foreign Affairs, the superintendent of the Naples Museum, Prince de San Georgio was induced to send some fragments of the glass found at Pompei to be examined by M. Bontemps. He says:—

"These fragments measured no less than ten centimetres, and from my examination of them, all doubt as to the method of their manufacture is removed. The glass had been well melted, except some small knots and other defects ; parts were entirely free from bubbles, while other parts were full of them, but all were not inherent to the melting. The thickness of the glass is unequal ; in some places it is more than five millimetres, and in others not more than three. This alone is a sufficient indication that such glass had not been blown. One of the surfaces of a specimen bears the impress of the form on which it had rested while in the warm state ; this might possibly be the mark of the unmelted portion of the stone on which the cylinder or tubular figure had been developed ; but the other surface bears no resemblance to what would have occurred had the glass been blown, a circumstance also proved by still more positive signs. The bubbles are neither those of a cylinder ncr a globe rolled out into a flat surface. It is clearly seen that each pane has been produced by a running out of the material which, in certain places, did not reach the full size of the mould, while in others, the workman having nearly touched the full size, has turned back by bending the glass upon itself, and by this means the air interposed, forming a stratum of bubbles. The inequality in the thickness, proves also that the workmen made use of no metal cylinders to press the glass."

It is probable, then, that a metal frame of the dimensions of the glass to be manufactured was placed upon a polished stone over which a small quantity of very fine clay was sprinkled ; the molten material was then poured into the frames probably by the means of ladles of bronze, and the glass was pressed upon by a wooden pallet, so as to fill up the frame completely. The ancients, therefore, came very close upon the invention of molten glass which was only practised in France seventeen centuries afterwards ; for had they passed a roller over the frame, they would have obtained a pane of glass of a regular thickness, which would then have simply required polishing, an operation with which they were acquainted, for Pliny tells us they made use of obsidian for mirrors, which they hung against the walls of their houses, which evidently meant that such obsidian had been polished.

The glass of these window-panes from Pompei is of a greenish-blue tint, like the common French glass of about fifty years ago. The exact analysis of some specimens made for M. Bontemps by M. Feéd Claudet, gives the following results :—

Silex	69·43
Limè	7·24
Soda	17·31
Aluminium	3·55
Oxyde of iron	1·15
„ manganese	0·39
„ copper	traces.
	99·07

This analysis is remarkable from its great similarity to the composition of glass manufactured at the present day. To take the analysis of window-glass, by M. Dumas, cited in his work under number 4, we find :—

Silex	68·65
Lime	9·65
Soda	17·70
Aluminium	4·00
	100·00

Perhaps in this analysis some traces of manganese and iron may have been overlooked ; but with these exceptions, it is clear that both analyses indicate an almost identical composition. The glass which M. Dumas analysed was a specimen inferior to what is generally manufactured now. Modern window-glass gives an average analysis of—

Silex	72·50
Lime	13·10
Soda	13·00
Aluminium	1·00
Oxydes of iron and manganese	0·40
	100·00

J. M.

NOTES ON THE SILK-PRODUCING INSECTS OF INDIA AND ITS ADJACENT COUNTRIES.

BY FREDERIC MOORE,

Mem. Entom. Soc. Lond., Stettin, &c.

1. Bombyx mori (Linn.). Syst. Nat. 1., p. 817 (1767). The common Mulberry Silkworm.

Habitat. Northern Provinces of China. Cultivated in China, Bengal, Cashmere, Persia, Herat, Afghanistan, France, Spain, and Italy, in all which countries it produces but *one* crop annually, spins the largest cocoon and the best silk. *Silk, pale yellow.* Caterpillar feeds on the mulberry. All who have attended to the rearing of silkworms, Captain Hutton writes me, will doubtless have remarked that there are always a number of dark grey worms among the pale cream coloured batch; noticing this, it struck me there must be some reason for it, and I thought that either the species had at some remote period been crossed by another and that nature was making an effort to separate them, or that the whole stock had originally been dark and become changed by a long course of domestication. I, therefore, picked out the dark ones and fed them separately, and when the moths came forth they were allowed to couple only with their fellows. I continued this for three seasons, and found that the dark worms thus produced always remained dark, and the white ones from which they had been separated always remained white. The dark ones were the healthiest and produced the best cocoons, while the white ones often died and the cocoons were not so well formed. In the moths produced by the dark worms, all, both males and females, were white *without* the band through the wing, but had the small brown double crescent mark on the upper wings.

2. BOMBYX SINENSIS (Hutton). Small Chinese or monthly worm of Bengal.

Habitat. China. Partially cultivated in Bengal, from whence it is said to be fast disappearing, as it is very delicate. It is noted by Captain Thomas Hutton that the monthly worms were not known in India earlier than between thirty and forty years ago, or at least, that they were not there cultivated, and previous to the time here indicated, an annual worm, and it only, was the species under cultivation both in India and Europe. Caterpillar feeds on the mulberry.

3. BOMBYX CRÆSI (Hutton). The Madrassee or Nistry worm of the Bengalese.

Habitat. China. Cultivated in Bengal (and also in China), where it yields *nine crops* of a golden yellow silk. The silk is good, and price, fourteen rupees per seer. Mr. D. W. H. Speed informs us that "the Madrassee or China Pooloo was introduced into India, though, by whom, it is not ascertained, about the year 1780 or 1781, but is degenerating by reason of carelessness and improper management of the worms ; a fresh supply of eggs was two or three years after obtained by a Mr. Frushard, which again falling off immediately his direct superintendence was withdrawn, a third supply was brought by the late Colonel Kyd in 1788, from Canton, which, from the vast increase he effected by personal attention for a considerable time, forms the origin of the present stock of this description of worm. Cocoons monthly between November and June, if attention be paid, but more generally from January to May. Rate of breeding much the same as the preceding, than which it is of a somewhat larger size, and is, perhaps, the most profitable sort of worm, being of shorter life, will feed on indifferent leaf, and is of hardier constitution, that is, less liable to be effected by the vicissitudes so injurious to the other worms."

4. BOMBYX FORTUNATUS (Hutton). The Dasee or Dessee worm of the Bengalese.

Habitat. China. "Cultivated in Bengal, where it is known by the above name—that is, country-worm—although, be it understood, it is truly Chinese, and not indigenous to India. It yields a golden yellow silk, and produces several crops annually. It is much smaller than the Madrassee, and while the one prefers the warmth of summer, the other prefers the winter months" (Hutton). Stated by Mr. Speed to "cocoon five times in the year, at periods from 40 to 110 days, according to which also is the quality of the cocoon, the longest period producing the best.

A cross breed between this and the Madrassee partaking even to a greater extent the chief qualifications of the Madrassee, as respects the cost of production of cocoons, which resemble that of the Desee, but it is decidedly an inferior worm to either; for the cocoon being of loose texture, though imperceptible in outward appearance, throws off a weak rough silk, and is the medium of vast imposition, under the Desee semblance at British reeling establishments, supported by a combination of the servants with the farmers of cocoons, and others interested."

5. Bombyx Arracanensis (Hutton). The Arracan silkworm.

Habitat. Arracan. "Cultivated in Arracan, but is said to have been introduced from China through Burmah. Yields annually several crops of silk superior to that produced in Bengal" (Hutton). In 1847, Major Bogle, the Commissioner of Arracan, sent to the Agri-Hort. Soc. of India some fine specimens of silk, raised in the southern part of the Sandoway district, not far from the Burmese town of Bassein. Lt. A. Fytche, Principal Asst. Comms. at Sandoway, in continuation, states: "The worm is fed on the mulberry plant, and is strictly the domesticated mulberry worm, and is attended with great care and attention. The silkworm and mulberry plant have been brought by immigrants from Burmah into this district; from several old men, who were asked concerning them, it appears that there were little *or none* in the time of the Arracan Rajahs, but that it sprung up during the reign in this province of the Burmese. The silkworms in the Ava territories came originally from the Shan states, and the latter are believed to have obtained them from China; they are tended in Burmah chiefly by the Ya-Cheins, but the Burmese have learnt the art from them, and cultivated the mulberry plant to some extent. The Ya-Cheins are a hill tribe bordering on the Shan States, and numbers of them have come down and settled in the Delta of the Irrawaddi. The mulberry plant is cultivated, and the silkworm tended in this district by Burmese immigrants; there are a few Karens, as also Kyengs, too, who have learnt the art from the Burmese, and are now pursuing it."

6. Bombyx textor (Hutton). The Boro Poloo of the Bengalese.

Habitat. China. "Cultivated in China, Bengal, Italy, and France, and produces, when healthy, a pure white cocoon. In Bengal, it does not thrive, and is there called the *Boro poloo*, or large cocoon. In the larva of this and *B. mori* there is no apparent difference except in size, this being an inch less, but the form and texture of the cocoon are totally different. Strange to say, although it is only an annual in France, Italy, Bengal, and China, with me at Mussooree, it invariably yields a second or autumnal crop, which *B. mori* never does. The appearance of the caterpillar as to colour and marking is precisely that of the Cashmere worm, which I hold to be true *B. mori*, but it only attains to about 2½ inches in length, invariably spins a smaller cocoon of a different shape and of a pure white silk, and when domesticated with me at Mussooree it is double brooded (spring and autumn), while the Cashmere worm remains an annual. The silk is white even in China, Italy, and France, as well as with us, although the worms differ only in size, as far as I can yet perceive." (Hutton.) The Burra or large annual Pooloo supposed to be the same as the Italian, seems to have been introduced into India about 120 years ago, but in what precise year, or by whom, is not ascertained. Cocoons spun in March and April. The life of this worm is from forty-two to fifty days, and the cocoon lasts from ten to fifteen days." (*D. W. H. Speed.*)

7. Bombyx Huttoni (Westwood).

Habitat. Forests of N.W. Himalaya. A wild mountain species, first discovered by Captain Hutton at Mussooree. The caterpillar is found abundantly feeding on the indigenous mulberry, and is confined exclusively to the forests of the N.W. Himalaya. Experiments made with this species at Mussooree, writes Captain Hutton, have elicited the fact that little is to be expected from its cultivation, as the worms can only be fed *upon* the mulberry trees in the open air, and all attempts to domesticate it have hitherto proved ineffectual; the only mode of rearing it, would, consequently be upon the trees, which would, however, be always uncertain in its results. Silk could be produced, and of very good quality, although scarcely in sufficient quantities to render it a lucrative speculation. The silk produced by it is decidedly good, and produced in considerable quantities, would undoubtedly be valuable, a ready market being available at twenty-five rupees per seer. The worm, however, has hitherto proved so intractable that it cannot be reared in the ordinary way in the house, and thrives only upon the trees in the open air. With a view to curb its restlessness and wandering propensities, I, with some trouble, effected a cross between it and *Bombyx mori* from Cashmere, but in every instance, with very few exceptions, the eggs thus obtained proved unprolific, and the worms produced retained all the intractable habits of the wild species; further crossings might possibly correct this. It must be confessed, however, that the trial with the worm has not been carried far enough to enable me to form a decided opinion as to what may possibly be effected by further crosses, and I have merely here shown the effects of the first cross from which little could be extracted. The caterpillar has long fleshy spines in pairs on every segment."

8. Bombyx religiosæ (Helfer). The *Joree* of the Assamese.

Habitat. Assam. Also a wild species, discovered by Mr. Hugon in Assam, where it appears to be little known. The caterpillar feeds on the *Bur* tree *Ficus religiosa.*

9. Bombyx Bengalensis (Hutton). Syn. *Bombyx Artocarpi* (Hutton).

Habitat. Bengal. A wild species found, according to A. Grote, Esq., feeding on the *Artocarpus Jacoocha* in the neighbourhood of Calcutta, where it appears to be scarce. The caterpillar spined like that of *B. Huttoni.*

10. Bombyx Horsfieldi (Moore).

Habitat. Java. Discovered in a wild state in Java by the late Dr Horsfield.

11. Bombyx Subnotata (Walker).

Habitat. Singapore.

12. OCINARA DILECTULA (Walker).

Habitat. Java. The caterpillar feeds on a species of *Ficus*, appearing but not very abundantly in April.

13. OCINARA MOOREI (Hutton).

Habitat. Mussooree. Caterpillar feeds on *Ficus venosa.*

14. OCINARA LACTEA (Hutton).

Habitat. Mussooree. Caterpillar of this also feeds on *Ficus venosa.*

15. OCINARA COMMA (Hutton).

Habitat. Deyra Doon.

16. ACTIAS SELENE (Mac Leay).

Habitat. Silhet, Darjeeling, Mussooree, Pondicherry, and Ceylon.

Common at Mussooree, writes Capt. Hutton, the caterpillar feeding upon *Andromeda ovalifolia*, *Carpinus bimana*, *Coriaria nepalensis*, *Cedrela paniculata*, *Glochidion ovatum vel Bradleia ovata*, the wild cherry and the walnut, and can be easily domesticated. M. Perrottet, of Pondicherry, has the credit of having first turned the silk of this to useful account, having sent to the "Madras Exhibition" of 1857 samples of the raw and spun silk, with gloves knit with the latter. He states that the caterpillar there feeds on the leaves of the *Odina wodier*, and the cocoons are softened in a solution of potash or wood ashes, taken out, picked, and immediately spun without being either combed or carded ; the silk being exceedingly strong, tenacious, elastic and brilliant, and that four broods can be produced annually.

17. ACTIAS MÆNAS (Doubleday).

Habitat. Silhet.

18. ACTIAS SINENSIS (Walker).

Habitat. North China. We know nothing of the last two, save the existence of the moths.

ANTHERÆA PAPHIA (Linn.) Syn. *Saturnia Mylitta* (Drury). The "Tusser" or "Tusseh" silkworm of the Bengalese ; "Bughy" of the Burbhoom Hills ; "Kolisurra" of the Mahrattas (Deccan) ; "Kontkuri Mooga" of the Assamese.

Habitat. Assam, Silhet, Upper and Lower India (but the precise localities not yet determined), and Ceylon. This is one of the most common in use of the native wild silkworms ; it is found in abundance over many parts of Bengal and the adjacent provinces, and has afforded to the natives, from time immemorial, an abundant supply of a most durable silk. Millions of the cocoons are annually collected in the forests and taken to the silk filatures near Calcutta, but the principal place of manufacture is at Bhagulpore.

Tusser silk is everywhere used as clothing by the natives and even by Europeans, while considerable quantities of woven Tusser is imported into England. The caterpillar feeds upon the leaves of the "Baer" or "Byer" (*Zizyphus jujuba*), the Asseen (*Terminalia alata*), and the Semul (*Bombax heptaphyllum*). Col. Sykes states it to feed in the Deccan, indiscriminately on the Sagwan or Teak tree (*Tectona grandis*), the Baer, the Asana, and the mulberry (*Morus indica*), and that the cocoons were there extensively used, cut into thongs, as ligatures for binding the native matchlocks. It is stated that at Behar, Burbhoom hills, Bhagulpore, and the Punjab, the Tusser is an annual *only*, and that in Bengal it has at least *three* broods in the year.

20. ANTHERÆA ASSAMA (Helfer). The "Moonga," or "Mooga" silkworm.

Habitat. Assam, Mussooree, (and ? Ceylon). The Moonga silkworm feeds upon the trees known in Assam as the Champa (*Michelia sp. ?*), the Soom, Kontooloa, Digluttee (*Tetranthera diglottica*), the Pattee Shoonda (*Laurus obtusifolia*), and the Sonhalloo (*Tetran. macrophylla*). It is extensively cultivated by the natives, and can be reared in houses, but is fed and thrives best in the open air and upon the trees. There are generally *five* broods in the year. The silk forms one of the principal exports of Assam, and leaves the country generally in the shape of thread.

21. ANTHERÆA MEZANKOORIA (Moore). The "Mezankooree" silkworm of the Assamese.

Habitat. Assam. The worms which produce the Mezankooree, Mazankoory, or Medanggori, are stated to feed on the Addakoory (probably a species of *Tetranthera*), which is abundant in Upper and Lower Assam. The silk is nearly white, its value being fifty per cent. above that of the Moonga, and constitutes the dress of the higher classes in Assam, being wrought into Dhoties.

22. ANTHERÆA SURAKARTA (Moore).

Habitat. Java. A close ally of the common "Tusser."

23. ANTHERÆA PERNYI (Guérin-Méneville). The oak-feeding silkworm of China.

Habitat. Mantchouria, N. China. This is described as having been long known to the Mantchour Tartars—very large quantities of the silk going into consumption among the Chinese. The caterpillar feeds on the chestnut oak (probably *Castanea japonica*), the cocoon differing from that of the "Tusser" in form and texture; it is attached to the leaves by the loose outer covering of silk, and the slender pedunculated appendage. The silk is represented as strong, having little lustre, and resembles thin yellow woollen linen. This species has been introduced into France.

24. ANTHERÆA ROYLEI (Moore). The oak-feeding silkworm of N. W. India.

Habitat. Almorah, Simla, and Mussooree. This is an abundant species, the caterpillar feeding upon the common hill-oak (*Quercus incana*). The cocoon is large and very tough, and the silk is pronounced as promising, and worth cultivation. Captain Hutton has lately had this under cultivation at Mussooree, and informs me that it can be easily reared in the house.

25. ANTHERÆA YAMAMAI (Guérin-Méneville).

Habitat. Province of Yamamai, Japan. M. Duchesne de Bellecourt, the French Consul-General at Jeddo, and M. Flury-Erard, recently sent the eggs of this, "the wild silk-worm of Yamamai," to the Imperial Society of Acclimatization. From these a single specimen of the moth was reared in August, 1861. The caterpillar was fed upon the leaves of *Quercus cuspidata*, and is stated to be an annual only. The cocoon and silk is of a pale yellowish-green colour—several samples of which are shown among the raw products in the Japan and French Courts of the International Exhibition.

26. ANTHERÆA PERROTTETI (Guérin-Méneville).

Habitat. Pondicherry.

27. ANTHERÆA HELFERI (Moore).

Habitat. Darjeeling Tarai.

28. ANTHERÆA JANA. (Cramer).

Habitat. Java.

29. ANTHERÆA FRITHI. (Moore).

Habitat. Darjeeling Tarai.

30. ANTHERÆA LARISSA. (Westwood).

Habitat. Java.

31. SATURNIA PYRETORUM. (Boisdùval).

Habitat. China.

32. SATURNIA GROTEI. (Moore).

Habitat. Darjeeling Tarai.

33. LOEPA KATINKA (Westwood).

Habitat. Assam, Sylhet, Mussooree and Java. This is abundant in Java during the months of December, January, and February, the caterpillar feeding on the Galing (*Cissus sp.?*), and on the Girang (*Leea sp.?*)

34. NEORIS HUTTONI (Moore).

Habitat. Mussooree, where it was recently discovered by Capt. Hutton. Caterpillar feeds on a species of wild pear tree, and forms an open net-like cocoon, appearing in April.

35. CALIGULA THIBETA (Westwood).

Habitat. Mussooree, and probably Thibet. Caterpillar feeds on *Andromeda ovalifolia* and on the common cultivated Quince, forming an open net-like cocoon.

36. CALIGULA SIMLA (Westwood).

Habitat. Simla. Caterpillar forms an open net-like cocoon.

37. CALIGULA JAPONICA (Moore).

Habitat. Japan, province of Kourinoki. Caterpillar forms a dark-coloured, open, net-like cocoon. Numerous samples of the cocoon of this are shown among the Japanese products in the International Exhibition.

38. SALASSA LOLA (Westwood).

Habitat. Silhet. Very rare.

39. CRICULA TRIFENESTRATA (Helfer). Syn. *Saturnia Zuleika* (Westw).

Habitat. Assam, Moulmein, and Java. Noted as being very common in Assam, where it is known by the natives under the name of Haumpottonee. The caterpillar feeds on the Soon tree, and forms an open net-like cocoon, of a beautiful yellow colour, and of a rich silky lustre, the silk being spun in the same manner as the Eria cocoon ; but the natives do not use it on account of its causing a severe itching in weaving (arising from the intermixture of the spinous hairs of the caterpillar). At Moulmein the caterpillar is stated to feed on the Cashew-nut tree (*Anacardium orientale*), and in Java on *Protium javanum*, *Canarium commune*, and *Mangifera ingas*.

40. ATTACUS ATLAS (Linn.). The Atlas moth.

Habitat. China, Burmah, India, Ceylon, and Java. The caterpillar of the Atlas moth feeds upon *Falconeria insignis*, *Bradleia ovata*, &c. It is easily reared in a state of domestication, producing a cocoon well stored with a fine yet strong silk of a greyish colour. It is stated that the Tusseh silk of China is produced by this.

41. ATTACUS EDWARDSII (White). The Sikkim Atlas moth.

Habitat. Sikkim.

42. ATTACUS CYNTHIA (Drury). The "Ailanthus" silkworm.

Habitat. China. This has been cultivated for centuries past in China, its silk clothing the people. It has two broods in the year.

Europe is indebted for the introduction of this valuable silkworm to the Abbé Fantoni, a Piedmontese missionary, in the province of Hang Tung, in China, who sent some living cocoons to friends in Turin, in 1856. These cocoons yielded moths in June, 1857, and eggs were hatched a few days after. These worms multiplied, and some eggs were transmitted to France. The produce of these, together with the Bengal "Eria" or "Arrindy," and a fertile hybrid between the two are now being extensively and profitably reared in France—through the praiseworthy exertions of M. Guérin-Méneville—and are known as the "Ailanthus silkworm," from the name of the tree (*Ailanthus glandulosus*) upon which they feed. Both the tree and silkworms have also been successfully introduced into England, Piedmont, Holland, Malta, as well as Africa, America, and Australia.

In England, Lady Dorothy Nevill is now rearing them at Dangstein, near Petersfield, and a numerous brood was raised by myself in 1859, in the centre of the "City" of London !

Var. ATTACUS CANNINGII (Hutton). The sub-Himalayan Eria silkworm.

Habitat. Sub-Himalayas. Discovered, according to Captain Hutton, at Mussooree in a wild state, feeding upon the "Mussooree" (*Coriaria nepalensis*). It will also feed on the Tex Bul (*Xanthophyllum hostile*), and the Cape Woodbine, and will likewise eat the leaves of the *Ricinus communis*, but does not take kindly to the latter. It is an annual only.

43. ATTACUS RICINI (Sir W. Jones), *vide* Roxburgh, Trans. Linn. Soc. Lond. (1804), p. 42.—Syn. *Bombyx* (*Saturnia*) *Arrindia* (Milne-Edwards).—Bull. d'Agri. de France (1854), p. 13.—*Attacus lunula* (Walker), 1855.—Var. *Attacus Guerini* (Moore).—The Eria, Arrindie or Arrindy Arria silkworm of Bengal.

Habitat. Bengal, and other parts of India ; Assam. This is the commonly cultivated Eria, and in Bengal yields four or five crops annually, and is reared over a great part of Hindostan, but more extensively in the districts of Dingajur and Rangpur, in houses in a domestic state, and feeds on the leaves of the Palma Christi or castor-oil plant (*Ricinus communis*). It gives a cloth of seemingly loose texture, but of incredible durability, the life of one person, it is stated, being seldom sufficient to wear out a garment made of it.

It is also largely reared in a domestic state in Assam, there being hardly a ryot who has not a small patch of the castor-oil plant near his house. The thread is wove like cotton, and the clothes are mostly used for home consumption by the poorer classes at all seasons, and by the highest for winter wear, a few being bartered with the Bhotias and other hill tribes. Large quantities used formerly to be exported to Lassa. It is also cultivated in Ceylon.

44. Attacus insularis (Vollen Hoven). The Eria silkworm of Java.

Habitat. Java.

India Museum, Whitehall.

THE FIBRES OF TRINIDAD.

BY HERMAN CRUGER, COLONIAL BOTANIST.

Only small quantities of cotton are cultivated, and none imported beyond some parcels from Venezuela. Before the emancipation of the slaves, the whole of our drier soils, that is the Islands of the Dragon's Mouth, and part of the East Coast, were devoted to cotton. Immediately after emancipation, labour became so expensive and unreliable, that cotton ceased to pay. At present prices of labour, cotton would give a return, but capital has been diverted into other channels, and our available means are devoted to existing plantations of sugar and cocoa. The abandoned cotton fields in the Bocas Islands have grown up in bush, but so favourable is the soil for cotton there, that the plant even now is found all over the former cultivated lands, bearing abundantly. Samples 94 and 95, shown in the International Exhibition, are of this wild cotton.

Just now, the question of West Indian cotton is one worthy of attention. Capital and labour could with ease and profit revive the cultivation. The land is very abundant and good, the climate is most favourable, and the distance from Europe, short.

97. *Down of Ochroma Lagopus*, Sw., Sterculiaceae, Corkwood Cotton, The fibre of this cotton is very smooth and elastic, and has been found useful for upholstery purposes.

98. Fibre of the base of leafstalk of *Oenocarpus Bacaba*, Mart., the Palma real.

When a palm leaf becomes useless to the parent tree it drops off in various manners, according to the variety of the tree. One mode, as in this case, is that the leaf stalk breaks off at some ten to fifteen inches above its base, and that the cellular tissue of the base of the leaf stalk itself separates from the wood bundles, which remain as a sort of bristle, more or less coarse ; a common example of a similar substance is the piaçaba, or grass cable.

99. *Fibre Timite* (*Manicaria Saccifera*, Gaertn).

From both this and the last-named a coarse sort of rope is made.

100. *Bag*, or *Spathe of Timite.*

The Spathe of palms in general is a large woody sort of envelope protecting the flowers in the bud. In some cases, it is considerably developed, as in the Cocurito, and other Maximilianeae, where specinens eight feet long, are not unusual. In our case, the spathe decays rapidly, and the fibres only remain, and are resolved in a sort of network, used variously by the natives as caps or filters, or pouches to keep seeds or such articles in.

101. *Vegetable Hair.* (*Tillandsia usneoides*, L.) Bromeliaceae. Steamed and dried.

This plant, depending to the length of several yards from the branches of our loftiest trees, gives a peculiar aspect to the West Indian landscape. It is used for upholstery. The sample sent has been steamed to insure its retaining a fresh colour. Another fibrous substance is the Moriche, 117 ; it is the tender leaf of *Mauritia flexuosa*, L., split up into small laminæ by twisting and rubbing them after having taken out the ribs ; it is worked up into line, nets, and hammocks, which latter are very light, cool, and strong.

102 to 142 is a collection of *Fibres*, which are more or less suited for textile fabrics or rope. Before entering into details, we shall enumerate them according to their respective families :—

102. *Bromelia karatas*, L. Bromeliaceæ. Raw unmacerated Carata.

103. Ditto. Macerated.

104. *Agave vivipara*, L. Amaryllideæ. Raw unmacerated.

105. Ditto. Raw macerated.

106. *Sanseviera guineensis.* Liliaceæ. Raw unmacerated.

107. Ditto ditto. Macerated.

108. Ditto ditto. Boiled, unmacerated.

109. Ditto ditto. Boiled, macerated.

110. *Sanseviera guineensis.* Raw, macerated.

111. *Heliconia Binai.* L. Musaceæ. Raw, macerated. Bijao balisier. Wild cane.

112. *Musa rosacea*, Jacq. Musaceæ. Raw, macerated.

113. *Musa textilis.* Nees. Raw, macerated.

114. *Musa sapientum.* L. var. Jumbie Plantain. Raw, macerated. Banane Zombi. Banane bornes. Fr.

115. *Musa sapientum*, L. var. Large red Banane. Raw, macerated. Banane Figue. Banane Figue rouge. Camburo.

116. *Musa paradisiaca*, L. Common Plantain, raw and macerated. Plantano, Sp. Bananier. Fr.

117. *Moriche* (*Mauritia flexuosa*, L.)

118. *Anon.* Mahœ cochiman. Cachiman grande bois. Raw, macerated.

119. *Apeiba tibourbon*, Aubl. Tiliaceæ. Mahault, Chardon.
120. *Apeiba ulmifolia.* H.B.
121. *Apeiba aspera*, Aubl.
122. *Triumfetta semitriloba*, L. Mahault cousin, Cabillo negro. Tiliaceæ.
123. *Guazuma ulmifolia*, Lam. Byttneriaceæ, Bastard Cedar, E. Bois l'Orme, Fr, Guacimo, Sp.
124. *Theobroma Cacao*, L. Byttneriaceæ.
125. *Ochroma Lagopus*, Sw. Sterculiaceæ. Bois flot, Fr. Corkwood, E. Tacarigua.
126. *Sterculia Caribea.* Sterculiaceæ. Mahoe. Majagua Mahault.
127. *Hibiscus Rosa sinensis*, L. Raw, macerated. Rose cayenne. Malvaceæ.
128. *Hibiscus Rosa sinensis*, L. Boiled. Malvaceæ.
129. *Hibiscus trilobus*, Cavan. Malvaceæ.
130. *Hibiscus esculentus.* Ochro, E. Gombo, Fr. Chimbombo, Sp. Malvaceæ.
131. *Paritium tiliaceum*, A. Juss. Guimauve. Sp. Mapœ. Malvaceæ
132. *Malachra capitata*, L. Guimauve. Malva. Malvaceæ.
133. *Malachra radiata*, L. Malvaceæ.
134. *Pavonia racemosa*, Sw. Cadillo de Cuatro. Malvaceæ.
135. *Pavonia bracteata*, Benth. Malvaceæ.
136. *Urena sinuata*, L. Cadillo colorado. Malvaceæ.
137. *Abutilon Indicum.* G. Don. ,,
138. *Sida cordifolia*, L. Mahault balai. ,,
139. ,, *rhombifolia*, L. ,,
140. *Couroupita Guianensis*, Aubl. Lecythidaceæ. Cannon-ball tree, E. Arbre à bombres, Fr. Apricot marrow.
141. *Lecythis adatimon*, Aubl. Lecythidaceæ. Guatecare. Guatequero.
142. *Bauhinia megalandra*, Gris. Palo de Vaca. Leguminosæ.

The first two numbers belong to the family of Bromeliaceæ, 102, extracted without, and 103, by maceration. The fibre of this family is in high repute, and in the Philippine Islands and some of the Indies a pine-apple is cultivated, giving a very fine fibre. The fibres exhibited are of *Bromelia caratas*, which has a much longer leaf. It is remarkably elastic, and composed of strong bundles, which can be subdivided. The single cells are very tender and short, and rather thin-walled. The fibre of this plant bears a strong resemblance to 104 and 105, *Agave vivipara* of L. Amaryllideæ, the first being again prepared without, the second by, maceration. This fibre is also strong, white, and easily obtained. The isolated fibres are tender, short, and thin-walled. Both of these plants grow on the poorest of soils.

106 to 110 are samples of a remarkable fibrous plant. Although a native of Africa, the *Sanseviera guineensis* will thrive here so well that, wherever a root, or even a piece of leaf, is left, it strikes root, and establishes itself, soon killing and stifling every other herbaceous plant. The leaves are slow of growth, but attain a length of four to five feet, and yield an abundance of the fibre exhibited. Various processes have been tried for

preparing the fibre ; the best was found to bruise the leaves and submit them to maceration. The bundles are of various sizes, the single cells tender, $\frac{46}{10000}$ of an inch, thin-walled, and perfectly smooth.

110 shows the quantity found on one square yard, when dry, exactly 1 lb. It is not pretended that this is the growth of a few months, but if anything near it can be obtained of one year's crop, the return of this plant is enormous. A sample, rather inferior to this, was valued at 20*l.* per ton. and the above proportion would give about two tons per acre. The cost of extracting the fibre would not exceed 25 per cent. of the gross return. As the plant destroys everything wherever it grows, its cultivation, when once established, is inexpensive. Add to this that the outlay for machinery would be also trifling, and that the crop cannot fail. The leaf is very long-lived, so that the planter, if pressed for time, may leave the fibre in the field until he is at leisure to devote his attention to it.

111 to 116 belong to another remarkable family of the fibrous plants—the Musaceæ. All, or nearly all, give a valuable fibre of more or less fineness.

117. *Heliconia bihai*, L., gives a coarse material, perhaps recommendable to the paper-maker, the plant growing here abundantly in spots where cultivation is impossible.

Of the next numbers, we notice—

113. *Musa textilis*, Nees, the Manila hemp plant. It thrives with the greatest luxuriance, though it has only been tried on poor soils. As a fibre-yielding plant, it is equal to the Plantain, but it bears no fruit. It grows on soils which could not, for any length of time, sustain the common Plantain. Its average yield of fibre would be about 1½ tons per acre.

Contrary to the observations of the majority of those who have written on the subject of the extraction of the fibre of Musaceous plants, I find that the strongest and best fibre is obtained by a purely mechanical process, though the quantity obtained may be somewhat less. The worst of all processes, in my opinion, is the one of boiling the substances in alkline leys. It imparts a gelatinous softness, which must be highly injurious to the fibre. The best long staple was obtained by crushing the cut leaf-stalks and drawing them through blunt knives and combs, until the cellular mass was separated. It is clear that machinery could do this work easily and satisfactorily.

114 shows the fibre of a very robust variety of *Musa sapientum*, L., approaching, in the form of its fruit, very near *M. paradisiaca*. It grows on the poorest soils, and has such pertinacity, that once planted, it never disappears again, even if the land were to grow into bush. The inhabitants plant it to mark the boundaries of property, and give it the French name of Banane or Figue borne.

It gives a considerable quantity of fibre, of great strength and length, its stem (the sheaths of the leaf), being often sixteen to twenty feet, by three feet in circumference at the base. It bears fruit in abundance, which, if not very palatable to people accustomed to the better varieties of the

Plantain and Banana, would form excellent food for cattle. The return, although I have no positive data, must at least be equal to Plantain ; and the advantage of this plant is, that it does not require good soil and careful cultivation. The same may be said with regard to

115. From a very robust sort of Banana, the large red sort.

Some authors pretend that the varieties of *M. sapientum* give no fibre or so little of it, that they are not worth cultivating. I am, on the contrary, of opinion, that for a combination of a stock and fibre farm, these varieties alone would answer. A small per centage less in fibre would be more than balanced by the superior power of vegetation possessed by these plants.

116. *Musa paradisiaca*, L. The common Plantain. This is, next to the plant giving the Manila hemp, the most celebrated of the family, and deservedly, as it will give a large return where the soil permits its permanent cultivation. But soils where this plant subsists for a long time are rare.

The extraordinary accounts which have, from time to time, been published with regard to what a plantain-walk ought to yield, have failed to attract capital to this branch of agriculture. These calculations were not always extravagant ; some have been sober enough, and yet they showed considerable returns. Several tons of plantain flour, besides one and a half tons of fibre, can be obtained per acre, and the outlay for tillage and machinery is small. Still the plantain is not the most frequently cultivated of our fibrous plants, and it may be well questioned whether these bananas, which produce no fruit, should not be preferred ; the stems keeping much longer alive, and perfecting the fibre gradually throughout. The last number of fibre produced by a monocotyledonous plant, the Moriche, has already been mentioned. Taking a general survey of the fibre substances furnished by this great class, it is found that its produce is coarse, and adapted rather for cords and ropes than for the finer tissues. It is true, that superior tissues have been produced, but it was done at an unremunerative outlay for labour. The rank and rapid vegetation of a tropical zone alone can produce these enormous quantities of fibre, which the monocotyledons give in a short space of time, but a certain coarseness appears to be inseparable from this luxuriant vegetation. Fortunately, the demand for coarser tissues, ropes, &c., is very considerable, and these coarse substances may, moreover, be manufactured into paper.

We turn to *Dicotyledons*, the second great class of flowering plants, and these also we group into families. While the fibres of the class just now discussed, are found in bundles, more or less defined in the stem or the leaf-stalk, the fibres of the Dicotyledons are always in the bark and in layers round the stem ; the consequence is, that these fibres are always separable with greater or lesser ease, in at least one direction, often in two, and that they may be subdivided into fibres of nearly any degree of fineness. The fibres of flax and of the nettle tribe are the extremes in one direction, whereas common bass for matting constitutes the other extreme.

The flaxy fibres, as we shall call the former, are always found in the state of bars. The fibres in each layer are of contemporaneous, while those of different layers are of successive, growth; the latter are more easily separated into bundles than the former. These are kept apart from each other by an intermediate tissue, which must be eliminated either by mechanical means, or by fermentation. Though this is not the place for a detailed discussion of the subject, it may be as well to record a few axiomata :—

1. The preparation of fibres consists in the separation of bundles of elongated cells from common cellular tissue.
2. The substance which causes vegetable cells to cohere, must either be eliminated, or the cells must be torn.
3. The latter process entails a loss of useful substance.
4. The same substance which connects the cells together, connects also the particles of each cell or fibre.
5. The process of retting, whether by chemical means or simple fermentation, must, therefore, be interrupted before the cells themselves, and, if possible, before the aggregations of analogous cells, are attacked.
6. Analogous cells are more strongly connected than different ones, and the particles of cells more strongly than whole cells.

Little is known of the nature of the substance which connects the cells, because it decomposes or is otherwise destroyed in the process of extraction from the tissues. But for practical purposes we handle it, and remove or retain as if it were a tangible body; we content ourselves with an acquaintance with some of its qualities. There can be no doubt that if we could isolate this substance, various applications might be found for it.

After the fibre-cell is separated from the surrounding tissue, the removal and destruction of the substance in question goes on, and the fibre gets con-consequently worn and loses its strength. The substance is more or less powerfully acted upon, dissolved, or destroyed, by moist air and heat, or by alkalies and acids. Hence, bleaching by chemical process, unless very carefully conducted, impairs the strength of the fibres.

In proportion to the inequality and paucity of the spaces between the layers of fibre is their lateral cohesion, and consequently their affinity to the Bass nature, and adaptability to textile fabrics. This ought to be borne in mind in the following enumeration; but it should also be remembered that this cohesion does not prevent, but rather promotes, their being manufactured into ropes and cords. Separately, the cells are short, hence we take them in the aggregate. The cell is rarely beyond an inch long, generally much less; that of Flax, for instance, one inch. I have met with a fibrous cell, *Urtica latifolia* (Biot.), which had a length of seven inches.

The following general remarks may possibly have their special interest:

1. Herbaceous plants generally give a small flexible fibre.
2. Thick-walled fibre-cells will, ceteris paribus, resist decomposition and violence longer and better than thin-walled fibre.
3. Pitted and slit fibre-cells offer less resistance than cells without slits and pits.

4. Thick-walled cells require less tar or oil for their protection against wet, &c.
5. The proportion of oil or tar thus being greater in the thin-walled fibres, for a given weight, the rope must be weaker, and the drying oil or tar will cause the rope to break or wear sooner. This is, probably, at least part of the phenomenon, when it is asserted that tar cuts the Manila rope quicker than hemp.

Of the family of *Anonaceæ*, but one requires notice—viz.:

118. *Anona Mahœ.* Cachiman, Cachiman grand bois. Bass, tissue dense, cells 9 to 10; porous, thick-walled, tolerably long. *The measures are means, and signify* 10,000*th of an inch, always in diameter.* Abundant in woods all over the island.

Of the family of *Tiliaceæ*, we quote:—

119. *Apeiba Tibourba,* Aubl. Bass. Cells short, porous, thick walls, 7. Common in dry soils.

120. *Apeiba ulmifolia,* H.B. Bass. Cells 5. Short, not porous, or indistinctly common; same localities as the last.

121. *Apeiba aspera,* Aubl. Cells. Bass, short, thick-walled, porous, hard, 10. Common dry soils.

122. *Triumfetta semitriloba,* L. Flax, very fine, silky, cells thick. Abundant.

The family of *Byttneriaceæ* furnishes the following:—

123. *Guazuma ulmifolia,* L. Bastard Cedar. Bois de l'Orme. Guacimo. Bass, dense tissue. Cells not porous, thin-walled, 8. Thick, abundant.

124. *Theobroma Cacao,* L. From the young shoots (choupons), which annually spring from the lower part of the stem. Bass, dense tissue, porous, thick-walled, cells 9.

Next come the *Sterculiaceæ*:—

125. *Ochroma Lagopus,* Sw. Bass, dense tissue, coarse fibre, bundles, cells 9 to 10; porous, thick-walled. Abundant.

126. *Sterculia Caribbea.* Bass, coarse, not very dense tissue, strongly cohering bundles, fibres stiff and cells not very thick-walled, 7 to 10. Abundant.

The family which furnishes most, and the best fibre, is that of *Malvaceæ*:—

127. *Hibiscus rosa sinensis.* Beautiful Bass, strong, white, flexible, not thick-walled cells, and 4 to 6; not porous, but slightly spirally striped. Cultivated everywhere, and may be said to grow wild.

129. *Hibiscus trilobus,* Sw. Abundant. Flax, brownish, fibre-cells thick-walled, porous, 4 to 5½.

130. *Hibiscus esculentus,* Med. The common Ochro, Gombo, Chimbombo. Flaxy, fine white, fibre-cells 8½ to 12, long and not very thick-walled. Common vegetable.

131. *Paritium Tiliaceum,* A. Juss. Coarse Bass, dense tissue, cells thick-walled, porous, 7. Abundant at the sea-side, particularly in sandy soils.

132. *Malachra capitata.* Flaxy, white, flexible, silky, cells long, thick-walled, not porous, 9½ to 12. Common, but not so much so as—

133. *Malachra radiata*, which covers hundreds of acres. The fibre is rather coarser than the preceding ; flaxy, silky, white, cells thick-walled, not porous, 6½ to 8.

134. *Pavonia racemosa.* Lowlands, near rivers ; extremely abundant ; half flaxy, strong, whitish, cells porous, thick-walled, 7.

135. *Pavonia bracteata.* Pretty shrub ; common in waste dry grounds, half flaxy, brilliant white, fibre long and strong, rather stiff, cells thick-walled, porous, 6 to 6½.

136. *Urena sinuata.* Flaxy, silky fibre ; flexible, strong, and long bundles, cells thick-walled, porous, 7. Abundant in poor soils.

137. *Abutilon Indicum*, G. Don. Bass, light tissue, fibre stiff, cells thick-walled, porous, 6 to 7. Hilly land.

138. *Sida cordifolia*, L. Flaxy fibre, cells rather stiff, thick-walled, porous, 5½ to 6. Very common on waste grounds.

139. *Sida rhombifolia.* Beautiful, half flaxy, lustrous fibre, white, fibre-cell thick-walled, not porous, 5. Very common on waste grounds.

From the family of *Lecythidaceæ*, we have :—

140. *Couroupita guianensis*, Aubl. Bass, tight, cells long, thick-walled, not porous, 5 to 6.

141. *Lecythis adatiman*, Aubl. Very dense tissue, Bass, resisting the comb, difficult to macerate, produces a sort of vegetable leather ; cells flexible, thick-walled, 8 to 10.

And, lastly, of the *Leguminosæ* :—

142. *Bauhinia megalandria*, Gris. Bass, fine light tissue, fibre-cells thick-walled, not porous, 4½.

143 is the fruit of the Torchon Gourd (*Luffa apercolata*). The fibrous part is worked into small baskets, &c. Samples are shown under 302.

The finer fibres, such as the *Rhea* (*Bœhmeria nivea*, and *utilis*), grow most luxuriantly in the Botanic Gardens, in indifferent soil. No samples are sent, because no one in the colony understands the preparation of the fibre.

In viewing such a collection as that shown in the Exhibition, intended to display the resources of our island, the question why those resources are neglected must occur to every inquirer. The answer will and must invariably be, that the scarcity of labour prevents our progress. This question has been so thoroughly misunderstood by a large portion of the British public, that a few remarks may not, perhaps, be considered superogatory.

If the productiveness of our island be compared with a similar area and population situated in a higher latitude, our powers of production must appear small and almost contemptible. This defect cannot be explained by want of enterprise or capital, for both enterprise and capital pour in wherever there is an opening for their advantageous employment. The real cause of our backwardness is want of labour, which may be traced to two chief causes.

Proceeding from higher latitudes towards the equator, it will be found that, *cetaris paribus*, the natural wants of man diminish with the latitude.

The fewer wants a man has, the less exertion will he require to satisfy them ; in other words, the less will he work. This is a natural law, always the most powerful, but its action may be disturbed or modified by a variety of circumstances.

Besides our natural wants, civilisation produces a variety of artificial wants. In a country where food and shelter are obtainable with the greatest ease, the work, what work there is, is done to obtain the wherewithal to satisfy artificial wants.

It may be an exaggeration to say that in Trinidad a given area of land would feed twenty-five to thirty times as many persons as in England. Yet the real amount approaches these figures, and if we consider that food is about the only positive want of man in these parts, the amount of work to be expected decreases not in an arithmetical, but in a geometrical ratio.

From this it will appear, that for a given amount of industrial power, a much denser population is required here than at home. Unfortunately, Trinidad has but a scanty population, amounting only to 47·78 per square mile. Land is abundant and cheap, and from various self-evident causes, people will rather work on their own account than on that of others, even though such dependent labour were more profitable. Trinidad is essentially different from Barbados, where a large population crowds a very limited area.

A combination of causes lessens in Trinidad, and most of the other West Indies, the available amount of labour. As for the assertions, that some races of men will not, or cannot, work, it is mere idle talk. No race of men will work if they can live comfortably without work ; and with the exception of the lymphatic branch of the Caucasian, the "white man," who is, perhaps, not fitted for field work under a vertical sun, all races work here as anywhere else, whenever necessity compels them.

As far as new branches of agriculture are concerned, a difficulty exists, which is, however, not local nor serious. It will be at first not very easy to withdraw the independent labourer and foreman from the routine of his accustomed work, particularly as he has a decided predilection for sugar, our chief product. Immigration under contract, which, as is well known, works in other respects to universal satisfaction, will remove this difficulty effectually. With regard to the assertion, that sugar, "after all, pays best," even in an average of years, I fear that no positive figures can be given in support of the statement. One circumstance unfavourable to sugar is, that short crops are not unfrequent, and large ones have sometimes not been brought in on account of the rains setting in too early. Many other cultivations would not be subject to these chances, and a greater variety of crops would establish our agricultural interest on a broader and firmer basis.

OUR COAL-TAR DYES.

BY WM. PROCTER, M.D., F.C.S.

It would be an extremely difficult matter to over-estimate the value of chemistry to the various arts and manufactures, neither can the important benefits which it has conferred on society through them be ranked too highly, although the results of such applications may be deficient in the grandeur and sublimity displayed by some others, yet in their usefulness in both great and small matters, in adding to the social comforts or even the luxuries of life, it holds a foremost position, and yields in these respects to no other. This is not the place to consider these advantages in detail, but none are more interesting than the utilization of waste products. A large number of substances, often vast in quantity, are the secondary results of many manufactures, which were formerly rejected as perfectly useless, or were even destructive to the neighbourhood in which they were generated. A large amount of these residues are at the present time, by improved processes, no longer wasted or injurious, but are made available for useful purposes, being often as valuable as the primary object of the manufacture. Numerous illustrations in support of this statement might readily be adduced. One example is sufficient, and is more remarkably exemplified in none than in the manufacture of coal gas ; at one time gas alone was obtained, and the gas liquor and tar were rejected as useless, but now the illuminating fluid is obtained free of cost, the secondary products, formerly wasted, yielding a profit sufficient to defray the expenses of the works—What are they ? Ammonia, Naphtha, Benzole, and Paraffin have numerous uses. Tar, which, in addition to other applications, furnishes by the magic of Chemistry, colours which rival the most brilliant of our dyes, and even the Lime used for purification forms a useful agricultural manure, and leaving finally the valuable fuel coke as a residue.

Our illuminating gas, it is well known, is attained by submitting coal to heat in closed iron vessels. This is what Chemists call destructive distillation, and under these circumstances the elements of the coal rearrange themselves to form a series of new and complete compounds whose name is legion. Dr. Hofmann enumerates no less than forty-five different substances as the result of the process.

Leaving out of consideration for the present these products, it may be stated, generally, that besides the residue, coke, first, volatile gases, and secondly, a liquid tar are the results of the distillation of coal, and it is to the latter, which is collected in proper cisterns, that attention is now to be drawn ; the material from which colours vieing in beauty with our finest crimson, purple, and blue are produced. To the consideration of their preparation this paper is to be directed. After the tar is separated from the water which exists with it in the gas works, it is submitted to distillation, the result is that a light (Sp. gr. 0.830) and heavy (Sp. gr. 0.885) oil passes over into the receiver, and a black substance known as pitch is left in the retort. Some more detailed knowledge of the constitution of tar is necessary for the elucidation of our subject, and subjoined is a table giving a general but by no means detailed constitution of these light and heavy oils.

1. LIQUID.—(a) *Constituents of Naphtha or light oil.*—Benzol, Toluol, Camol.

(b) *Constituents of the heavy oil.*—Aniline, Picoline, Leucoline, Carbolic acid.

2. SOLID.—Naphthaline, Paranaphthaline, Pyren, Chrysen.

Of the substances composing this list, Aniline is the one which it is the object of the manufacturer of tar dyes to obtain, this being the basis of one large class of colouring matters. Aniline was discovered in 1826 by Undervorben by the distillation of indigo, and from which the name is derived, *anil* being the Hindoostanee for indigo. It is also a product of the distillation of coal, but requiring a tedious and difficult process to be followed out for its separation, an indirect method from Benzole is found to be a more economical source of production. Benzole is the principal constituent of Naphtha, which affords it by purification, and it is, then, a thin, limpid, colourless liquid, used for many purposes in the arts.

The action of nitric acid is peculiar on this substance ; if a stream of benzole mixed with the acid is made to trickle through a worm kept cool, the two liquids react on each other, and a yellowish liquid, nitro-benzole, appears at the end of the worm, having the odour of the essential oil of bitter almonds, which renders it useful in perfumery, especially for scenting fancy soaps. The nitro-benzole procured in this manner is now put into a retort with iron filings and acetic acid. Without the application of external heat, the mixture from the chemical action which ensues becomes hot, and gives off a vapour which is condensed in a receiver kept well cool. This distillate being treated with potash, the aniline separates as an oily layer. Aniline is especially characterised by the various colours it displays under the action of different reagents ; in this respect none are more marked than the hypochlorites ; they, it has long been known, produce, with aniline, a purple solution of which little was known except that it was very fugitive. Mr. Perkins, in some experiments on the formation of quinine artificially, was led to use this substance, and attained an unpromising black precipitate, which he subsequently found to contain aniline, purple or mauve. With great industry and perseverance, he followed up the subject, and, finally, perfected the process now employed for the preparation of this dye ; which consists in mixing a cold solution of aniline in sulphuric acid with bichlorate of potass, and the result is a black precipitate. This is purified by solution in alcohol, and on evaporation the colouring matter is left in the form of a beautiful bronze-coloured substance, which is soluble with difficulty in water, but readily in alcohol, giving a solution having the well known purple tint. Two other colouring matters, named from the character of their tints, Violine and Roseine, are prepared from Aniline by the action of peroxide of lead, by processes similar in character to the preceding, and giving use to a similar compound.

The three substances enumerated seem to be closely allied, and are found, under like circumstances, by the action of oxidising agents with the presence of water, and are likewise similarly acted upon by most re-agents. Deoxidising substances deprive them of colour, but this is again restored by exposure to oxygen. Sulphuric acid forms with them green solutions, whilst their original colour is restored by dilution ; tannin forms insoluble compounds with them. They are soluble in alcohol, and but slightly soluble in water, from which they are thrown down by alkalies.

Another well-known dye, Magenta, is also prepared from aniline, but possesses different properties, and belongs to a different series of compounds. It was practically introduced into the arts by Dr. Hofmann. On a large scale, it is prepared by the action of perchlorides of tin, or mercury, or the nitrates of mercury, on aniline. Chemically, Magenta is basic, so that by the former process, a hydrochlorate, by the latter, a nitrate, of Magenta is obtained. It is precipitated by ammonia as a red paste, which, on drying, becomes a red powder, soluble with difficulty in water, but tolerably soluble in alcohol, which, on evaporation, leaves the colouring matter as a brittle mass with a golden grain metallic reflection, appearing red by transmitted light. Allied to Magenta are two other products of aniline, namely, bleu de Paris and emer aldine. The former is a beautiful blue dye, preserving its colour by artificial light, resisting the action of acids, and being darkened by alkalies. The latter, called also aniline green, is formed by oxidising a hydrochloric acid solution of aniline with chlorate of potash, or perchloride of iron. This colour may readily be impressed on a fabric by printing the design with a thickened solution of chlorate of potash and then passing it through a solution of an aniline salt. Under the action of an alkali, the colour becomes dark blue.

It is a curious and interesting fact that the production of these beautiful pigments is not confined to aniline. The bases Toluol and Camol yield similar colouring matters ; but, for practical purposes, neither the colour nor general results are so good as those obtained from the aniline products. But amongst the constituents of coal tar there is one substance—carbolic acid—which is eminently useful to the dyer, on account of several colours which the chemist extracts from it. Picric acid has been known since the latter part of the last century, as a product of the action of nitric acid on indigo and other substances, and was introduced for dying purposes five or six years since, but is now more economically prepared by treating carbolic acid with nitric acid. It occurs in shining lamina, having a light crimson colour, and forming with water a beautiful yellow solution. The fashionable orange colour, capucine (the French name for the Nasturtium), which before the late mourning rivalled mauve in popularity, is this substance. By combination it affords a goodly list of other tints ; with oxide of iron it yields a red ; and with oxide of copper a yellow green, long known to the dyer.

Rosolic acid, obtained likewise from carbolic acid, has been used as a red dye, especially for printing muslins, but is now, in a great measure, superseded by other tar colours.

These colouring matters, it will be admitted, are a fruitful result of chemistry on refuse matter, so disagreeable, so uninviting, and apparently so little adapted for decoration as coal tar ; but the list by no means ends here, matters possessing innumerable variety of colour are attained from Naphthaline and the other constituents of coal tar, some of which admit of useful application, whilst others are capable of no practical use, either from inferiority of tint or deficiency in permanence, but as this branch of chemical science advances, useless as they now seem, they may rival mauve and magenta. In the hands of the dyer, these colouring matters require no complex processes to effect their transfer to silk or wool, in fact, it would seem that the fibres of these fabrics possess a most powerful affinity for the colouring matter, and take it up so perfectly that the liquid in which they have been dyed is left colourless.

The process is thus :—A solution of the mauve, roseine, &c., in spirits of wine is mixed with hot water, previously acidulated with tartaric or oxalic acid, and then diluted with cold water ; in this mixture the fabric is worked until it acquires the required shade. With some other of these colouring matters the proceeding is still more simple, a cold watery solution of the material being alone necessary to form the bath. Small bottles of these dyes are now sold by druggists, and by dilution with water, form a solution, so that ladies (if they are regardless of staining their figures) may become their own dyers. Thus, then, with regard to silk and wool, these colours are *substantive*, that is, white with the fibre without the aid of any second substance or *mordaunt*, as they are called. But this is not the case with cotton ; with this material the colours are not " fast " without a mordaunt. The process which is adopted to fulfil this object is interesting from displaying the application of a property possessed by these dyes which might at first seem to be of minor importance. Mr. Perkins discovered that the colouring matters of tar formed insoluble compounds with tannic acid, which exists largely in gall nuts ; this property, coupled with a metallic base in the fibre, he made the basis of his mordaunt. Practically it is effected by soaking the cotton in a decoction of galls, and then in a solution of tin salt (stannate of soda), after wringing out in an acid liquor and washing, it is immersed in a bath of the colouring matter. A similar plan is adopted in printing, the pattern is impressed on the cloth with tannic acid, on a surface prepared with the tin, and on being immersed in the dye, that portion retains the colour.

Of the numerous pigments yielded by the refuse matter of gas-water, Mr. Perkins says that there are only four which are used extensively by the dyer—namely, mauve, magenta, picric acid, and azaline, a beautiful blue prepared recently by a Parisian chemist, who has not made his method known. Of these, the first resists the action of light best, and patents are being taken out almost daily for the purpose of giving greater permanency to these colours.

Such are a few of the wonderful results of the magic of chemistry on the refuse matter of gas works, serving to show that that which is apparently worthless may, by the application of science, be made most valuable in truly practical alchemy. The perseverance and industry of experimentalists are well illustrated in productions like these, which seem to show us the wonderful machinery which is ever at work around us, giving different forms, unlimited in number, to a few elements entering into combination with each other, in obedience to fixed natural laws which science has made known to us, and serving to show how vast are the treasures still open to discovery, by the careful and patient investigator. Besides their scientific interest, the commercial results which will probably follow these discoveries,—due in a great measure to the untiring industry of Mr. Perkins,—are most important; for, as it has lately been said, if the progress in the manufacture, and simplicity in the application of them, proceeds with the same rapidity which it has done since the introduction of this class of dyes, we shall produce staple colours of our own, be independent of foreign countries for our supply, and may even become a colour-exporting nation.

York.

ON THE CULTIVATION OF COTTON IN ITALY.

Cotton has been cultivated in Southern Italy from time immemorial, and was probably introduced by the Saracens, in the ninth century. We have historical evidence that as early as the eleventh century it formed one of the principal agricultural products of Sicily and of the provinces on the shores of the Adriatic and Ionian seas. G. B. della Porta, a writer of the sixteenth century, states that in his time it was extensively cultivated in the Puglie, "*apud Appulos . . . . ubi copiosissime seritur.*" Documents of the year 1050 exist at Bisceglia, *Terra di Bari*, by which some priests of Adueno let their church tenures for the cultivation of cotton, "*ad colendum gossypium.*" In the last century the cultivation extended as far north as the provinces of Sienno and Grosseto, in Tuscany. During the wars of Napoleon I. and the Continental blockade, the Italian mainland supplied almost the whole of Europe with cotton; it was especially grown around Naples, being generally known in commerce under the name of *Castellamare cotton.*

Subsequently, the sad economical condition of the Southern provinces, due to the entire absence of drainage, irrigation and road communication over large tracts of country, was sufficient to cause the almost entire cessation of cotton cultivation in Italy, it being impossible, under such disadvantages, and with the depressed prices, to compete with America and India. Henceforth it was restricted to certain localities, where the peasants were accustomed to spin cotton yarn by hand for making counterpanes, stockings, and common stuffs. The cultivation of cotton in these provinces has since slightly extended by the introduction of spinning machinery. Considering the immense national importance which it might acquire, the

Royal Italian Commission has made the utmost exertions to procure the largest possible collection of Italian-grown cotton, which they have exhibited in the International Exhibition.

Two species of cotton are grown in Italy, the *Gossypium herbaceum*, Lin., and the *G. Siamense*, Ten., or Siamese cotton.

The *Gossypium herbaceum* generally grows to the height of a foot or two; its roots are fusiform, and about six inches long. Stem erect, round and woody, reddish, and sometimes marked with black dots; it ramifies alternately into spreading branches, forming a pyramid. Leaves composed of five short oval lobes, indented at the base and pointed at the extremity with a small gland on the median nerve. Leaf stalks two or three inches long, with black dots—each has two lanceolate and somewhat curved stipules. Flowers arising from the axillæ of the leaves, and supported on peduncles shorter than the leaf stalks. Calyx double, the external calyx being the larger, and composed of three smooth sub-cordiform leaflets, deeply indented, or even fringed. Internal calyx entire, deep, with five marginal indentations. Corolla bell-shaped, consisting of five yellow petals with purple spots at the base; when dried the petals become uniformly red. Stamina numerous and grouped, the pistil rising from their midst. Stigma divided into three or four portions. Capsule oval, the size of a small walnut, three or five-celled, opening into four valves. Seeds roundish, about the size of a pea, and enveloped in dull greyish-white wool.

The *Gossypium herbaceum* is cultivated in many localities on the shores of the Mediterranean; the wool is of ordinary quality, rather grey than white; its use is only local, especially for common manufactures.

The *Gossypium Siamense* has a brownish fusiform root, about a foot long. Stem reddish-brown, dotted all over; rather taller than the *G. herbaceum*, rising to the height of two or three feet; erect and cylindrical, covered with hairs, some of which are in stellate tufts, and often pungent. Branches alternate and spreading, forming a pyramid. Leaves brownish-green, with three or five deep lobes, terminating in a point; the two external lobes cordiform, and cleft nearly to the base of the leaves. Leaves always indented, rough above, hairy underneath, with black dots, especially on the nerves, of which the median one is provided with a gland at a third of its length. Leaf stalks reddish and hairy. Flowers arising from the axillæ of the leaves, either singly or in pairs. Peduncles, like the stalk, hairy and reddish-brown, at first shorter, but eventually longer than the leaf stalks. Corolla two or three times as large as the internal calyx, the latter five-lobed, cordiform, and fringed. Petals somewhat folded, yellow at first, and turning red before fading. Stamina grouped, varying in length from a few lines to an inch. Capsules oval, attaining two inches in length by one in width, with projecting lips. When ripe they divide into four valves, composed of as many cells, closely packed with glossy snowy-white wool. Seeds invested with greenish cotton, which adheres firmly to them. Six or eight in each cell, disposed in double row along the axis of the capsule.

Two varieties are cultivated ; one, yielding a very fine, glossy, white wool (*lana albo-nivea*, Ten.), is that known as Castellamare cotton. The other produces tawny-coloured wool (*lana rufa*, Ten.) This species, as far as regards Italy, is an annual, although some have asserted that they have seen it sub-arboreous in Calabria.*

It is not easy to say which of these species of cotton was first cultivated in Italy, but we know that the white Siamese, the most valuable, has been known there from very ancient times, and is evidently that referred to by the writer whom we have already quoted ; *Nullum lini genus huic candore et mollitiæ præfertur*" (G. B. Portæ, Vil. lxi., c. 54).

Repeated experiments have been tried to introduce Pernambuco cotton (*G. Vitifolium*, Wild.) at Naples, but the winters are too severe. Another attempt has been made at Lecce to introduce the *G. arboreum*, Lin., cultivated in Spain, but although it has produced every year it suffers in the winter.

The cotton region embraces a great extent of country, that is to say, from the extreme south to the neighbourhood of the Valley of the Tronto, lat. 43° N., on the Adriatic side ; on the western shore it extends rather further north. The slopes facing the south and east, and not more than 500 feet above the level of the sea, are those best suited for its cultivation in Italy.

Cotton is grown with or without irrigation, and has been cultivated with advantage, whenever the price was very high, even on the arid flanks of Vesuvius. It is quite necessary, however, before thinking of an extensive cultivation in Italy, to introduce an efficient system of drainage and irrigation in those provinces. By the former a large extent of country, now the seat of malaria and malignant fevers, would be recovered, while irrigation would render cotton one of the most valuable crops to be grown in the country.

In general it may be assumed that a hectare of land in Italy yields from 250 to 600 kilogrammes of cotton, or from 2 to 4¾ cwt. per acre, although progress in agriculture would considerably increase that quantity. The net profit depends on the relative value of land and the price of labour.

The quantity of cotton now grown in Italy is quite insignificant, even where most cultivated. In the province of Terra di Otranto only 700 to 800 tons are produced annually, and 140 in that of Terra di Bari. Both in Southern and Central Italy, as before mentioned, large tracts of country would be suited to the growth of cotton, were they only drained ; indeed, it might easily be made one of the staple products of Italy, without in the least degree interfering with the present agriculture. All that district along the Ionian Sea, once Magna Grecia, is now depopulated, and the neighbouring inhabitants cannot settle there from want of drainage, which has never been attended to from that very ancient period of Italian civilization. To

* Giorn. Encicl. An. 4, Vol. 4, p. 194.

give an idea of the extent of land that might be thus turned to account, it may be stated that upwards of 8,000 square kilometres, now lying waste, might be cultivated with cotton in the southern continental provinces alone. Of these 8,000 square kilometres, or 800,000 hectares, if only one-third were cultivated annually with cotton there would be a produce of 100,000 tons, or about 550,000 bales.

South Carolina produces 500,000 bales of cotton, with a population of 715,000 inhabitants. In Italy there is no want either of inhabitants or land to commence at once an extensive cultivation of cotton, which might, perhaps, prevent the recurrence of one of the most fearful commercial crises which could take place, and possibly not a little contribute to the solution of that vital problem of modern civilization—the abolition of slavery in the United States.

THE FOREST-TREES OF NEW BRUNSWICK.

BY D. R. MUNRO.

TAMARAC (*Larix Americana*).—Among the many trees found in the forest of New Brunswick, there are none more valuable to the ship-builder than the tamarac, otherwise known as larch, hacmatac, or juniper.

Trees of this description are very numerous in all parts of the province, and attain to an altitude of, and in many cases exceed, eighty feet, while it is from eight to eleven feet in circumference at the base.

At the present time there can be seen an immense number of very fine tamarac trees stored by Messrs. Gass, Stewart, and Co., in their extensive ship-building yard at the port of St. John, which square upwards of two feet five inches, with sap-wood hewed off; many of them exceed fifty-six feet in length, and square two feet at the extreme end.

The wood of the tamarac is of a dark cast, and is generally considerd to be durable, easy to work, and soon seasoned. It is used in the foundations of wharves, buildings, and other structures; it is also very valuable for railway sleepers, water pipes, or drains, planking for ships, treenail fastening, keelsons, beams, knees, hooks, bitts, stem and stern posts, aprons, knight heads, hawse timbers, foothooks, top timbers, also for rising floors in the fore and after ends of ships, for which purpose the root of this tree is highly prized, it being easily obtained of an acute or obtuse angle. It may be well to remark that these roots meet with a ready sale in the United States and other markets, and they should not fail to attract the attention of the naval authorities in England, as they form, when properly converted, any desired curve, for ships' bodies or bilges.

Tamarac trees of the largest size are not now so plentiful as in former years, except inland, where the forests are most dense; thus the labour and expense in their transit to market are very great, and largely enhance their value. It may be well to remark here, that many of our best ships have been constructed of tamarac timber—among the number may be mentioned, with no small degree of pride, the fast sailing ship "Marco Polo," and others of later date and nearly equal renown. Indeed, ships built of this material, and noted for their beauty, buoyancy, and fast sailing qualities, are to be found in all the principal lines of Australian and other oceanic clippers. Many, if not all, of these ships have been built according to the established rules laid down by the Committee of Lloyd's Register of British and Foreign Shipping, and have deservedly attained a high character.

Tamarac, when devoid of sap and seasoned, has been said to last in ships for a longer period than the seven years at present assigned to it by Lloyd's.

It is extremely strong and elastic, and being devoid of acid, tends to preserve the iron or metal fastening from oxidation, which is more than can be said of even English, African, or other oaks.

The tamarac tree grows on a variety of soils, but more particularly in low swamps, as well as on the most rocky and sterile ground, and as luxuriantly as other trees of the forest in more favoured localities.

BIRCH (*Betula*).—The next descriptions of wood in general use, especially for ship-building purposes, are the birches, which embrace four kinds, the black, yellow, grey, and white.

BLACK BIRCH.—This tree is produced in unlimited numbers, and grows to a height of fifty and sixty feet, and upwards of four feet in diameter. The wood is prepared in large baulks, and shipped to the markets of Great Britain and elsewhere. In ships of the seven years and lower classes, it is very generally used for planking, midship floors, and foot-hooks. When confined under water, it is considered to be unsurpassed by any other material of a like nature, for ship-building purposes. In planking ships of the seven years' class, its height is properly restricted to the light line; in vessels of the six years' class, it is allowed for first foot-hooks amidships, not exceeding one half the length of the keel; and in vessels of the four years' class its use is unrestricted, except for the main pieces of rudder and windlass; when used for these purposes, it is confined to vessels under 300 tons register. This wood is likewise generally used by boat-builders, cabinet-makers, carriage-builders, and for other mechanical purposes; and it is very extensively used for fuel. The land whereon the black birch is found is generally of a good description, and much esteemed for agricultural purposes.

YELLOW BIRCH is very plentiful in various parts of the province; indeed, as much so as the black birch. It grows to a height of sixty and sometimes seventy feet, and about four feet in diameter. This wood is close in grain, and as much used by ship-builders, carriage-makers, and others, as the black birch; and like it, too, is prepared and shipped in baulks, for sale in the various European timber markets, and extensively used by the people in the province for fuel.

WHITE BIRCH.—This tree is to be found in abundance in every section of the province. It usually attains an altitude of sixty feet, and two feet in diameter. The wood is generally used for fuel. The Indians, or aborigines of the province, use it for making baskets, tubs, and pails, while they make use of the bark for sheathing the shells of their canoes, and, in many instances, for covering their camps, or the rude tenements in which they live. From the white and grey birch the best charcoal is principally made.

Grey Birch.—The grey birch, a wood generally used for the planking of coasting and inland vessels, and for fuel, is to be found in large quantities in various sections of the province, but more particularly in the vicinity of the St. John, the largest river in the province, navigable for vessels of light draught a distance of 140 miles from its mouth, and for beauty of scenery allowed to be unsurpassed by any other on the Continent of America. Its growth, as regards both height and diameter, in many cases exceeds that of the white birch. The bark of the grey birch, like that of the white, is much used in the manufacture of canoes. It may be well to observe here, that these canoes are used by the Indians in navigating the rivers and shallow streams ; they are long, narrow, light, and fragile in appearance, extremely buoyant, and, when guided by a skilful hand, capable of being propelled with great rapidity.

Spruce (*Abies*).—There are two kinds of spruce trees, differing materially in their properties—the black and the white.

Black Spruce.—Throughout every section of the province black spruce abounds in great profusion—in many places to such an extent as to form immense forests. It attains to a height of ninety, and very often of one hundred feet, and eleven and twelve feet in circumference at the base. The wood has been pronounced, by many who have tried it, to be of a tough nature, and, when seasoned, very lasting. It is considered by shipbuilders to be deserving of a higher classification than Lloyds' at present assign it. Ships built of the black spruce, *twenty-five* and even *thirty* years ago, are known to be now running, have had but little repairs, carry heavy cargoes, and do their work well. That species of the black spruce termed, from its extraordinary density, bull spruce, which grows in the portion of the province laved by the Bay of Fundy, is held in higher esteem than that which grows inland. This extreme density and toughness is supposed to be produced by the saturation which the fibre receives from the thick vapours or fogs which at times envelope the bay shore in a hazy gloom.

It is singular that the spruce tree, although of a softer nature than the birches, should retain its beautiful dark green foliage throughout the whole season, while the foliage of the birches and maples, and others termed hard woods, fade and decay as the autumnal season advances, and maintain a bleak appearance until the return of spring, when the leaves again bud forth in all their beauty.

The black spruce may, in not a few instances, be found growing in all its splendour upon the most rocky and towering heights, the roots twining and twisting over rock and into crevice, without a particle of earth for a covering. The wood of this tree, like the white spruce, which shall be noticed in order, is used for masts and spars, and manufactured into deals, boards, scantling, battens, shingles, and laths. The transportation of these manufactured articles to Great Britain and elsewhere, gives employment to a vast amount of tonnage, foreign vessels having received, for some years past, nearly 40 per cent. of the carrying trade.

WHITE SPRUCE.—The production of this tree is unlimited, and grows principally in soft soil, which permits the roots to expand to a prodigious extent; and, owing to the elasticity and toughness of the wood, it is highly esteemed. The trees attain a height of eighty feet and upwards, and from nine to eleven feet in circumference at the base. This species of spruce, like that just noticed, bears a cone about two inches long, and three-fourths of an inch in diameter, and retains its green foliage throughout the whole year.

The white spruce is very useful to the Indian on account of the tar or resin which it contains. This substance exudes from the knots and "blazes" made in the tree, and is used for more effectually securing the seams of canoes and various utensils. Fangs, with which the canoes are secured, are also procured from the roots of the white spruce.

Spars, piles, deals, boards, battens, laths, shingles, &c., are made from this tree; and, in conjunction with similar articles manufactured from the black spruce, form a very large item in the annual exports of the province.

FIR (*Abies*).—The fir tree abounds in all parts of the province, attains a height of forty-five and fifty feet, and from eighteen inches to two feet in diameter at the base. The foliage is heavier than that of the spruce tree, while the cone it bears is somewhat larger, and affords food for the squirrel, &c., in the winter season. The grain of the wood is neither so close nor so hard in its nature as that of the spruce, is more resinous, but, when free from sap, is considered to be durable. This wood, like the spruce, is cut up into deals, boards, battens, &c., for exportation. It is much used in wharf building. When manufactured into tubs, pails, butter firkins, and churns, it is greatly esteemed by farmers' wives, from the fact that the more frequently these utensils are used, the whiter the wood becomes.

It is from the fir tree, sometimes designated "Silver Fir," that the "Canada Balsam," so highly esteemed throughout the province and elsewhere, for its great healing properties, is procured.

ROCK MAPLE (*Acer Saccharinum*).—There are four kinds of maple. The soil in which they grow is of a rich loamy nature, and very justly is more highly valued on account of its agricultural capabilities, than land covered with wood of an inferior description. The species now more particularly under notice is known as the "Rock Maple." It grows to a height of seventy and eighty feet, and the trunk is generally from three to four feet in diameter. The maple sugar which this tree produces is a great source of profit to the farmer; indeed, many make the procuring of the sap and the preparation of the sugar a branch of business. It has been estimated that the quantity of maple sugar annually made in New Brunswick amounts to about 400,000 lbs. weight. The average value of the sugar may be set down at nine cents per pound. The sap is procured by "tapping" the trees in the month of March. After the sap is procured, it is made to undergo a process of boiling, and by this means the sugar is prepared. Wherever sugar is made in any considerable quantity, the trees are preserved for this purpose.

Rock maple is much used by cabinet-makers, coach-builders, &c., for various purposes, and, in many instances, by millwrights for cogs of wheels and other articles, in which the material is exposed to friction. It is, in some instances, used by shipbuilders inland for bottom planking, being, when confined under water, considered equally as lasting as birch.* This wood likewise furnishes the best fuel, when prepared for this purpose, and of course commands a higher price than any other wood.

Bird's-Eye, Curly, and White Maple (*Acer Saccharinum*).—Bird's-eye, curly, and white maples, like rock maple, grow in unlimited numbers. The species called "Bird's-eye" is much esteemed by cabinet-makers as a superior wood for various articles of furniture; it presents, when made up, a very handsome appearance.

The "Curly Maple" is likewise much sought after, for articles of furniture. The wood is susceptible of a very fine polish, and when made up, the grain is mnch admired.

"White Maple" is much used for the planking of vessels, agricultural implements, and many other purposes. The wood is strong and dense, and is much esteemed for fuel.

Oak (*Quercus*).—There are three species of oak—the white, red, and grey. They are all abundant in the interior of the province, and usually attain to an altitude of seventy feet and upwards, while the diameter is from two feet six inches to three feet. All of these species of oak are considered elastic, and are much used by carriage-builders and millwrights. Shipbuilders also use them for paul bitts, treenail fastenings, main pieces of rudder, windlass, aprons, and stem and stern-posts. Agricultural implements are very frequently made from all these descriptions of oak. Staves also are made from them for exportation, and the bark is extensively used in tanning. The wood, however, is not so dense, nor is it held in so much esteem as the African oak.

Pine (*Pinus*).—There are three species of pines, known as the red, white, and prince's.

White Pine.—The white pine is unlimited in quantity, and when manufactured, forms a very large item of the annual exports of the province. It is to be found of an altitude of from 100 to 130 feet, though in some cases it has been found 150 feet, and from 12 to 15 feet in circumference at the base. It is considered to be the finest, most valuable, and most majestic tree of all which compose the forests of the province. The foliage is of a beautiful green, and contributes much to the natural grandeur of the tree. White pine is extensively used in the manufacture of doors, sashes, blinds, flooring, scantling, clapboards, trimming, laths, shingles, palings, and indeed every appliance that wood can be put to in house-building. It is likewise manufactured into sugar box shooks, an immense quantity being annually shipped to the West Indian markets. In ship-building, it is used for water-ways in vessels of the seven years class, and for finishing the interior of ships' cabins, and is found to be very suitable for masts, bowsprits, &c. It is likewise converted into baulks, deals and scantling for export to Great Britain and elsewhere. The baulks in many cases square over three and four feet. This wood is of a light colour, is easily worked, makes a good appearance, and when devoid of sap and properly seasoned, will last for a long time.

Red Pine.—The red pine grows to a height of 70 and 80 feet, and two feet in diameter. It is much impregnated with resinous matter, grows exceedingly straight, and is quite free from limbs until near the extreme end. The grain of this wood is coarse, but when devoid of sap (of which this tree bears a large proportion), is said to be durable. It is used pretty generally for the planking of ships, and owing to its elasticity, the ship-builder holds it in much esteem for hooding ends. Pumps for coasting and inland vessels are invariably made from this wood; and for abutments, piles, ane planking for wharves, it is very much in repute.

Prince's Pine.—This tree is very numerous in various parts of the province. In height and diameter it somewhat exceeds the red pine. The fibre bears a striking resemblance to Southern pitch pine, which is indigenous to milder latitudes. The grain appears to be very resinous. The prince's pines are generally found in low land, and present an exceedingly picturesque appearance. The timber prepared from the tree under notice, is devoid of knots, and makes rather clean work.

Elm (*Ulmus*).—There are two species of Elm—the red and white. They are very numerous, and to be found in various localities throughout the province. In many cases the white exceeds ninety feet in height, and attains a circumference of twelve feet; while the red, although lofty is scarcely to be found of so large proportions. The appearance of both species of the elm tree is very imposing, the foliage being very luxuriant, and the trunk bearing the same proportions from the base to within a few feet of the summit. They are to be found on meadow or intervale land, on the margin of rivers, and in swampy marshes, where the soil is in the least degree fertile. The wood is generally used in the manufacture of agricultural implements, for ships' blocks, keel pieces, planking and abutments for mills and dams, and lasts well, either when immersed in water, or placed in exposed positions. It is not, however, held in such esteem as tamarac or birch for keel pieces or bottom planking in ships.

Butternut or Walnut (*Juglans Cinerea*).—Butternut, sometimes known as walnut, and not unfrequently oilnut, is very numerous. This tree grows very straight, and generally reaches a height of from seventy to eighty feet, and over two feet in diameter at the base. It bears a very palatable nut, of an oblong shape, which is ripe in autumn, and then generally abundant. These nuts, in former times, were very much used by the aborigines for the oil which they contain. The wood of the butternut tree is very much used by cabinet-makers in the manufacture of the more superior articles of furniture, such as hall chairs, ward-robes, book-cases, toilet and other tables. This wood presents a handsome appearance when manufactured, and being very easily worked, its value is greatly enhanced.

Beech (*Fagus Americana*).—There are three species of beech—the white, red, and pasture beech.

White Beech.—The white beech grows to an altitude of sixty, and sometimes seventy feet. It is very plentiful, and is to be found in various parts of the Province, and particularly in fertile valleys, or where a deep alluvial soil exists. In some places these trees cover acres of land, unmixed with other wood. The wood of this tree is used by carriage-makers, and also converted into planking for coasting and inland vessels. Treenail fastening is also made from it, for which purpose it is considered by many equal to bolts in the flat of ships' bottoms. This wood is close in grain, and somewhat durable, either in exposed situations or otherwise. It will last for a very long period when immersed in salt water or confined below the light line. Ships planked with this material under the flat have been known to run for years before requiring a renewal of planking on account of defect.

Pasture Beech.—The pasture beech, generally termed sapling or common beech, grows to a height of twenty and thirty feet, and is seldom, if ever, found over fifteen inches in diameter. The fibre is dense, and the outside or sap is considered by those who have tested it, to be the toughest, and remains sound equally as long as the heart, which is of reddish cast, and about an inch in diameter.

Red Beech.—The red beech attains a height of sixty feet, and upwards of two feet in diameter. It is highly prized for the nut it bears, which in winter supplies food for the farmers' hogs and other animals. Many people allow their hogs to roam at large in the forest, to grow and fatten upon the nut, which they do very rapidly. The pork, however, is not held in much repute, being soft and oily. The wood of the red beech is used by carriage-builders, and also manufactured into implements of agriculture, treenail fastening, and staves for exportation. The beech under notice presents a very beautiful and glossy hue when made into articles of furniture and polished. All of the beeches mentioned are very much used for fuel.

White Cedar (*Juniperus Americana.*)—The white cedar is to be found in vast quantities throughout all the forests of New Brunswick. It is a very beautiful tree, and looks well in forest or on ornamental grounds. It is found from forty to fifty feet in height, and nearly two feet in diameter; when exceeding these dimensions, the heart is occasionally discovered to be somewhat defective. White cedar is generally found in groves unmixed with other trees, covering perhaps twenty to forty, and even eighty acres in extent. The wood is extremely light, and next in specific gravity to white pine. It is remarkable for its durability, when kept either wet or dry, and is said to retain its fastenings in a better state, and for a much longer time, than any other tree in the forest, and to resist the attack of insects. It splits easily, and is very valuable for fencing-poles, posts, pickets, railway-sleepers, planking of boats, and is very generally used by the Indians in manufacturing pails, tubs, and churns. Shingles are made from it, and shipped in very large quantities to the West Indian and other markets. The Committee of Lloyds' Register allow it in many parts of the higher class colonial ships. Cedar most abounds in swamps, and although the soil in which it grows is damp and cold, yet it is alluvial; and valued for the large crops it produces.

American Lime Tree (*Tilsa Americana*).—The American lime tree, generally known as the bass-wood tree, grows to a large size in New Brunswick forests, in many instances exceeding eighty feet in height, and of a proportionate diameter. It presents a very fine appearance in the forest, having, with its loftiness, perfect symmetry, but it is not much valued as timber, being rather deficient in strength, and is not extensively used. The wood makes a very smooth and clean finish, and owing to this and its elasticity, is mostly used by carriage-makers for frame-work, as it is not so liable to shrink as other descriptions of wood ; ship-builders use it for ship's rails in many cases. It grows in large quantities in the northern parts of the province.

Ash (*Fraxius*).—There are three kinds of ash—the white, black, and yellow or splint ash.

White Ash.—This tree reaches a height of fifty and sixty feet, and a diameter of nearly two feet. It does not generally grow in groves, but is very much scattered and intermixed with other trees. The wood is very elastic, much more so than any other wood found in the forest. It is extensively used by carriage-makers for shafts and poles, runners of sleds and sleighs ; and by boat-builders for planking. Capstan-bars, oars, staves, scythe and axe handles are made of it, and indeed all the implements of agriculture in which wood is deemed necessary.

The ash tree bears a beautiful foliage, and makes a very fine ornamental tree.

Black Ash.—The black ash grows to a size nearly similar to that of the white ash, but the wood is not so dense, nor yet so much esteemed for general purposes. Among the Indians, however, it is very frequently used in the manufacture of baskets, &c. It is found in low, flat land, and on the banks of streams. Wherever this description of tree is found, the land is generally alluvial.

Yellow Ash.—The yellow or splint ash is unlimited in quantity ; but seldom, if ever, exceeds twenty feet in height. It is found in swampy ground, of a character not much esteemed for agricultural purposes. The wood is chiefly used by coopers.

Hemlock (*Abies*).—Of this there are two descriptions—the black and white hemlock. These trees reach a height of seventy and eighty feet, are found on the margin of rivers, lakes and swamps. In many cases it is found in groves also, in company with maple and other hard woods. The wood is not esteemed for mechanical purposes, except in bridge and wharf-building, and for piles, abutments, and ships' ground ways. It is very generally cut up into boards and lathwood, the latter being exported in large quantities to Great Britain. The wood is considered very durable under water—in wharves it has been known to remain in a good state of preservation for thirty years and upwards. Lloyd's committee admit it in ships of the four year class for floors foothooks, top-timbers, and inside and outside planking.

The bark of the hemlock tree is greatly used by tanners, and takes the place of oak bark. The bark is stripped off the tree in long slabs, and answers as a substitute for boards in covering the camps or hovels used by the lumbermen when engaged in the forests in lumbering pursuits.

Wherever the hemlock and lofty pine exist, the soil, being cold and wet, is not held in much esteem for agricultural purposes.

ON SOMBRERITE.

BY DR. T. L. PHIPSON, F.C.S.,

Member of the Chemical Society of Paris, &c.

This mineral forms a large portion of some small islands in the Antilles especially that of Sombrero Island (N. lat. 18° 35′, W. long. 63° 28′), about sixty miles from St. Thomas. Its composition and properties prove it to be a new species, to which I have given the name Sombrerite. It is remarkable by the large proportion of phosphoric acid it contains.

Sombrerite presents itself in nature as a white, yellowish white, or reddish coloured rock, having a straight fracture, and in some portions a peculiar horny aspect. Its appearance is in general compact, though in reality it is extremely porous. It shows no signs of crystallization whatever, but appears to be an amorphous, gelatinous phosphate, that has been submitted to a high temperature in contact with steam, and at a high pressure. It is thought to be of comparatively recent geological origin, as it encloses fossil bones (of mammalia ?), and several kinds of shells. In a mineralogical point of view, Sombrerite is a compound of phosphate of lime with phosphate of alumina. In some specimens a certain proportion of the isomorphous oxide of iron is substituted for a corresponding portion of alumina; in others, where little or no iron is present, the mineral adheres to the tongue like other aluminiferous minerals.

Sombrerite is not phosphorescent by heat, like apatite; before the blow-pipe, when moistened with sulphuric acid, it colours the flame pale green.

It contains no fluoride nor chloride of calcium. Its specific gravity is 2·52. A well-chosen specimen has given me the following composition:—

		Atomic ratio.	
Water	9·00	1·00	20
Phosphate of lime 3 CaO, PhO^5	65·00	0·41	8
Phosphate of alumina 3 Al^2 O^3, PhO^5	17·00	0·05	1
Carbonate of lime	5·00		
Chloride of sodium	1·44		
Sulphate of lime	1·36		
Silicia	1·00		
Crenate of ammonia, &c.	0·20		
	100·00		

which gives for sombrerite the formula—

$$8\,(3\,CaO,\,PhO^5) + (3\,Al^2\,2\,O^3,\,2\,PhO^5) + 20\,HO.$$

Persons who have seen this rock think that it owes its origin to guano—some looking upon it as "fossil guano," and others as "guano modified by volcanic action." In order to bring forward, if possible, some proof of these theories, I took a large quantity of the mineral, and sought carefully for uric acid. Though the experiment was repeated several times, I have not been able to find the least trace of that compound, but only a very slight quantity of *crenate of ammonia*, which I have frequently met with in different minerals, notably in iron-ores of various ages. At the same time, it is possible that sombrerite may have derived its origin from ancient deposits of guano, modified by time and geological phenomena, as we see large beds of limestone and sandstone almost completely formed by the *dêbris* of organised beings. However that may be, I look upon this rock as having found its way to the surface at a high temperature, in contact with water or steam, and under great pressure. This would account for its peculiar appearance.

As regards the uses of sombrerite, it might be turned to account, and I believe it has been employed, for the preparation of phosphorus, phosphoric acid, and its compounds. But for agricultural purposes, its application meets unfortunately with a drawback; by converting the rock into what is called "superphosphate of lime," a certain quantity of sulphate of alumina is formed, and this salt, being deliquescent, attracts and retains so much moisture, that the product can be dried only with great difficulty. Sombrerite has, however, the advantage of being easily reduced to powder, and would, doubtless, in that state, be advantageously mixed with certain soils.

SIAMESE PRODUCTS.

BY SIR ROBERT H. SCHOMBURGK, H.M.'S CONSUL-GENERAL.*

The collection which I transmit from Siam and its tributary states, the Lao country, for the International Exhibition, consists of manufactures, made principally of silks in the latter territories, which lie to the north of Siam Proper, and border the southern provinces of China, as Kiang-tung and Yunnan. The second division consists of produce, either cultivated or growing spontaneously.

The dress of the men and women in the Lao country, approaches more the Burmese than the Siamese ; the women wear petticoats in lieu of merely the piece of cloth which is wrapt from the loins to the knee of the Siamese, leaving, with the exception of a shawl to cover the breast, the other parts exposed, and the men of the Lao tribes, generally speaking, are likewise clad in a more substantial manner than the Siamese.

The petticoats of the Lao are manufactured by women, of the raw Chinese silks brought by caravans from the southern provinces of China, as Kiang-tung and Yunnan. They are embroidered with gold thread and coloured silks, and are woven in the most rude manner, with hand-looms so primitive, indeed, that the supporters or posts of the machine are fixed into the ground under the shed, which at the same time serves as the principal habitation, or as an outbuilding. Here the woman sits before the loom and guides the horizontal thread by means of the shuttle with her hand.

The same process is followed as regards the manufacture of the waist-cloths for men, and the coarser cotton fabrics, as blankets, or coverlets, hammocks, shirts, &c. With regard to the waist-cloths of the Lao men, I would draw attention to the Scotch pattern which they exhibit.

Head cushions are made of a softer substance than the head-stools of the ancient Egyptians,—they are sometimes richly ornmented.

While passing over the other articles of handicraft of the Lao and Siamese, I would draw attention to the mosaic work of the Siamese, as exhibited in the drum marked 25.

The next division of my collection consists of produce and articles of trade, and amongst these, rice forms the staple article of export ; next to it ranges sugar, both efforts of cultivation ; as regards cotton, it is to be regretted that the Siamese cannot be induced to cultivate it more extensively.

Sapan wood is largely exported. Teak wood, this excellent material for ship-building, becomes more scarce yearly ; that which is brought to Bangkok is almost entirely employed for home-use, and but little is exported. This wood is likewise employed for furniture, and how well it is adapted for carving, I would wish to draw attention to the two Fauteuils marked 23.

* The reader will find an interesting article on the 'Vegetable Products of Siam,' by Sir Robert Schomburgk, in the TECHNOLOGIST, vol. 1, page 355.

Amongst other articles of export are Cardamoms, of which there are two kinds ; I consider both species of the genus *Alpinia.**

I have to regret that the botanical character of a large number of the trees and plants employed as simples by the Siamese and Chinese doctors is unknown. They are reeeived from the interior, leafless and flowerless. These medicine-men possess, no doubt, some knowledge of the nature and application of herbs and trees, as well as of some animal substances (in regard to the latter, greatly combined with superstition), but there, their knowledge rests. The mountainous region, principally of the Lao country, furnishes these simples.

Fish, in its fresh, dried, and salted state, is of great importance, not only for the nourishment of the thousands of Siamese inhabitants, but likewise as an article of export to Singapore, Java, and China. The feathers of birds transmitted, are principally exported to China. The poop of the boats of high Siamese noblemen is adorned with peacock feathers, those of the pelican are employed for fans, and would equally make excellent quills.

Messrs. A. Markwald and Co., merchants of Bangkok, have added a collection of produce, &c.; amongst it, I would wish to draw the attention to the bird's-nests, beche de mer, hemp, raw silk, cotton, sticklacks, long pepper, teel-seed, gamboge, rosin, shark-fins, dammar Kan Chai, tin and lead, all of which do not exist in my collection ; both these collections united, will give a fair idea of the produce of Siam, whether taken from the animal, vegetable, or mineral kingdom, produced by cultivation, or the spontaneous production of a congenial soil under the tropics.

Bangkok, January, 20, 1862.

List of Articles forwarded from Bangkok, in Siam, for the International Exhibition, 1862, by Sir Robert H. Schomburgk.

1 to 3. Petticoats for Lao females of rank, manufactured of Chinese, or of Korat silk, embroidered with gold thread, and coloured silks.

These dresses are executed without any of the improvements which our looms afford, indeed altogether in the most primitive manner.

4. Ditto unfinished.

5. The lower border for the above.

6. The Petticoat of a Burmese female.

7. Ditto of a Karen female, ornamented with seeds of two species of Job's tears (*Coix Lacryma*).

8 to 10. Waistcloths of men of the Lao tribe, of the northern tributary States of Siam, manufactured of Chinese silks, by Lao women.

11. Dress of a Karen, manufactured by females of his tribe.

12 and 13. Blankets or coverlets, manufactured in the Lao country, from native cotton. 14 and 15, Ditto of Karens.

* Elettaria.—Editor.

16. Travelling-bag of an opulent person, gold thread running through the manufacture. 17. Ditto for common use.

Head Cushions.—18. Of a superior person ; 19. For a lady of distinction ; 20. As commonly in use.

21. Cotton thread, coloured with native dyes (from Tavoy).

22. Spindle usually employed for spinning cotton.

23. Fauteuils made of teak-wood, showing specimens of Siamese carving.

24. A collection of walking-sticks made of different woods and palms.

25. A drum ornamented in mosaic, the drum-head made of snake skin.

Produce and Articles of Trade.

26. Samples of paper, made from the bark of a tree, and generally employed in Siam and Lao to write upon.

27. Cutlasses manufactured from native iron ore, by the Lao and Lovas tribes.

28. Knife-cutlass, with handle made from the root of a tree.

29. Thua dam—black beans.

30. Ditto. Introduced from China, but now cultivated in Siam.

31. Thua Kiau—Peas.

32. Thua Thong, ditto.

33. Makham—Tamarinds.

34. Luk Cowfai—Indian Water Caltrops.

35. Thua Lazong—Earth-nuts.

36. Nam tan tamit ; Nam tan mo ; Palm Sugar.

37. Luk Buah—Seeds of the water-lily, or sacred bean (*Nelumbiun speciosum*) ; used for preparing a kind of flour, and likewise, when boiled, eaten like chesnuts. The flowers when not yet opened, are used in curries.

38. Kaison Buah—the filaments and stamens of the water-lily, used in curries. The root, or more properly speaking, the creeping stem, is used for food in China.

39. Nomai, stamens of the flowers of a Dipteraceæ, used in curries.

40. Munnack, used as a stomachic.

41. Phutza pen, circular cakes eaten with curry.

42. Thua-rat—white beans.

43. Kravan—true Cardamoms.

44. Luk Rheu—Bastard Cardamoms. Both species of Cardamoms form not only an article of export, principally to China, but are likewise used for culinary purposes, and as a stomachic. The seeds of the Luk Rheu are of less strength and value than the Kravan. Infusions of its seeds are used in headache.

45. Manglack. Basil seeds (*Ocymum*). The seeds being placed in water, swell up to a large size, and form a mucilage like the Bungtalai seeds, which mixed with cocoa-nut water and sugar, makes a refreshing beverage.

46. Kamyan. Gum Benjamin (*Benzoin*), is placed in hot-water, and when cooled used as a drink for inward pains. It is likewise employed in rheumatic pains. A pan having been filled with hot coals, the gum is

placed upon it, and the paining limb having been brought as close as endurable, the limb is covered with a blanket in such a manner, that none of the vapours arising from the gum can escape. The gum is sometimes mixed with Leeplee (49), and Prickthai (black pepper), to increase its efficacy in rheumatic complaints.

47. Ngah-met. Till seed, (*Sesamum orientale*, Lin.) The seeds yield a fine bland oil, which is a good substitute for olive oil. It is used in curries, and also burned in lamps, and as a simple employed in ulcerations of the head.

48. Luk Makan Liqui. The seeds are burned, or rather roasted, and an infusion made of it, employed as a cooling drink.

49. Leeplee, an infusion ; is used in colds and catarrhs.

50. Prickthai, black pepper ; exported and used for home purposes.

51. Mekhanun, seeds of the Jack fruit (*Artocarpus integrifolia*, Lin.)

52. Bungtalai seeds ; when immersed in water, they form a large gelatinous mass. This jelly, as I may call it, is sweetened with sugar, and lime-juice having been added to it, it thus forms an agreeable beverage. It is considered abroad as an excellent remedy in diarrhœa and dysentery. Such a reputation it does not bear here ; the Matoan, or Bale fruit (*Ægle Marmelos*, Corr.), is considered a remedy against dysentery ; but the bungtalai is sold in the bazaars for preparing cooling drinks. The Basil seed (*Ocymum*) has the same property of swelling up when immersed in water, and is likewise used in that state amongst the Siamese. (See No. 45.)

53. Zaropi ; used as a stomachic.

54. Pihkoon ; used as a stomachic.

55. Prickhang ; infusions, after the seeds have been pounded, are used inwardly against headaches and fevers.

56. Bilang Karta ; a decoction of the seeds pounded, is used against vomiting.

57. Prickhom ; pounded and placed in cold water, the infusion is used against eructations.

58. Luk Hang tshikat ; an infusion of it is used as a strengthening remedy after child-birth.

59. Fruits of the *Areca Catechu*, Lin., or betel-nuts, used as a masticatory.

60. Betel-pepper leaves (*Chavica Siriboa*), used for chewing, in conjunction with the fruits of the *Areca Catechu*, after the latter have been cut in slices by means of a powerful lever scissor, and surrounded with lime, coloured with turmeric (*Curcuma longa*) to a beautiful pink colour.

61. Sipziet ; the enjoyment of the betel-nut chewing is increased by partaking of the Sipziet at the same time.

62. Kapan, a mortar, or contrivance to pound the slices of betel-nut.

63. Katrai ; scissors or lever slicers for cutting the nut.

63A. Pun ; prepared lime coloured pink with turmeric. A portion of it is placed on the betel-nut leaf, and a slice of the betel-nut having been wrapt up in it, the pellet is placed in the mouth and chewed.

Woods used Medicinally, or as Dyes.

64. Rang deng, in conjunction with 67, 68, and 85, against rheumatism and lumbago. The wood having been rasped, a decoction is made, with which, when yet hot, the aching limbs or spots are bathed.

65. Muat Kong. 66. Sang Kung noi.

67. Tiam leek, or Talumnook, against rheumatism (see 64); it is likewise used with Yawkowyien (76) and Kampengtshet'tshan (82) in a decoction against eruptions.

68. Saikhi (see 64); 69. Kehleh; 70. Hanglaideng; 81. Fang, or Sapan wood. Dye woods. The quantity of Sapan wood (*Cæsalpinia Sappan*, Lin.) exported, amounted in 1859 to 203,597 piculs; in 1861 it had decreased to 71,318 piculs.*

71. Plowyai, in conjunction with Plownoi (78), steeped in the common rum of the country, is used in cases of over-fatigue by bathing the limbs and body with the infusion.

72. Xaimah thalai, as a lotion against swellings of the joints.

73. Nua mai. Eagle or Aquila wood (*Aquilaria Agallochum*) containing a resin which, when burnt, diffuses great fragrance. This resin is only found inside the trunk or heart on its commencing to decay. It is used in infusions against headaches.

74. Kritzana, said to be obtained from a tree similar to the eagle wood. Infusions are likewise used in headaches.

75. Samkung—an infusion in brandy or rum, in connection with Sam Kung noi (80), is given as a strengthening remedy to lying-in women. It is likewise used without Samkungnoi in menstrual disorders.

76. Yawkowyien (see 67).

77. Muakdeng—infusion against eruptions, used as a lotion, or in a bath.

78. Plownoi (see 71).

79. Hanglai-phuak, rasped and steeped in orange-water, is employed against sore throats.

80. Samkung noi.

81. Fang, or Sapan wood (see 68—70).

82. Kampengtshet'tshan (see 67).

85. Kow 'one' priam (see 64).

86. Lodammung—infusion against costiveness.

Dried and Salted Fresh and Sea-water Fishes.

Sea-water Fishes.

87. Pla Talam.

88. Kurow.

89. Kapung.

90. Yalomet hamang.

91. Siziet.

92. Pla tsong.

93. Yalomet.

* A picul is $133\frac{1}{3}$ lbs. avoirdupois.

94. Yalomet foamit.
95. Hang kai.
96. Tuett.

River, or Fresh-water Fishes.

97. Pla Salit.
98. Kau.
99. Tshong.
100. Zou.
101. Hangkai (river).
102. Kapienn.
103. Kha.
104. Soi (used for preparing oil).
105. Tepo.
106. Muk (cuttle fish).
106a. Kung thale (prawn).

Animal Substances, &c., used as Articles of Trade, or for Medicinal Purposes, Exported principally to China.

107. Nangret—rhinoceros' skin.

107a. Luet nangret—coagulated blood of the rhinoceros, used as medicine in cases of inward hurts.

108. Nangkabeng—ray skin.

109. Lim—armadillo skin.

110. Nang Xang—elephant skin.

111. Enn'ana—deer sinews ; the hoofs grated are used for the curing of wounds.

112. Nang mou—skin of the boa snake *(Python reticulatus*, Schneider), used as skin for Siamese drums.

Feathers, as Articles of Trade.

113. Hang Nok Yong—peacock tails, principally exported to China, worth about 7s. each.

114. Kon' noka' dong—heron feathers, exported to China.

115. Pik' noka' ten—kingfisher's feathers, exported to China.

116. Pik' noka' dong—pelican feathers, exported to China, and used likewise in Siam for the manufacture of fans for the Talpoins, or Siamese priests.

117. Khi phung—bees' wax in a solid piece—cylinder form.

118. Do., in small cakes, black, yellow, and white.

119. Ja sub—tobacco.

120. Klong sub j'a—tobacco pipe manufactured of a bamboo root in the Lao country.

Siamese Books, for Records, Tales, or Romances.

121. Sumutt dam—paper prepared from the bark of a tree, and coloured black, to be written upon with a pencil, or crayon of white clay or chalk.

121a. Summutt dam—written upon (see 122), relating a love story—"Lakumaroan."

122. Sumutt Kao—Do., of white colour, to be written upon with a crayon white in colour.

123. Legend, in the Bali or sacred language, written, or rather incised, on the blades of the Talipot Palm or Tara (*Coryphia taliera*, Roxb.) The edges are coloured and gilded. The writing, or rather copying of these records or legends forms one of the priest's occupations—well informed in sacred lore.

124. Thighbone of the elephant, used as a coarse ivory for knife-handles.

125. Breast shield and buckler of turtle.

Reviews.

COTTON CULTIVATION IN ITS VARIOUS DETAILS, THE BARRAGE OF GREAT RIVERS, &c. By JOSEPH GIBBS. London: E. and F. N. Spon. (Pp. 248.)

This is a carefully-written and essentially practical work, by a thoroughly competent man: it, therefore, recommends itself to notice and extensive circulation at the present time, when cotton-culture is being so extensively promoted. Mr. Gibbs starts with some general remarks on the countries capable of growing cotton, and we take the following extract from his first chapter:

"My practical acquaintance with the nature and growth of the cotton-plant extends over a period of more than forty years. Having been much engaged in large drainage works, I have paid great attention to the capabilities of several countries, by irrigation, to produce cotton, more especially in districts and lands now entirely unused for cultivation.

"It will be well to premise the following observations by stating that most of the lands which will have to be alluded to hereafter as capable of growing cotton, have been examined by me, and some of them with great minuteness, and accurate surveys made thereof, with a view of bringing such lands into cultivation.

"These countries are comprised in the following list:

"1st. The coast of British and Dutch Guiana and French Cayenne, the island of Jamaica, and the Bahamas.

"2nd. The coast of the Mediterranean along the Gulf of Comachio.

"3rd. Egypt.

"4th. Asia Minor, near Tersoos (Ancient Tarsus), and other parts of the Ottoman Empire.

"5th. The east coast of Ceylon.

"6th. India.

"7th. Madras, and along the Bay of Bengal, and in the other parts of India.

"8th. Australia, and the north island of New Zealand.

"The whole of the lands here spoken of are situated near, and influenced by, their contiguity to the sea, which undoubtedly exercises a beneficial effect on the quality and quantity of the cotton grown."

New Zealand is the only doubtful quarter of those here mentioned. In the absence of any detailed system of tropical culture, this handbook will be found invaluable; for it treats of every subject with a masterly hand, in clear and precise language. The barrage of rivers, irrigation, embankments, steam and animal ploughing, fertilising land, and the details of the practice of cotton cultivation in various countries are severally touched upon.

THE VICTORIA GOVERNMENT PRIZE ESSAYS (pp. 387). Melbourne: John Ferres.

In 1860, the Colonial Government placed at the disposal of the Royal Society of Victoria 600*l.* to be awarded in premiums for essays. The volume before us contains the four prize essays, for which a medal and 125*l.* each was awarded. They treat of the following subjects, and are eminently practical and useful :—

"1. On the Collection and Storage of Water in Victoria for Gold-Washing, Irrigation, Motive-Power, and General Water Supply ; with reference also to the practicability of Artesian Wells in certain localities, by Frederick Acheson, C.E.

"2. On Agriculture in Victoria, with special reference to the Geological and Chemical Character of Soils, to the Rotation of Crops, and to the Sources and Application of Manures, by William Story.

"3. On the Origin and Distribution of Gold in Quartz-Veins, and its Association with other Metals and Minerals, and on the most improved Methods for extracting Gold from its Matrices, by Henry Rosales, C.E.

"4. On the Manufactures more Immediately Required for the Economical Development of the Resources of the Colony ; with special reference to those Manufactures the raw materials of which are the produce of Victoria, by Charles Mayes, C.E."

The following few notes are from the section on Perfumery in Mr. Mayes' paper :—

"Pomades, or Pomatums, are made by mixing in a peculiar manner hog's lard, beef suet, and the leaves of the flowers whose perfume is required. These materials undergo certain preparations, simple and easily understood, but which I need not refer to more particularly. As a substitute for flowers, which are too valuable except for the best pomades, 'the essences commonly used in the manufacture of pomades, are those of bergamot, sweet lemon, rosemary, thyme, lemon thyme, lavender, marjoram, &c.'

"Scented Oils are made by infusing flowers in pure, fresh oil, such as rose leaves, orange flowers, &c. ; the more delicate flowers, such as jessamine, jonquil, and violet, are spread upon stretched calico, saturated with salad or other suitable inodorous oil ; fresh flowers are renewed until the oil is saturated with their odour, the calico is then pressed to obtain the scented oil, which operation requires seven or eight days.

"Essence of roses, orange flowers, violets, &c., are obtained by distillation, which is repeated for the best kinds.

"Scented or perfumed spirits, of which so large a quantity are annually imported into this colony, are obtained by digesting 25 lbs. of the scented oil of roses, orange flowers, jessamine, or violets, &c., and 25 quarts of spirits of wine, for three days, when the perfumed spirits are drawn off.

"Eau de Cologne.—The only essences which should be employed, and which have given such celebrity to this water, are bergamot, lemon, rosemary, Portugal, neroli, or the essence of orange flowers.

"Pastes are made from the kernels of apricots, almonds, &c.

"Pastilles for burning are made with gum, nitre, cloves, charcoal powder, vanilla, &c.

Vanilla is the oblong narrow pod of the *Epidendron vanilla*, Linn., which grows in Mexico, Columbia, Peru, &c. It has a delicious aroma, and is much sought after by makers of chocolate, ices, creams, by confectioners, perfumers, and distillers ; and is, therefore, a fruit well worth cultivating in Australia.

A Manual of the Geography and Natural and Civil History of Prince Edward Island. By the Rev. George Sutherland. Charlotte Town: John Ross. (Pp. 164.)

This is an exceedingly useful little work, designed for the use of schools, families, and emigrants. The author, a member of the Local Board of Education, has brought the statistics and general information down to the close of last year. Half the book is devoted to civil history, and the general details of progress in the island have been given. The style adopted is concise and sometimes abrupt. The natural history has been well attended to.

Publications Received.—Abstract of the Census of the Population and other Statistical Returns of Prince Edward Island for 1851. Catalogue of the Natural and Industrial Products of Queensland. Deuxième envoi des Etablissements Français dans l'Inde. Pondicherry: Geraget. Catalogue des Produits des Colonies Francaises. Statistique de l'Industrie Minerale France. Catalogue of the Canadian Collection for the International Exhibition. Official, Classified, and Descriptive Catalogue of the Contributions from India, forwarded from Bengal. By A. M. Dowleans, Calcutta. Large 4to. Annual Report of the Yorkshire Philosophical Socicty for 1861. The Chemist and Druggist for May and June. The Pharmaceutical Journal. Paris Technologiste for May and June. Etat Actuel de l'Algere in 1862. Algere: Bonyer. Short Notice of the Telodynamic Transmission of Motive Power. By C. F. Hern. Colmar: Decker, 1862. The Practical Mechanic's Journal Record of the Great Exhibition. Parts I. and II. (This is an admirably-arranged work, with descriptive papers, by the best-informed writers, on the several classes and objects.) Statistical Notes of the Progress of Victoria, from the foundation of the Colony, 1835-1860. By Mr. Henry Archer, Registrar-General of the Colony. (A very carefully-prepared series of tables, with accompanying accounts and remarks, which furnish an admirable insight into the social condition of this important colony.) An Account of the Colony of South Australia. By Frederick Sinnett. New Brunswick, as a home for emigrants. By J. V. Ellis. The City of Hamilton, Canada West: its position and resources. The Products and Resources of Tasmania. The Colony of New South Wales: its agricultural, pastoral and mining capabilities, &c. London: J. Haddon. Description d'un Nouveau ver a soie du chêne (*Bombyx Yamamai*) provenant du Japan. Par M. F. E. Guérin-Méneville. Reprinted from the Revue and Magazin de Zoologiè. Report à S. M. l'Empereur sur les Travaux Entrepris, par ses ordres pour introduire la ver à soie de l'Ailante en France et en Algerie. Par F. E. Guérin-Méneville. Education des vers à soie de l'Ailante et du Ricin, &c. By the same author. Paris: Bouchard Huzard. Experiences sur Education du ver a soie de l'Ailante au Jardin de l'Exposition de Nantes. Quelques Observations sur le ver à soie (Bombyx Cynthia) de l'Ailante. Par H. de Baillet. Berguac: Faisandris. De l'Acclimatation en France du Bombyx Cynthia et sur Education en Anjou. Par M. F. Blain. Angers: Cosnier and Lachese. Notes sur le Bombyx Cynthia, et sur l'Introduction en Champagne. Par M. Roy. Châlons-sur-Maire: T. Martin. Rapport à S. E. M. Ministre de l'Agriculture sur le Progrés de le Culture de l'Ailante, et de l'Education du ver à soie. Par M. Guérin-Méneville. Paris: Imprimerie Imperiale, 1862.

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