PROCEEDINGS

OF

THE ROYAL SOCIETY

OF

EDINBURGH.

VOL. I.

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PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1832–33. No. 1.

December 3.

SIR THOMAS MAKDOUGALL BRISBANE, K.C.B.,
President, in the Chair.

The following Donations were presented :—

Transactions of the Society of Arts, Manufactures, and Commerce, Vol. XLVIII.—*From the Society.*

Examen relatif aux Projets de Barrage de la Seine dans le Voisinage du Havre: par M. le Baron du Prony.—*From the Author.*

Formule et Table pour calculer l'effet d'une machine à vapeur: par M. le Baron du Prony.—*From the Author.*

Memoirs of the Literary and Philosophical Society of Manchester. Vol. V. New Series.—*From the Society.*

Memorie della Reale Academia delle Scienze di Torino. Vol. XXXV.—*From the Academy.*

Transactions of the American Philosophical Society. Vol. IV. New Series. Parts I. and II.—*From the Society.*

Annual Report of the Council of the Yorkshire Philosophical Society for 1831.—*From the Society.*

Philosophical Transactions of the Royal Society of London for 1832. Part I.—*From the Society.*

Flora Batava. Nos. 90 and 91.—*From the King of Holland.*

Arsberattelser om Vetenskopernas Frœmsteg, &c. D. 31 Mars 1829, and 31 Mars 1830. 2 vols.

Kongl. Vetenskaps Academiens Handlingar för Ar. 1829 and 1830. 2 vols.—*From the Academy.*

Transactions of the Cambridge Philosophical Society. Vol. IV. Part II.—*From the Society.*

On the Osteological Symmetry of the Camel. By Walter Adam, M.D.—*From the Author.*

Transactions of the Geological Society of London. (Second Series.) Vol. III. Parts I. and II.—*From the Society.*

Nouvelle Maniere de Defense, avec des Habits d'Amiante à l'usage des Pompiers dans les cas d'Incendies. Par A. Vanossi.—*From the Author.*

The Sixth to the Fourteenth Annual Reports of the Devon and Exeter Saving Banks.—*From Sir Robert Abercrombie.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin, 1828 and 1829.—*From the Academy.*

Untersuchung über die gegenseitigen Störungen des Jupiters und Saturns. Von P. A. Hansen.—*From the Author.*

Physiologie Vegetale. Par M. A. P. De Candolle. 3 Tomes.—*From the Author.*

Mecanique Celeste. By the Marquis De la Place. Translated, with a Commentary, by Nathaniel Bowditch, LL.D., &c. Vol. II.—*From the Translator.*

Mémoires de la Societé de Physique et d'Histoire Naturelle del Geneve. Tome V.—*From the Society.*

Memoir of the Pearly Nautilus, with Illustrations of its External Form, and Internal Structure. By Richard Owen, Esq.—*From the Royal College of Surgeons, London.*

Mémoires de l'Academie Royale des Sciences de l'Institut de France. Tome II.—*From the Academy.*

Palœologica zur Geschichte der Erde und ihrer Geschöpfe von Herman von Meyer.—*From the Author.*

Essay on the Natural History of Thermal and Mineral Springs. By Meredith Gairdner, M.D.—*From the Author.*

Inquiries concerning the Intellectual Powers, and the Investigation of Truth. By John Abercrombie, M.D., F.R.S.E., &c.—*From the Author.*

Materia Hieroglyphica. By J. G. Wilkinson, Esq. Three Parts, and Plates.—*From the Author.*

Comparative Account of the Population of Great Britain, in the years 1801, 1811, 1821, and 1831. By J. Rickman, Esq.—*From the Author.*

On the Moral and Physical Condition of the Working Classes in Manchester. By Dr Kay.—*From the Author.*

Nouveaux Mémoires de l'Academie Royale des Sciences et Belles Lettres de Bruxelles. Tomes V. and VI.—*From the Academy.*

Mémoires Couronnés en 1829 et 1830, par l'Academie Royale des Sciences et Belles Lettres de Bruxelles. Tome VIII.—*From the Academy.*

Astronomische Beobachtungen auf der Königlichen Universitäts Sternwarte in Königsberg. Von F. W. Bessel. Funfzehnte Abtheilung.—*From the Author.*

Two Specimens of the Draco Lineatus, from Ava.—*From Mrs R. Cockburn.*

Twenty-nine Specimens of British Fishes.—*Presented by J. F. W. Johnston, Esq., F.R.S.E.*

The following communications were then read:—

1. On the Colours of Natural Bodies. By Sir David Brewster, V.P.R.S. Ed.

The only Theory of the Colours of Natural Bodies that has met with reception in modern times, is that of Sir Isaac Newton, who considers them as identical with those of thin plates, and as varying with the size of the ultimate particles of the body.

Although this theory, ingenious as it is, be liable to many great objections, and be not capable of explaining the phenomena, even if its postulates be admitted; yet the author of the present paper does not assail it with any arguments of this kind. He has, on the contrary, attacked it in its stronghold, and has endeavoured to bring it to the test of direct experiment.

Sir Isaac Newton considers the green colour of plants (the most general colour which nature presents to us) as a green of the *third* order of periodical colours, and has also given us the exact composition of this particular colour.

In order to determine the composition of the green colour of plants, the author dissolved their colouring matter in alcohol; and having analyzed it by a fine prism, he found it to have, in every case, the same composition. The portions of the spectrum, however, which entered into its compound tint, were totally different from its theoretical composition, as assigned by Sir Isaac Newton; and had no relation whatever to the colour of their plates. The green colouring matter exercised an arbitrary specific action upon different parts of the spectrum, and its green colour was owing to its having absorbed a certain number of rays, which, when subtracted from the white light, left the colour under consideration.

In order to render this result more general, the author examined an immense number of coloured solutions, obtained from plants and artificial salts, and a great variety of coloured solids, either formed by art, or obtained in nature; and in all these cases, he found no indication whatever of periodical colours. The colours were invariably produced by the absorption of certain definite rays taken arbitrarily and unequally from different parts of the spectrum; and, excepting in the case of certain imperfectly transparent and opalescent fluids, there never was the slightest trace of a reflected tint similar to that which might have been expected had the Newtonian theory been true.

2. Notice respecting the Determination of the Geographical Positions of the Village of Chamouni, and of the Convent of the Grand St Bernard. By James D. Forbes, Esq., F.R.SS.L. & Ed.

The author undertook the determinations of these positions at the suggestion of Professor Gautier of Geneva, who informed him that they had not been fixed by any direct observations. The great discrepancies of the best maps of the Alps in laying them down confirm this opinion; and the author has quoted the latitudes and longitudes, given by the best authorities, at the end of his paper.

The new determinations give for the positions—

	Latitude.	Long. E. of Geneva.
Chamouni, ...	45° 55′ 54″ . . .	27m 25s
St Bernard, ...	45° 50′ 16″ . . .	28m 19s

The latitudes were determined by successive altitudes of the pole star, taken with an altitude and azimuth circle, upon Captain Kater's construction, the circles being 4½ inches in diameter, and divided to 15″. The position of St Bernard is the best determined, eight altitudes of the pole star having been taken, the results of seven of which agree closely.

The longitudes were determined chronometrically, in the *first* place, by comparisons with the Geneva Observatory clock, and in the *second*, by the time at the two places, calculated from altitudes of the sun taken with the instrument just mentioned. Though the rate of the chronometer was wonderfully steady, considering the shocks to which it was exposed, the author does not conceive that the longitudes are determined with very great precision.

December 17.

Professor RUSSELL, Vice-President, in the Chair.

The following Donations were presented:—

Philosophical Transactions of the Royal Society of London for 1832. Part II.—*From the Society.*

Contribution to a Natural and Economical History of the Coco-Nut Tree. By Henry Marshall, Deputy-Inspector of Army Hospitals.—*From the Author.*

Astronomische Nachrichten. Nos. 221–232 inclusive. *From Mr Bessel.*

The time usually employed in the ordinary business of the Society having been occupied by a discussion on extraordinary affairs, the reading of the communications announced for this meeting was deferred.

January 7.

Sir THOMAS MAKDOUGALL BRISBANE, President, in the Chair.

The following Donations were presented:—

The Entomological Magazine. No. I.—*From James Wilson, Esq., F.R.S.E.*

Historical View of the Progress of Discovery on the more Northern Coasts of America. By P. F. Tytler, Esq., and James Wilson, Esq.—*From the Authors.*

The following communications were then read:—

1. Researches on the Conducting Power of the Metals for Heat and Electricity, tending to establish a New Analogy between these principles. By James D. Forbes, Esq., F.R.SS.L. & Ed.

The paper began by pointing out the very limited class of bodies to which observations of the kind alluded to have been extended. The author was led to a careful examination of the existing determinations of the conducting powers of the metals for heat, by some collateral trains of experiment in which he was occupied two years ago. He points out the degree of confidence which may be placed in the *arrangement* of conductors given by different authors; for we appear to be far from reaching a correct estimate of their numerical values. In viewing those of M. Despretz as the best, he remarks, that the position of platinum, which is certainly erroneous, shews how imperfectly we can depend upon experiments on this point, made with even more than usual care. Platinum is placed by this writer almost at the top of the list, between gold and silver, whilst the commonest experiments serve to shew that it is really a very imperfect conductor.

In order to verify the conclusions of previous observers, and to determine the position of some metals upon which no experiments seem to have been made, the author employed Fourier's Thermometer of Contact, an elegant instrument, which he believes has not before been practically applied. His experiments, however, being only intended for the illustration of a subject of collateral inquiry, were not made with the detail that they would otherwise have been, nor are they presumed to be perfectly accurate. They served, however, to confirm previous experiments on the order of the metals as conducting substances; to restore platinum to its right place, and to fix the positions of antimony and bismuth. From these and other data, he considers the following as the most probable arrangement of conductors of heat, beginning with the best:—*Gold*, *Silver*, *Copper*, *Brass*, *Iron*, *Zinc*, *Platinum*, *Tin*, *Lead*, *Antimony*, and *Bismuth*.

In like manner, by a careful comparison of the results of Harris, Becquerel, and Pouillet, including some experiments on antimony and bismuth, made at the author's request by Mr Harris, he concludes, that the arrangement of the metals as conductors of electricity is the following, which he observes is probably better established than the corresponding one for heat:—*Silver*, *Copper*, *Gold*, *Zinc*, *Brass*, *Iron*, *Platinum*, *Tin*, *Lead*, *Antimony*, and *Bismuth*. He observes, that the deviations from a common arrangement only occur where it is agreed, by experiments on both points, that the metals are extremely closely allied; as, for example, Gold and Silver, Iron and Platinum. His general conclusion is this; *That the arrangement of conductors of heat does not differ more from that of conductors of electricity, than either arrangement does alone under the hands of different observers.*

2. The reading of a paper by Robert Knox, M.D., F.R.S.E., on the Natural History of the Salmon, was commenced.

January 21.

Dr HOPE, Vice-President, in the Chair.

The following Donation was presented:—

Tableau de Terrain du Department du Calvados. Par M. Herault, Ingenieur en Chef du Corps Royal des Mines.—*From the Society of Antiquaries.*

The following communications were then read:—

1. On the Super-Sulphuretted Lead of Dufton. By J. F. W. Johnston, Esq., A.M., F.R.S.E.

The object of the author of this paper was to shew that the mineral alluded to is not a new atomic compound, but that it consists merely of common sulphate of lead, with a portion of pure sulphur, varying from 6 to 10 per cent.

2. The reading of Dr Knox's paper on the Natural History of the Salmon was concluded.

The object of the author was a careful examination of facts in the Natural History of the Salmon, which hitherto have been taken merely upon opinion. He watched and carefully observed personally the deposition of the ova or eggs of the salmon under the gravel,—its long confinement in that situation,—its growth into a fish about an inch in length,—its ascent through the gravel, and rapid growth whilst in the rivers: the journals of observation were partly read to the Society. Twenty weeks was the period from the time of deposition to their bursting the outer shell; for nine days longer they continued under the gravel as fishes, drawing their nourishment from the yolk of the egg, which is of course attached to them by the umbilical vessels, or more properly, by the ompholo-mesenteric vessels. During this period they do not eat or grow much, but without doubt acquire strength. When the yoke on which they have been feeding becomes nearly exhausted, they rise from their sandy and gravelly bed, making their way to the surface, through a thickness varying from one to two feet, and at last gain their new habitat in the waters. In ten days they may be caught in the rivers, very considerably grown, and in twenty days have attained a length varying from six to nine inches.

An extensive personal inquiry shewed that they are never the prey of trout; and a more limited one renders it doubtful if they *ever* become the prey of kelt, or spawned salmon, on its return to the ocean. It is probably to avoid the effects of severe frosts, that the salmon selects the bed of the running stream as the spot for the favourable deposition of the ova. The beds of rivers, he conjectures, must vary somewhat in temperature; and the author supposes that extreme frosts are less likely to reach the gravel under the stream than under the pool. Frequent experiment has convinced the author, that the opinions of Sir Humphry Davy, Jacobi, and others,—opinions which maintain that the gravel below the stream is selected by the salmon, on the ground of the better aëration of the ova, have no real foundation whatever.

The food of the fry has been determined precisely, and their whole habits, by repeated anatomical examinations made by himself.

The salmon seems to hybernate somewhat in certain seasons; a great number of salmon and trout do not enter into the spawning condition, and consequently may be got in first-rate order as food at any time, provided they have the means of subsistence: now, this the salmon can always get at in the ocean, which is his true feeding ground. He cannot get food in rivers of the kind he desires. The salmon-trout, on the contrary, even at the mouths of rivers, will take to the fry of other fishes, to small fishes, and to worms; and in rivers, he will feed on the larvæ of insects, insects themselves, and, in short, on the ordinary food of trout.

The true salmon prefers a peculiar kind of food, the ova of the echinodermata, and takes with great reluctance any other. Hence, the moment he enters rivers, having abandoned his natural feeding-ground, he deteriorates constantly, refuses all kind of food, loses weight and flavour, and gets, in short, entirely out of order. Nor can he ever recover from this state till he has revisited the feeding-ground in the ocean. It is easy to perceive in these few statements, how entirely they alter the whole question of the salmon-fisheries.

These inquiries led the author to examine into the history of the herling. They resemble in their habits the salmon-trout, haunting the feeding-ground of the salmon ; and when fed on the peculiar food of the salmon, their flavour is excellent ; but they take readily to coarser food, as small herrings, fry, sand-eels, and the fry of any other fishes. Their stomach and intestines get loaded with putrescent debris, their flesh loses its flavour, and their condition, as articles of human food, has changed materially. No two conditions can be supposed more opposite than the herling presents when fed on salmon food, and when fed on fishes. They differ, therefore, from salmon-trout in this respect, that, when feeding on the food of the salmon, they attain almost the flavour of the salmon, which the salmon-trout never does.

The author discovered and exhibited the food of the Vendace of Lochmaben, which had never been seen before by any one ; explained the reasons why this fish could not be taken with bait ; proved the vendace to be male and female, and offers suggestions for the stocking of the various lakes in Britain with this exquisite fish, pointing out first the necessity of locating its natural food, without which it cannot live. The discovery of these circumstances with regard to the vendace, led the author immediately to think of the herring, whose food and natural history generally he believed to be unknown.

It was ascertained that the herring resembles the vendace in its habits, as to food more particularly ; and that whilst feeding on the incredibly minute entomostraceous animals, which it more especially affects, the condition of the herring is excellent, rendering it an extremely desirable food for man. In this state, the stomach seems as if almost altogether empty (as in the vendace), though at the moment full of minute animals, to be discovered only with the microscope, and on which the animal has been feeding. The intestines also seem as if empty ; the tunics of the whole digestive canal are fine and semitransparent, and as free of intestinal and putrescent debris found in the stomach and intestines of animals, as if the herring actually fed on nothing but air and water. When he approaches the shores, thus quitting the proper feeding-ground, he takes to other and coarser food; his condition alters, and his flesh becomes soft and tasteless. The stomach and intestines are found loaded with putrescent remains, and gutted or ungutted, this fish could never be brought into the market as equal to the product of the Dutch fisheries.

February 4.

Sir THOMAS MAKDOUGALL BRISBANE,
President, in the Chair.

The following Donations were presented:—

The Present State and Future Prospects of Mathematical and Physical Science in the University of Oxford. By the Rev. Baden Powell, Savilian Professor of Geometry.—*From James D. Forbes, Esq.*

Transactions of the Cambridge Philosophical Society. Vol. IV. Part III.—*From the Society.*

Charter and Bye-Laws of the Cambridge Philosophical Society.—*From the Society.*

The following communication was read:—

Account of some Optical Phenomena observed upon the Rigi, on the 16th October 1832. By James D. Forbes, Esq., F.R.SS.L. & Ed.

The object of this paper was to describe an example of a class of phenomena, which is imperfectly understood. The author observed an indistinct mass of reflected light, surrounded by a faint glory, on the surface of a stratum of thick white clouds, 1000 or 1200 feet below him, when descending from the Rigi. The centre of the coloured circle was the point diametrically opposite to the sun, and consequently varied with the position of the observer. As he approached the level of the cloudy ocean, the colours became brighter, and the circle more distinctly formed, and the shadows of the author and his companion were thrown with distinct outlines upon the illuminated surface. The diameter of the red ring of the corona was about 18°, and he ascertained, by experiment, that the distance of the plane on which it was formed, was only 70 feet. The red occupied the interior of the prismatic circle. When completely immersed in the cloud, the shadow of the observer assumed a new appearance, owing to the want of a definitely illuminated surface upon which it could be thrown; and the continuation of the shadow towards the interior of the cloud, presented the aspect of shadows when a sunbeam is admitted into an atmospheric space filled with light dust; and, by the effect of perspective, gave an appearance of a true convergence of rays, such as is occasionally observed on a great scale opposite to the sun.

The author pointed out that the theory of the coloured rings suggested by Mr Fraunhofer is untenable. It supposes the inflexion of rays by watery particles round the head of the observer, whilst experience shews, that these effects are produced when the observer stands in a perfectly pure atmosphere, and even at the distance of 1000 feet from the cloud. The theory of Dr Young was also noticed, which presumes a quadruple reflection in the interior of the aqueous drops; an opinion which, perhaps, it may be difficult to reconcile with the great brilliancy of the colours displayed.

February 18.

Dr HOPE, Vice-President, in the Chair.

The following Donations were presented:—

Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. Vol. XLIX. Part I.—*From the Society.*

Flora Batava. No. 92.—*From His Majesty the King of the Netherlands.*

The Annual Reports of the Leeds Philosophical and Literary Society for 1828, 1829, 1830, and 1831.—*From the Society.*

The following communications were then read.—

1. Notice respecting the Application of Heated Air to Blast Furnaces. By Robert Bald, Esq., F.R.S.E. (To be continued.)

2. An attempt to illustrate the remaining Monuments of the Ancient Etruscan Language. By the Rev. John Williams, A.M., F.R.S.Ed.

The principal object of this paper was to defend some interpretations of words in the ancient language of Etruria, proposed by Lanzi, and attacked by Niebuhr; as well as to point out some new analogies with other dialects. The languages which the author proposes particularly to call to his assistance are, Greek, Latin, Anglo-Saxon, and Cambrian or Welsh. The paper concluded with an application of these aids to a variety of words in the Etruscan language.

March 4.

Sir THOMAS MAKDOUGALL BRISBANE, President, in the Chair.

The following Donations were presented :—

A Brief Inquiry into the State and Prospects of India.—*From William Blackwood, Esq., Bookseller.*

Essays by the late Robert Hamilton, LL.D., Professor of Mathematics in the Marischal College and University of Aberdeen. —*From Alexander Thomson, Esq. of Banchory.*

Principes de Philosophie Zoologique. Par M. Geoffroy Saint-Hilaire.—*From the Author.*

Tableau de l'Hyoide dans les Quatre Classes des Animaux Vertébrés. Par M. Geoffroy Saint-Hilaire.—*From the Author.*

The following communication was read :—

On the Gradual Elevation of Land in High Northern Latitudes. By J. F. W. Johnston, Esq., F.R.S.Ed.

In this paper, the author shewed, by a number of phenomena observable within the coasts of Sweden, chiefly around Stockholm, and on the shores of the Lake Macler and its arms, that the conclusion of the Swedish surveyors in 1821, that a change of the relative level of the land and water along the coasts of the Baltic had in many localities taken place, could not reasonably be disputed.

He then considered if it were possible that the level of the Baltic could have fallen, being, by its connection with the North Sea, a branch of the great ocean; and concluded, from the permanency of the respective level of the land and water on the coasts of Pomerania, among the Danish islands, and at some points on the shores of Finland, that the level of the Baltic Sea had undergone no change of level for the last six hundred years. The change observable on the coasts of Sweden, therefore, must be due to an elevation of the land, now gradually, though insensibly, in progress. This rising is estimated to proceed at present at the rate of about one foot in twenty-five years.

The absence of any record of violent volcanic action in the Scandinavian Peninsula, renders it improbable that the rise is due to such a cause. The author referred it, therefore, to the gradual cooling of the crust of the earth, which, by causing a contraction and compression in parts where the cooling was a maximum tending to elevate other portions of the earth's surface at points or in lines of minimum resistance.

The centre of the action in Scandinavia, he considered to be in the mountain chains which traverse Norway and Sweden, and Finland, respectively; and which are mutually connected beyond the head of the Bothnian Gulf: and attributing the original elevation of these chains, with Elie de Beaumont, to the secular refrigeration of the earth, he found in the rise still observable in Scandinavia a relic only of that once powerful action by which these mountain ranges were originally projected. He suggested the probability, also, that on other coasts where high mountain ridges ran parallel with the sea, accurate measurements of the mean level of the water, in reference to the scarped rocks on the coast, if repeated at certain distant intervals, might make known other gradual elevations still in progress, similar to those observable on the shores of the Baltic.

March 18.

Professor RUSSELL, Vice-President, in the Chair.

The following Donations were presented:—

Exposition Elementaire des Principes qui servent de Base à la Theorie de la Chaleur Rayonnante. Par Pierre Prevost, F.R.SS.L. and E., Professeur Emerite de Physique et de Philosophique, à l'Academie de Gèneve.—*From the Author.*

A variety of Specimens of Minerals from the Coast and Interior of Ceylon.—*From Dr Sibbald.*

The following communications were laid before the Society :—

1. Observations on the Anatomy of the Rorqual (a Whalebone Whale of the largest magnitude), drawn up from the dissection of a specimen found dead off North Berwick. By Robert Knox, M.D., F.R.S.Ed.

This paper, composed chiefly of anatomical details regarding the anatomical structure of the Rorqual, scarcely admits of abridgement. The author has described the skeleton of the cavity for receiving the brain, and the mechanism of the larynx, at greatest length. The entire length of the whale, measured by a straight line, drawn on the sand from the nose to the middle part of the tail, and making a slight allowance for the curved position in which the animal lay, was 80 feet. Length of the head 23 feet. The girth of the carcass at the pectoral extremities (though the animal had been ten days on the beach, and was much collapsed) 34 feet. Breadth of the tail from tip to tip 20 feet. The author describes the appearance of the mouth, lined with whalebone, as very surprising. The whole surface of the palatal plates of the superior maxillary bones, each extending to 14 feet in length, was covered with a mass of what appeared to be well-teased baked hair, of a clear and shining black. This was the whalebone, arranged in the most regular manner, and composed of many thousand plates; the number as seen in profile, and which are the largest plates, amounted to upwards of 650. It weighed nearly two tons while soft. The whole skeleton weighed nearly thirty-two tons, and was removed to Edinburgh with much difficulty. The weight of the brain, calculated by Sir William Hamilton's method, from the capacity of the cranium, must have been about fifty-four lbs.

The larynx is quite simple, and totally unlike that of the Dolphin and Porpoise. The nostrils are filled by two enormous cartilaginous masses, acted on by muscles occupying the centre of the superior maxillary bones. When the animal breathes, they are withdrawn sideways to admit of the passage of air. This extraordinary structure the author considers as unique, and that it had not fallen previously under the notice of any scientific observer.

2. Dr Knox verbally communicated some new observations on the structure of the Foot of the Horse. He demonstrated the navicular bone of the horse's foot not to be a sesamoid bone, nor a peculiar structure formed expressly for the horse, but the *Epiphysis* of the *Os pedis* or coffin-bone. This was proved satisfactorily by a direct appeal to structure. Besides anticipating results of practical consequence from this discovery, the author is led to observe, that an organ may be displaced and employed to perform different functions in different animals,—that the epiphyses of bones are intended by nature to form separate bones in a vast variety of animals,—and that they may often lead to the discovery of the type of the skeleton in fossil remains of extinct animals.

3. The reading of a paper was commenced, entitled Experimental Researches regarding certain Vibrations which take place between Metallic Masses having different Temperatures. By James D. Forbes, Esq., Professor of Natural Philosophy in the University of Edinburgh.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1832-33. No. 2.

April 1.

SIR THOMAS MAKDOUGALL BRISBANE, K.C.B., President, in the Chair.

The following Donations were presented :—

Annual Report of the Yorkshire Philosophical Society for 1832. —*From the Society.*

Collections of Specimens from the Volcanic District of the Rhine. —*From Professor Forbes.*

The following Communications were then read :—

1. Continuation of "Experimental Researches regarding certain vibrations which take place between Metallic Masses having different Temperatures." By James D. Forbes, Esq., Professor of Natural Philosophy in the University of Edinburgh.

The vibrations here referred to, are those which, with their accompanying sounds, were first observed by Mr Arthur Trevelyan, and communicated to this Society in a paper published in the 12th vol. of their Transactions. The author of the present paper undertook the inquiry as soon as the remarkable fact was announced by Mr Trevelyan, and was induced to prosecute it to a considerable extent experimentally, in consequence of being dissatisfied with the only plausible explanation yet offered,—that of the successive expansions of the cold metal by the hot one at the point of contact at each successive vibration, which was conceived to afford the necessary impulse or maintaining power.

In this paper, the phenomena of sound are first discussed, which, with Mr Faraday, the author imputes solely to the number of vibrations taking place in a given space of time. This seems completely proved by observation, and the note depends upon the frequency of the oscillations, which have been observed as high as between 700 and 800 in a second, and must often be greatly more frequent. The phenomena of vibration are next considered as affected by the nature of the metals, by the form of the masses, and by temperature. The order of the metals as vibrators, is the following, meaning that the cold metal must always stand lower in the list than the hot one, and that the force or intensity of vibration is, generally speaking, proportional to the space intervening between two metals on the list, *Silver*, *Copper*, *Gold*, *Zinc*, *Brass*, *Platinum*, *Iron*, *Tin*, *Lead*, *Antimony*, *Bismuth*. Antimony and Bismuth are placed at the bottom of the list, because no other metal is capable, under any circumstances which have been examined, of producing vibrations in conjunction with those two metals: they are the only metals yet observed which, when heated, do not vibrate on cold lead.

From experiments detailed at considerable length in the paper, the author is led to the following practical conclusions, which, whatever may be the fate of the hypothesis which he is disposed to found upon them, will, he conceives, be viewed as valuable in themselves. 1. As far as has been observed, the vibrations never take place between substances of the same nature. 2. Both substances must be metallic. 3. The vibrations take place with an intensity proportional, within certain limits, to the difference of the conducting powers of the metals for *heat* (or *electricity*,*) the metal having the least conducting power being necessarily the *coldest*. 4. The time of contact of two points of the metals (between which the oscillations take place) must be longer than that of the intermediate portions. 5. The impulse is received by a distinct and separate process at each contact of the bar with the block, and in no case is the connection of these points in any way essential. 6. The intensity of vibration is (under certain exceptions), proportional to the difference of temperature of the two metals.

From these data, the author first endeavours to show, that the hypothesis of expansion is untenable, by tracing closely the process of communication of heat, and proving that it must lead to several conclusions totally at variance with experiment, and particularly

* See the abstract of a former paper on the identity of those arrangements.

that as far as conducting power for heat is concerned, both the hot and the cold metal should possess it in the highest degree. The author is led by the striking analogy of the powerful repulsive action of electricity in passing from a good to a bad conductor, to infer a similar property in heat, which, without entering into any speculations as to the nature of those principles, appear to have a repulsive character in common indicated by a tendency to diffusion and equilibrium. He conceives, that while some very delicate experiments in France have given indications of the actual force exerted by heat equally diffused through two adjoining masses, that the energy in this case is produced by the accumulated repulsive power in the last particles of the good conductor, the current (without meaning any thing hypothetical by the term) being suddenly cut short by the resistance opposed by the inferior conductor to its passage. The destructive energy of electricity indicative of its repulsive force, is never exerted in a state of equilibrium, but by the accumulation of separate repulsive energies which take place in the transition from a good to a bad conductor, or during its passage through the latter.

2. On the Equations of Loci traced upon the surface of the Sphere, as expressed by spherical co-ordinates. By T. S. Davies, Esq., F.R.S.E.

This paper is intended as a necessary supplement to the paper bearing the same title already printed in the Society's Transactions, though but an abridgment of a larger one which the author had prepared on the subject. Particular circumstances induced him to alter the plan he had originally contemplated, and instead of a complete development in detail of his researches and his views, he has only on the present occasion given so much of his results as were necessary to bring the system of polar spherical co-ordinates to a state analogous to that in which plane polar curves has long been stationary, one point of the analogy excepted, viz. where the author has extended the method of treating tangents and normals, and the consequent investigations dependent on these, by giving the polar equations of those lines, instead of merely examining the relation between the radius-vector, and perpendicular upon the tangent. In a note the equations of the tangent and normal, to plane curves, is given from first principles ; and the analogy between plane and spherical curves is shown to be remarkably close.

Amongst the properties of spherical curves, the following curious one occurs.

If the pole of a loxodrome to rhumb α be made the centre of another equal sphere, the visual cone under which the loxodrome will appear, will cut the second sphere (the eye being at centre of first sphere) in a curve, whose equatorial subtangent is constant, and equal to α: and if conversely, the pole of the spherical logarithmic (the equisubtangential curve just mentioned) be made the centre of an equal sphere, the visual cone of this logarithmic, seen from the centre of its own sphere, will cut the second sphere in a loxodrome whose rhumb is equal to the subtangent of the logarithmic.

The author expresses his intention of discussing in a separate work the singular points of spherical curves, certain new systems of co-ordinates, and other classes of research, which, on account of the length to which they necessarily extend, were not adapted to the Transactions of the Royal Society.

3. Experiments and Observations on the Arterialization of the Blood. By William Gregory, M.D., F.R.S.E., and W. J. Irvine, Esq.

The object of these experiments was to ascertain some of the circumstances under which the blood changes in colour, from the dark venous to the florid arterial hue.

Dr Stevens first showed, that the venous clot deprived of its serum by washing, remained dark even when in contact with oxygen ; and that the addition of a saline solution caused it immediately to become florid. He stated also, that a strong saline solution would cause this change in an atmosphere so highly charged with carbonic acid as to prove rapidly fatal to animals.

It appeared to the authors necessary to ascertain whether this effect took place in pure carbonic acid containing no free oxygen, as the atmosphere used by Dr Stevens most probably did; and they also proposed to extend their observations to other gases, likewise free from oxygen. They accordingly prepared pure nitrogen, hydrogen, and carbonic acid, removing the last traces of oxygen by means of potassium. The water with which the clot was washed, and the saline solution used in the experiments, were deprived of atmospheric air by being boiled and allowed to cool in close vessels. The clot was then introduced into the gases over mercury, and as soon as the strong saline solution came in contact with it, the colour, in all the three gases, changed from black to bright red, and the same change was found to take place in the Torricellian Vacuum.

It was obvious, therefore, that a strong saline solution could change the colour of the blood from venous to arterial without the contact of oxygen, or indeed of any gas whatever.

But in blood, the colouring matter is in contact, not with a strong saline solution, but with a very dilute one, viz. the serum. It was necessary, therefore, to see whether the washed clot, placed in contact with serum or a weak solution of salt, in the same gases, would change its colour. On repeating the experiments, both with serum and a solution of salt in water of equal strength to the serum, no change whatever took place, until atmospheric air or oxygen gas was admitted.

The conclusions of Dr Stevens, therefore, must be somewhat modified. It is true, as he states, that the presence of saline matter is essential to the change of colour: But it is obvious, that there is an essential difference between that change as it occurs in the lungs, where serum is present, and as it appears out of the body when a strong saline solution is employed. In the former case, oxygen is necessary: In the latter, the change of colour is independent of the presence of any gas whatever. We must, therefore, be cautious how we reason by analogy from the one class of phenomena to the other.

April 15.

Professor RUSSELL, Vice-President, in the Chair.

The following Donations were presented:—

Memoires présentés par divers Savans à l'Academie Royale des Sciences de l'Institut de France. Tome 3.—*From the Royal Institute of France.*

Quarterly Journal of Agriculture, 3 vols., and Prize Essays and Transactions of the Highland Society of Scotland (New Series), 3 vols.—*From the Society.*

The following Communications were then read:—

1. Observations on the Lines of the Solar Spectrum, and on those produced by the Earth's Atmosphere, and by the Action of Nitrous Acid Gas. By Sir David Brewster, LL.D., F.R.S.

The author was led, in prosecution of his researches on the absorptive action of transparent media of light, which have been partly communicated in previous papers to the Society, to examine the influence of coloured gaseous bodies. Iodine vapour was one of these, and its action was found of a similar character to that of fluids having a similar tint. Nitrous acid gas presented a far more extraordinary phenomenon.

The Spectrum of Newton, and of all the philosophers of the 18th century, was a parallelogram of light with circular ends, in which the *seven* colours gradually shaded into each other without any interruption. The illumination was a maximum in the yellow rays, and the light decayed by insensible degrees towards the red and violet extremities. In the year 1808, Dr Wollaston conceived the happy dea of examining a beam of day-light that passed through an aperture only the 20th of an inch wide, and he was surprised to see it crossed by seven dark lines, perpendicular to its length.

About ten or twelve years afterwards, the celebrated optician, Joseph Fraunhofer, without knowing what had been done by Dr Wollaston, observed the spectrum formed by the sun's light transmitted through small apertures; and by applying a telescope behind the prism, he discovered about 600 parallel dark lines traversing the spectrum. As no such lines appeared in the spectra of white flames, Fraunhofer considered them as having their origin in the nature of the light of the sun. The strongest of these lines were seen in the spectra of the Moon, Mars, and Venus; and by means of very fine instruments, he was able to detect one or two of them with other new lines in the spectra of Sirus and Castor.

Upon examining with a fine prism of rock-salt, with the largest possible refracting angle (nearly 78°), the light of a lamp transmitted through a small thickness of nitrous acid gas, whose colour was a pale straw-yellow, the author was surprised to observe the spectrum crossed with hundreds of lines or bands far more distinct than those of the solar spectrum. The lines were sharpest and darkest in the violet and blue spaces, fainter in the green, and extremely faint in the yellow and red spaces. Upon increasing, however, the thickness of the gas, the lines grew more and more distinct in the yellow and red spaces, and became broader in the blue and violet, a general absorption advancing from the violet extremity, while a specific absorption was advancing on each side of the fixed lines in the spectrum. It was not easy to obtain a sufficient thickness of gas to develop the lines at the red extremity, but the author found that heat produced the same absorptive power as increase of thickness, and by bringing a tube containing a thickness of half an inch of gas to a high temperature, he was able to render every line and band in the red rays distinctly visible.

The power of heat alone to render a gas which is almost colourless as red as blood without decomposing it, is in itself a most singular result; and the author succeeded in rendering the same pale nitrous acid gas so absolutely black by heat, that not a ray of the brightest summer's sun was capable of penetrating it. In making the experiment, the tubes frequently exploded; but by using a mask of mica and thick gloves, and placing the tubes in cylinders of tinned iron with narrow slits to admit the light, there is little danger of any serious accident.

The author then points out various practical applications which may be made of this discovery, especially its substitution for the more difficult process, when Fraunhofer's lines in the solar spectrum are employed, of determining the dispersive powers of substances. Since the absorptive action, by increasing the thickness of the medium, generally *enlarges* the lines already defined, these may be rendered as distinct as may be required, which it is impracticable to do with the solar lines, and hence the difficulty of applying these to useful purposes. The lines in the sun's light, and those of the nitrous acid gas spectrum, when directly compared, have a strong analogy; but in order to establish it completely, the author found Fraunhofer's map of the solar spectrum insufficient, and was induced to undertake the laborious task of going over the whole ground. By dint of perseverance, and by the use of some original methods, he has been enabled, with very inferior instruments, to distinguish about 2000 lines, instead of the 354 which Fraunhofer had laid down.

The author watched narrowly the state of the defective solar lines at different seasons of the year, in order to observe if any change took place in the combustion by which the sun's light is generated, or in the solar atmosphere through which it must pass. Such changes he found to be very general in every species of terrestrial flame. The definite yellow rays which exist in almost all white lights, flicker with a variable lustre, and analogous rays in the green and blue spaces proceeding from the bottom of the flame, exhibit the same inconstancy of illumination. In the course of the winter observations, he observed distinct lines and bands in the *red* and *green* spaces, which at other times wholly disappeared; but a diligent comparison of these observations soon showed that these lines and bands depended on the proximity of the sun to the horizon, and were produced by the absorptive action of the earth's atmosphere.

The atmospheric lines, as they may be called, or those lines and bands which are absorbed by the elements of an atmosphere, have their distinctness a maximum when the sun sinks beneath the horizon. The study of them consequently becomes exceedingly difficult in a climate where the sun, even in a serene day, almost always sets in clouds; but the author has been able to execute a tolerably accurate delineation of the atmospheric spectrum.

Most of the lines thus widened by the atmosphere, are faint lines previously existing in the spectrum.

The author's observations, whilst they indicate the remarkable fact, that the same absorptive elements which exist in nitrous acid gas exist also in the atmospheres of the sun and of the earth, lead us to anticipate very interesting results from the examination of the spectra of the planets. Fraunhofer had observed in the spectra of Venus and Mars some of the principal lines of the solar spectrum. This, indeed, is a necessary consequence of their being illuminated by the sun; for no change which the light of that luminary can undergo is capable of replacing the rays which it has lost. But while we must find in the spectra of the planets and their satellites all the defective lines in the solar spectrum, we may confidently look for others arising from the double transit of the sun's light through the atmospheres which surround them.

2. Notice relative to the Pigmentum Nigrum of the Eye. By Thomas Wharton Jones, Esq.

The objects proposed by the author of this paper are,—

1. To correct certain opinions prevalent with regard to the membrane of Jacob, this having been frequently confounded with another, the structure of which forms the immediate subject of the paper.

2. To show that the *Pigmentum Nigrum* is not a mere mucus or varnish exhaled by the surfaces on which it is found, but is deposited in a membrane distinct from the choroid, which possesses a peculiar structure hitherto unknown. This membrane, being the seat of the pigment, but not the pigment itself, which may or may not be present, the author proposes to call the *Membrane of the Pigment.*

If a portion of this membrane be examined by the aid of the microscope, it is seen to consist of very minute hexagonal plates, in which are deposited numerous black particles, which are to be considered as properly constituting the pigment, but not essential to the hexagonal plates composing the membrane, because these may, and do, exist without the black particles.

In the eye of the Albino Rabbit, the author found, as he had *a priori* expected, the membrane of the pigment to exist. The plates composing which, however, are still less developed than those of that part of the membrane which lies over the tapetum, in the eyes of the horse, ox, &c. They are in fact not hexagonal, but circular, a structure similar to which the author has found in the eye of a very young human fœtus.

Behind and around the ciliary processes, and on the posterior surface of the iris, the membrane of the pigment ceases to present the hexagonal structure, although still composed of small irregularly rounded masses of about the same size as the hexagonal plates, to which they are evidently analogous.

This change in the structure of the membrane of the pigment, which is only partial in the eyes of the Mammiferæ, the author has found to obtain in its whole extent, in the eyes of those animals lower in the zoological scale which he has examined, except in the eye of the Cuttlefish, in which there is an approach to the hexagonal structure in that part of the pigment which lies on the posterior surface of the part in which the crystalline lens is fixed.

May 6.

Sir THOMAS MAKDOUGALL BRISBANE,
President, in the Chair.

The following Donations were presented :—

Geological Sketch of the Vicinity of Hastings. By W. H. Fitton, M.D., &c.—*From the Author.*

Notes on the Progress of Geology in England. By W. H. Fitton, M.D.—*From the Author.*

Abstracts of the Papers printed in the Philosophical Transactions of the Royal Society of London, from 1800 to 1830 inclusive. 2 vols.

Proceedings of the Royal Society of London, No. 11.

List of the Fellows of the Royal Society of London for 1832–33.

Addresses delivered at the Anniversary Meetings of the Royal Society of London on November 30. 1831, and November 30. 1832.—*From the Royal Society of London.*

Memoirs of the Royal Astronomical Society. Vol. V.—*From the Society.*

Astronomische Nachrichten. No. CCXXXIII. to CCXXXVIII.—*From M. Schumacher.*

Nova Acta Physico-Medica Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum. Vols. X. XI. XII. XIII. XIV. and XV. Part I.—*From the Imperial Academy of Bonn.*

Transactions of the Linnean Society of London. Vol. XVI. Part III. —*From the Society.*

Treatise on Conic Sections, from the Encyclopædia Britannica. By Professor Wallace.—*From the Author.*

Bulletin de la Societé Geologique de France. Tome III. Feuilles I.-V.—*From the Society.*

The following Communication was then read :—

On the Composition of some Iron Slags. By J. F. W. Johnston, Esq., F.R.S.E.

This paper described the composition of some crystallized slags from Birtley Iron-Works, in the County of Durham. These slags, like those from Wales described by Professor Miller in the Cambridge Transactions, had the form of the olivine, and in composition were nearly pure silicate of iron, containing about 0·4 per cent. of foreign matter, chiefly magnesia. The author also gave a short account of a method by which the magnet might be made available in giving immediately very near approximations to the quantity of iron contained in the basic silicates of iron.

At the Birtley Iron-Works, the author stated that beautiful crystals of titanium had likewise been found.

Dr Knox made some verbal remarks on the Structure of the Ribs.

The Society then adjourned to the general meeting in November.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1833–34. No. 3.

December 2.

Sir THOMAS MAKDOUGALL BRISBANE, K.C.B., President, in the Chair.

The following Donations were presented :—

Flora Batava. Nos. 93 and 94.—*From the King of Holland.*

The Fortunate Union, a Romance. Translated from the Chinese original, with Notes and Illustrations, by John Francis Davis, F.R.S. 2 vols.

Hoeï-Lan-Ki, ou l'Histoire du Cercle de Craie, Drame en Prose et en Vers, traduit du Chinois, et accompagné de Notes. Par Stanislas Julien.

San Kokf Tsou Ran To Sets, ou Aperçu Général des Trois Royaumes. Traduit de l'original Japonais-Chinois, by Mr J. Klaproth.

The Shah Nameh of the Persian Poet Firdausi. Translated and Abridged, in Prose and Verse, with Notes and Illustrations, by James Atkinson, Esq.

History of the Pirates who infested the China Sea from 1807 to 1810. Translated from the Chinese Original, with Notes and Illustrations, by Charles Fried. Neumann.

The Life of Hafiz Ool-Moolk, Hafiz Rehmut Khan, written by his son. Abridged and translated from the Persian, by Charles Elliot, Esq.

The Geographical Works of Sádik Isfáhani. Translated by J. C. from original Persian MSS. in the collection of Sir William Ouseley, the Editor.

The Algebra of Mahommed Ben Musa. Edited and Translated by Frederic Rosen.

The Life of Sheikh Mahommed Ali Hazin, written by himself. Translated from two Persian Manuscripts, and illustrated with Notes, by F. C. Belfour, M.A., Oxon, F.R.A.S., LL.D.

History of the War in Bosnia, during the years 1737–38–39. Translated from the Turkish by C. Fraser, Professor of German in the Naval and Military Academy, Edinburgh.

Customs and Manners of the Women of Persia, and their Domestic Superstitions. Translated from the original Persian Manuscript, by James Atkinson, Esq.

Miscellaneous Translations from Oriental Languages. Vol. 1.

Yakkun Nattannawā; and Kōlan Nattannawā. Cingalese Poems. Translated by John Callaway.

Memoirs of a Malayan Family, written by themselves, and translated from the original by W. Marsden, F.R.S., &c. &c.

The Siyar-ul-Mutakherin; a History of the Mahommedan Power in India during the last century. By Mir Gholam Hussein-Khan. Revised from the translation of Haji Mustefa, and collated with the Persian original by John Briggs, M.R.A.S., Lieutenant-Col. in the Madras Army.

History of the early Kings of Persia. Translated from the original Persian of Mirkhond, by David Shea.

The History of the Maritime Wars of the Turks. Translated from the Turkish of Haji Khalifeh, by James Mitchell. Chapters 1 to 4.

The History of Vartan, and of the battle of the Armenians; containing an account of the Religious Wars between the Persians and the Armenians. By Elisæus, Bishop of the Amadunians. Translated from the Armenian by C. F. Neumann.

The Mulfuzāt Timūry, or Auto-Biographical Memoirs of the Moghul Emperor Timūr. Translated from the Persian by Major Charles Stewart.

The Adventures of Hatim Tai; a Romance. Translated from the Persian by Duncan Forbes, A.M.

History of the Afghans. Translated from the Persian of Neamet Ullah by Bernard Dorn. Part 1.

Hān Koong Tsew, or the Sorrows of Hān: a Chinese Tragedy. Translated from the original, with notes, by John Francis Davis, F.R.S.

The Travels of Macarius, Patriarch of Antioch; written by his attendant Archdeacon Paul of Aleppo, in Arabic. Translated by F. C. Belfour, A.M. Oxon. Parts 1, 2, and 3.

Memoirs of the Emperor Jahangueir, written by himself; and translated from a Persian Manuscript by Major David Price.

Raghuvansa, Kalidasæ Carmen, Sanskritè et Latinè. Edidit Adolphus Fredericus Stenzler.

Private Memoirs of the Moghul Emperor Humāyūn. Written in the Persian language by Jouher, a confidential domestic of his Majesty. Translated by Major Charles Stewart, M.R.A.S., &c.

Annals of the Turkish Empire, from 1591 to 1659 of the Christian era, by Naiman. Translated from the Turkish by Charles Fraser. Vol. 1.—*From the Oriental Translation Fund.*

Sexagesimal Logarithms.—*From Fletcher Raincock, Esq.*

Astronomische Nachrichten. Nos. 39 and 40.—*From Professor Schumacher.*

Alphabetical Index of the Transactions of the Royal Society of London, from vol. cxi. to vol. cxx. inclusive.—*From the Royal Society.*

Abhandlungen der Königlichen Akademie der Wissenchaften zu Berlin, aus den Jahre 1830 and 1831. 2 vols.—*From the Academy.*

Reports of the Commissioners appointed to fix the boundaries of the English burghs under the Reform Bill. 10 vols.

Reports of the Commissioners appointed to fix the boundaries of the Irish burghs under the Reform Bill. 1 vol.—*From —— Drummond, Esq.*

Transactions of the Cambridge Philosophical Society. Vol. v. part 1.—*From the Society.*

Recueil de Voyages et de Mémoires publié par la Société de Géographie de Paris. 3 tomes.—*From the Society.*

The Internal Structure of Fossil Vegetables, found in the Carboniferous and Oolitic Deposits of Great Britain, described and illustrated. By Henry T. M. Witham of Lartington, F.G.S., F.R.S.E.

The Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland Society of Scotland. No. 21.—*From the Highland Society.*

Mémoire Explicatif des Phénomènes de l'Aiguille Aimantée. Par Demonville.

Sur la possibilité de mesurer l'Influence des Causes qui modifient les Elémens Sociaux. Par A. Quetelet.—*From the Author.*

Bulletin de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles, 1832–33. Nos. 1–12.—*From the Society.*

Recherches sur les Poids de l'Homme aux différens Ages. Par A. Quetelet.—*From the Author.*

Philosophical Transactions of the Royal Society of London, 1833. Part 1.—*From the Society.*

Address to the third General Meeting of the British Association for the Advancement of Science. By the Rev. W. Whewell.—*From Professor Forbes.*

A Letter to the Members of the Temperance Society. By James Henry, M.B.

Miliaria accuratius descripta, a Jacobo Henry, M.D.—*From the Author.*

Catalogue of Preparations, &c., in Morbid, Natural, and Comparative Anatomy, contained in the Museum of the Army Medical Department, Fort Pitt, Chatham.—*From Sir James M'Grigor, Bart.*

Bulletin de la Société Géologique de France. Tome iii. Feuilles 6–9 and 14–16.—*From the Society.*

Barometrical Tables for the use of Engineers, Geologists, and Scientific Travellers. By William Galbraith, M.A.—*From the Author.*

Transactions of the Literary and Historical Society of Quebec. Vol. iii. parts 1 and 2.—*From the Society.*

Transactions of the Royal Irish Academy. Vol. xv.—*From the Academy.*

Asiatic Researches, or Transactions of the Society instituted in Bengal, for inquiring into the History, the Antiquities, the Arts and Sciences, and Literature of Asia. Vol. xvii.—*From the Society.*

The American Journal of Science and Arts. Conducted by Benjamin Silliman, M.D., LL.D., Professor of Chemistry and Mineralogy, &c., in Yale College. Vols. xx.–xxiv.—*From the Editor.*

Transactions of the Zoological Society of London. Vol. i. part 1.

Proceedings of the Committee of Science and Correspondence of the Zoological Society of London. Parts 1 and 2.—*From the Society.*

Tabelle über die Geologie, von Hermann von Meyer.—*From the Author.*

Lettre à la Nation Anglaise, sur l'union des Peuples et la Civilisation comparée; sur l'Instrument économique du Tems, appelé Biomètre, ou Montre Morale. Par Marc-Antoine Jullien de Paris.—*From the Author.*

Proceedings of the Geological Society of London, 1833. Nos. 31–32.

List of the Members of the Geological Society of London, 1833.—*From the Society.*

Memorie della Reale Accademia delle Scienze di Torino. Tomo xxxvi.—*From the Academy.*

Transactions of the Royal Asiatic Society of Great Britain and Ireland. Vol. i. parts 1 and 2, vol. iii. parts 1 and 2.—*From the Society.*

Conjectures relative to the origin of Numeral Hieroglyphics. By T. S. Davies.—*From the Author.*

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, pour les Anneés 1824–33. Jan. Févr. Mars, Avril, Mai, Juin. —*From the Society.*

Astronomical Observations made at the Royal Observatory at Greenwich. By the Rev. Dr N. Maskelyne. Vols. 2, 3, and 4.

Astronomical Observations made at the Royal Observatory at Greenwich, from 1811 to 1832, 44 parts. By John Pond, Esq.

Mémoires de l'Académie Impériale des Sciences de St-Pétersbourg, VIme Série (Sciences Mathématiques, Physiques, et Naturelles). Tomes i. and ii. Livres 1, 2, 3, 4.

Mémoires de l'Académie Impériale des Sciences de St-Pétersbourg, VIme série. (Sciences Politiques, Histoire, et Philologie.) Tomes i. and ii.

Mémoires de l'Académie Impériale des Sciences de St-Pétersbourg, Presentés pars divers Savans, et lus dans ses Assemblées. Tome i. Livr. 1–6.

Recueil des Actes de la Séance publique de l'Académie Impériale des Sciences de St-Pétersbourg, 1828–32. 5 parts.—*From the Imperial Academy.*

Verzeichniss der Pflanzen. Vom Dr C. Anton Meyer.—*From the Author.*

Catalogue Raisonné des Objets de Zoologie recueillis dans un Voyage au Caucase. Par E. Ménétries.—*From the Author.*

Hyperanthraxis, or the Cholera of Sunderland. By W. Reid Clanny, M.D., F.R.S.E., M.R.I.A.—*From the Author.*

The following Communications were then read :—

1. On a New Species of Coloured Fringes developed between certain pieces of plate-glass, exhibiting a new variety of polarization, and a peculiar property which renders them available for the purposes of Micrometry. By Mungo Ponton, Esq.

The author, when he first observed these fringes, found that they presented the appearance of three rectilinear bands, each consisting of black, white, and coloured stripes ; but the central band was afterwards found to be composed of two united into one. There is thus a band for each of the four surfaces of the plates, the two side ones, appertaining to the uppermost and undermost surfaces, and the centre ones to the surfaces which are approximated. The peculiarities by which they are distinguished are as follows :—

1*st*, They are confined to certain specimens of glass, but not to perfectly parallel plates.

2*d*, They are exhibited while the plates are at a considerable distance from each other, provided their surfaces are preserved as nearly parallel as possible; and they are not affected even by the interposition of another plate between those by which they are formed.

3*d*, They are destroyed by the application of Canada balsam or oil of turpentine to any one of the four surfaces.

4*th*, They are of uniform breadth and appearance, so long as the disposition of the plates remains the same, and are not affected by pressure in whatever manner it may be applied. The Newtonian fringes, on the other hand, are affected, both in breadth and direction, by the manner in which the plates are pressed together, so that they can be produced at right angles, or in any other position, with respect to the new bands.

5*th*, The fringes under consideration are produced by the light which is returned inwards upon the plates by reflection from their anterior surfaces, so that the rays suffer three reflections and four refractions before reaching the eye.

6*th*, They present phases of revolution which follow a different order according to the surfaces that are placed together, and varying, as the revolution is made, from right to left or from left to right. The bands revolve only at half the rate at which the plates move during the first semi-revolution; and during the last quarter of revolution, when certain faces are together, there is a complete breaking up of the rectilinear fringes, which spread themselves in curvilinear forms over the whole surface of the plates.

7*th*, When viewed by homogeneous light, the fringes appear as light and dark stripes, covering the entire surface of the plates, and of uniform breadth which cannot be altered, except by changing the arrangement of the plates; but by turning one of these, both the breadth and direction of the stripes are changed. Their number varies from 10 or 12 to nearly 2000.

8*th*, The plates which exhibit the fringes do not display any symptoms of possessing the doubly refracting structure, when viewed by polarized light. The appearance of the bands, however, is the same as that of the fringes, produced by crossing wedge-shaped plates of sulphate of lime, and passing polarized light through them, as described by Dr Brewster. It is therefore probable, that the new fringes are occasioned by the intersection of oppositely polarized pencils of light, whose polarity is induced by the repeated reflections and refractions which they undergo in passing and repassing through the plates—and it would seem as if each surface exerted an independent and peculiar polarizing effect on the rays,—a hypothesis which appears necessary to account for the phenomena attending a change in the disposition of the surfaces.

9th, They possess a peculiar property, which the author conceives will render them available for the purposes of micrometry. When the surfaces of the plates are parallel, two of the bands are united into one at the centre; but if a film be introduced between the plates, so as to cause them slightly to diverge, the two bands in the centre will be separated, and move laterally from each other, still preserving their perfect parallelism. A film, $\frac{1}{500}$th of an inch in thickness, causes the central bands to separate to a distance of an inch, so that every $\frac{1}{20}$th of an inch of separation is equivalent to $\frac{1}{10000}$th of an inch of thickness. When smaller thicknesses are to be measured, recourse must be had to the side bands, which are affected by a much slighter degree of divergence than the centre ones. A thickness so minute as that of gold leaf may be rendered sensible by the side bands, and a scale for micrometry might be found, by introducing successive leaves of gold of a known thickness.

2. Communication relative to the Fresh-Water Limestone of Burdiehouse, near Edinburgh, belonging to the Carboniferous Group of Rocks. By Dr Hibbert.

In his paper, the author explains that the limestone in question, which is confounded with the common carboniferous or mountain limestone of marine origin, is, in his opinion, of fresh-water origin.

On an irregular line extending from Joppa on the coast of the Firth of Forth, in a south and south-west direction to the Pentland Hills, strata of mountain or carboniferous limestone crop out at intervals; and their marine origin is indicated by encrinites, the Productus, &c., and corallines. This limestone is developed with least interruption between Edmonstone and Muirhouse, where it is from twelve to twenty feet thick. At this part of the line may be seen fractures and elevations of the strata of limestone and superincumbent shale and sandstone, evidently occasioned by a sudden and violent uplifting force acting from north-east to south-west, and causing the uplifted strata to dip south-east at an angle of 25°. These uplifted beds, between Edmonstone and Muirhouse, and subsequently to Burdiehouse, form the strata which dip under the coal-measures of Gilmerton, Loanhead, and other sites.

At Muirhouse Quarry the same mountain limestone is seen, but a covered state of the ground succeeds in the same south-west direction for a mile, in which no outcropping strata are observable, except some beds of sandstone about the middle of that space, dipping with the other strata towards the south-east at an angle of 25°, and situated higher than the limestone.

At the south-west termination of this space is situated the Quarry of Burdiehouse. It is difficult to determine, from the covered state of the ground, whether the bed of limestone here seen is lower or higher than the mountain limestone hitherto described; possibly the mountain limestone may here thin off, and be replaced by the Burdiehouse bed. The appearance of the strata, however, which crop out between Burdiehouse and Loanhead, dipping near the former site towards the south-east at an angle of 30°, and towards the latter at a less angle in the same direction, shew that the limestone of Burdiehouse, in common with the mountain limestone cropping out between Edmonstone and Muirhouse, is lower, and therefore of older formation, than the coal-measures of Gilmerton and Loanhead. Hence the limestone of Burdiehouse and the mountain limestone of marine origin, are jointly referable to one common epoch of formation.

The Burdiehouse limestone, however, is clearly not of marine, but of fresh-water origin. It forms a bed of twenty-seven feet in thickness, composed of strata about four and a-half feet thick, dipping south-east at angles of 23° and 25°, with the seams of stratification regular and continuous, and also with intersecting vertical seams. The bed is surmounted by bituminous shale, with which very thin layers of limestone occasionally alternate. The colour of the limestone is grey, brown, and occasionally purple; its fracture conchoidal, but often slaty, from the intervention of thin striæ of vegetable or bituminous matter; its texture hard and compact; its aspect dull, and it is not crystalline like the limestone of neighbouring quarries. It is tolerably pure, shewing little foreign matter except what is bituminous; and this is often disposed between the layers of the limestone where its structure is slaty. But its most remarkable character is the nature of the organic remains contained in it. These are, in the first place, plants belonging to the oldest vegetation of the globe; among which the *Sphenopteris affinis*, *Sphenopteris bifida*, *Lepidostrobus variabilis* of Mr Lindley, and various kinds of the *Lepidodendron*, seem to be ascertained. The species are numerous and distinct, so as to afford the most beautiful specimens that can be conceived, and a rich store of observation in fossil botany. But, secondly, the animal remains are even more interesting. One fragment of a fish, which, when entire, must have measured a foot in length, is closely allied to the fresh-water species of the family of *Cyprinidæ*. Innumerable minute animals referable to the fresh-water *Entomostraca* are also to be seen; one of these is probably a *Cypris*, and indications have been found of minute *Conchifera*, and of coprolites in great abundance.

The inference appears to the author irresistible, that the Burdiehouse limestone is of fresh-water origin. The neighbouring mountain limestone abounds in corallines, encrinites, and shells, all evidently marine. These are in vain sought for in the limestone of Burdiehouse; which, on the other hand, presents the remains of Fishes apparently inhabiting fresh-water, and of Ferns, Lycopodiaceous plants, and such aquatic vegetables as flourish most among fresh-water lakes and marshes. This limestone, then, is the memorial of some inland fresh-water lake or tank, within the waters of which it was elaborated.

December 16.

Sir HENRY JARDINE in the Chair.

The following Donation was presented:—

Transactions of the Agricultural and Horticultural Society of India. Vol ii. parts 1 and 2.—*From the Society.*

The following communications were read:—

1. "A General View of the Phenomena displayed in the Neighbourhood of Edinburgh by the Igneous Rocks in their relations with the Secondary Strata; with reference to a more particular description of the section which has been lately exposed to view on the south side of the Castle Hill." By the Right Hon. Lord Greenock.

The author referring, in the introductory part of his paper, to the views taken by Hutton of the structure of the earth's surface around Edinburgh, explained,—That the prevailing rocks are strata of sandstone and shale of the coal formation, with occasional beds of limestone; and interrupted by insulated as well as grouped hills of igneous origin, rising abruptly through them,—That the latter or trap-rocks, seem in many quarters interstratified with the former, as if they had burst while in a state of fusion between the strata of the secondary rocks,—That fragments of the secondary rocks are often seen imbedded in the trap, as if they had been broken away from the strata to which they belonged, and been hurried along by the fused erupted mass,—And that the trap-rocks often present very different appearances in the same hills, shewing that they were erupted under varying circumstances at different periods of time. The author farther explained, that the environs of Edinburgh seem to constitute a great basin, surrounded by trap-rocks, which dip outwards in all directions from a common centre,—the Pentland Hills, forming the southern boundary, the rocky coast of Fife at Burntisland the northern, and Salisbury Craigs and Corstorphine Hill the eastern and western limits.

The paper then proceeds to describe the appearances presented by a late section of the southern face of the Castle Hill, where several of the phenomena referred to above are very well illustrated. The great mass of the Castle Hill rock is a dark compact greenstone. Towards the south-west point, altered rocks are seen resting on the trap in a highly inclined position; and within the Castle wall, fragments of sandstone are imbedded in the greenstone, shewing that the latter must have burst in a state of fusion through the strata of the former. But at the south-east point of the rock, beyond the walls, the section lately made in cutting the new south-west road has displayed appearances, which, in the author's opinion, supply strong evidence that, subsequent to such eruption, the secondary and trap-rocks had been uplifted together by a common cause, probably acting on a great extent of the face of the country. This section shews five or six beds of sandstone, with alternate layers of slate-clay or marl. Signs of great confusion are found in these strata, more especially as they approach the point of junction with the trap rock,—their eastern extremity being thrown upwards, while their western portion is cast down, so as to lie unconformably on the upturned strata; and near the point of junction with the greenstone, the ends of the strata of sandstone and slate-clay are shattered, and have actually fallen over, so as to come obliquely in contact with the tabular masses of the greenstone. Yet it is remarkable, that the sandstone and shale present no appearance of semi-fusion or intermixture, where they are in contact with the greenstone; nor does the greenstone here present any imbedded masses of the secondary rocks, nor send out any veins among their adjacent strata. At the time, therefore, when the dislocation of the sandstone strata occurred at the point of junction with the greenstone, the latter could not have been in a state of fusion; and the only rational explanation which occurs is, that both rocks were raised, *in a solid state*, by some common cause, above the level of the waters under which they were originally formed; and that the fault or dislocation in the sandstone strata was produced by some subsidiary disturbing power acting at the same period.

2. Researches on the Vibrations of Pendulums in Fluid Mediums. By George Green, Esq. Communicated by Sir G. Ffrench Bromhead, Bart.

The author proposes in this paper to resolve a particular case of the motion of fluids, not previously noticed, and susceptible of practical application, namely, the circumstances of the motion of an indefinitely extended non-elastic fluid, where agitated by a solid ellipsoidal body moving parallel to itself, according to any given law; always supposing the body's excursions very small compared with its dimensions. The question here stated is considered by the author to admit of an easy general solution. As the principal object of his paper is to determine the alteration produced in the motion of a pendulum by the action of the surrounding medium, he insists more particularly on the case where the ellipsoid moves in a right line parallel to one of its axes; and endeavours to prove that, in order to obtain the correct time of a pendulum's vibration, it will not be sufficient merely to allow for the loss of weight caused by the fluid medium, but that it will likewise be requisite to conceive the density of the body augmented by a quantity proportional to the density of this fluid. He determines the value of the quantity last mentioned, when the body of the pendulum is an oblate spheroid, vibrating in its equatorial plane; and finds, that when the spheroid becomes a sphere, the quantity is precisely equal to half the density of the surrounding medium. Hence in the last case, the true time of the pendulum's vibration is obtained, if it be supposed to move in vacuo, and its mass be simply conceived to be augmented by half that of an equal volume of the fluid, while the moving force with which it is actuated is diminished by the whole weight of the same volume of fluid.

8. Observations on the Fossil Fishes lately found in Orkney. By Dr Traill.

The geologist has been for some time acquainted with the occurrence of Fossil Fishes of Caithness, and they have been more lately found also in Orkney, especially near Skaill, the seat of W. G. Watt, Esq. in Pomona.

The author describes these fishes as imbedded in a dark-coloured flag, which lies beneath three feet of soil and loose stone, and eleven feet of solid beds of similar flag, but destitute of organic remains. The fishes are contained in two strata, measuring together about two feet in thickness. The upper stratum contains only fishes belonging to the *Cartilaginei*, and seemingly the genus *Raia;* the lower contains numerous fishes that belong to the orders Thoracici and Abdominales, most of them with distinct scales. Almost all of them lie on their bellies or sides, none on their backs, and their attitudes generally bespeak the energy of their final struggles. The fishes of these two contiguous strata are never intermixed. The strata dip about one foot in seven to the north-west. The author found only a single specimen of a petrified vegetable with the fishes. It was the leaf of a canna or a reed.

The Orkney Islands have much uniformity in their geological structure. The principal rock is this sort of slate, which is connected with sandstone, and has occasionally interposed thin beds of limestone, that seldom contain any organic remains.

The only primitive rocks in Orkney are in a limited district around Stromness, and in the contiguous small island of Græmsey. There granite, and gneiss approaching to mica-slate, appear in the surface, and have resting on them a coarse sandstone conglomerate. This last is in immediate contact with the slaty rock described above. The highest ridges in Orkney are the mountains of Hoy, which are composed of thick beds of sandstone, in which the author lately discovered a vast bed of trap. This sandstone, as well as that which occurs in the other islands, belongs to the old sandstone; and the slaty rock is probably a newer part of the same formation.

There are not any distinct traces either of the mountain limestone or of the coal formation in Orkney, unless we are disposed to consider this slaty rock as the oldest member of the mountain limestone. But from its connexion with the sandstone, it is safer to reckon it a member of the old red sandstone series.

Specimens were exhibited to the Society illustrative of the author's statements.

4. Notice of further Discoveries at Burdiehouse. By Dr Hibbert.

The author announced that, since his former paper was read, on the organic remains of the limestone quarry at Burdiehouse, discoveries of still greater interest had been made. These chiefly consist of the remains probably of a large animal of the Saurian tribe, namely, what appears to be the epiphysis of one of the vertebræ, presenting, when broken across, the cancellated structure of bone—several large scales obtained by Mr Connell,—and, in particular, a large and beautifully perfect tooth, two inches and a quarter long, and covered with its enamel, which is quite entire. The remains here alluded to were exhibited and presented by the author and Mr Connell to the Society's Museum.

January 6, 1834.

Sir T. M. BRISBANE, President, in the Chair.

The following Communications were read :—

1. On the Investigation of Magnetic Intensity, by the Oscillations of a Horizontal Needle. By William Snow Harris, F.R.S.

The chief disturbing causes by which the magnetic intensity, as ascertained by the oscillations of the horizontal needle, are effected, are 1. Variations in the air in which they are performed; 2. The influence of changes in the mechanical conditions incidental to the mode of suspending the needle; 3. Changes in the disposition and intensity of the magnetism of the needle from heat and other causes.

These causes of disturbance the author proceeded to investigate.

I. He compared the oscillations of the needle vibrating in air, with those of the same needle oscillating *in vacuo;* and he minutely described the apparatus which he had contrived for allowing the needle to vibrate freely in an exhausted receiver, and his mode of determining the arcs of vibration. This apparatus enabled him to appreciate the resistance of air to the oscillations of the needle, and its effect in rendering *unequal* the duration of vibrations performed in long and in short arcs. Hence he inferred the impossibility of ascertaining the alleged diurnal changes of magnetic intensity by the common apparatus.

II. The second source of disturbance he endeavoured to obviate by a more accurate mode of suspending the needle; by which its centre of gravity and point of magnetic neutrality should be made to coincide. This the author proposes to accomplish by greater care in finding its true centre, and in adjusting its horizontality by means of small sliding counterpoises of platinum on each arm.

III. The influence of increase of temperature on the magnetic needle has generally been considered as *lowering* the tension of its magnetism; and it has been represented as again restored by cold: but the author's experiments seemed to prove the contrary, when the comparative experiments were made *in vacuo.* He considers, however, that if the needle be prepared, by being previously exposed to a variation of temperature from 212° to 0° of Fahrenheit, its tension will not afterwards be affected by ranges of temperature within these limits.

One of the most interesting parts of Mr Harris's paper is his mode of determining changes of magnetic tension in a particular magnet.

It is well known that if a needle be made to vibrate within a ring of copper, it will be more speedily brought to rest, than if vibrating in open space. The influence of the ring of copper, therefore, might be employed to detect changes in tension, provided the force which induced motion in the needle, and that force by which it would eventually be reduced to rest *without* the ring, were both constant quantities. This, however is not the case; but the author proposes to reverse the experiment, and cause the *ring to vibrate round the needle,* placed within it, so as just not to touch the ring. This will afford a comparative measure of the force of the needle at its poles, if we observe the influence of the needle in reducing the ring to a state of rest. A convenient mode of doing this he has given, and has deduced a general formula for estimating the differences in magnetic tension thus detected.

The author has also examined the influence of bright sunshine on the suspended needles; and has shewn that the difference observed in the oscillations of the needle in sunshine and in the shade, may be made nearly to vanish in the exhausted receiver; and he has rendered it probable, that the slight differences observed in bars oscillating in the sun's rays, are not altogether dependent on magnetism.

Lastly, the author endeavoured, by an artificial electric *aurora* in a *luminous conductor,* six feet long and four inches wide, to ascertain whether there was any effect produced on a finely suspended needle, placed within eighteen inches of the conductor; but the oscillations of the needle were not affected by a stream of electricity procured for twenty minutes from a powerful machine in this apparatus.

2. Experiments on Magnetic Intensity made at Liverpool and Manchester. By Dr Traill.

Dr Traill made a report to the Society of experiments made by him in 1832 at Liverpool and Manchester on magnetic intensity, measured by the oscillations of the horizontal needles belonging to the Society, which had been sent to him for that purpose. The reporter also stated the result of a series of experiments made by Professor Oersted and himself in Liverpool in 1823, which is important, as having been made use of by Professor Hansteen in constructing his *isodynamic magnetic lines* for Great Britain.

The result of Dr Traill's experiments is, that Hansteen has estimated the magnetic intensity of England a little too high, as Mr Dunlop found he had that of Scotland; and the reporter concluded that this arose from the experiments on which Hansteen founded his calculation being affected by some degree of local attraction, from the confined spaces in which the experiments were made.

The magnetic intensity, as deduced from the time of 300 vibrations in the reporter's experiments with the Society's needles, is, with Hansteen's cylindrical needle—

At Liverpool, mean of three series = 798".21
At Manchester, from one series . = 798 .82

With Dollond's flat needle—

At Liverpool, mean of three series = 1052.83
At Manchester, from one series . = 1051.76

The reporter also stated, that the magnetic dip at Liverpool, as ascertained by several experiments made there by Lieutenant Allen, R.N. and himself, with a needle furnished by the Board of Admiralty, for the late expedition up the Niger, is = 72° 2′ 24″.

The experiments on the dip, as well as two other series on magnetic intensity with a horizontal needle belonging also to the Admiralty, were made on the same spot as those with the Society's needles, viz. an open space in the Botanic Garden at Liverpool.

3. Description and Analysis of a Mineral from Faroe, not before examined. By Arthur Connell, Esq.

The mineral in question was put into the author's hands by Mr Rose, mineral-dealer of this city, as a substance supposed to be a variety of mesotype. Mr Rose obtained it from Count Vargas Bedemar of Copenhagen, who had brought it from Faroe.

It has a pure white colour, with some opalescence and translucence, a glistening vitreous lustre, and somewhat greater hardness than fluor. Its texture is imperfectly fibrous; but the fibres in some places diverge with considerable regularity, shewing an approach to a crystalline structure. The specific gravity is 2.362; it is remarkably tough and difficultly frangible, so as to require much time and labour to separate a mass of it into smaller fragments.

It gives off water at a red heat; and is fusible *per se* before the blow-pipe only on the edges, without any swelling up. With soda it fuses with effervescence into a semi-transparent glass; with borax and salt of phosphorous, gives colourless glasses; and, with nitrate of cobalt, presents no alumina reaction. It gelatinizes readily with muriatic acid when reduced to powder. The analysis was effected by this reagent. After separating silica, the metallic oxides were thrown down by ammonia, and the lime by carbonate of ammonia. The alcalies were separated from one another by chloride of platinum, and the water was determined by ignition. Its composition is as follows:

Silica	57.69
Lime	26.83
Water	14.71
Soda	.44
Potash	.23
Oxide of Iron	.32
Oxide of Manganese	.22
	100.44

This composition differs from that of all other minerals, so far as the author's knowledge extends; and shows the substance under analysis to be a hydrated quatersilicate of lime, conformably to the formula, $9\ S^4\ C + 16\ Aq$.

Sir David Brewster, who possesses a mass of the mineral which he received from Count Vargas Bedemar, has observed crystallized faces, but so near the general surface, that they cannot be separated. He has also found that it possesses double refraction; that it reflects a bluish light, and consequently transmits a yellowish one; and that it possesses no pyroelectricity. He has no doubt that it is a new mineral.

The author proposes to distinguish it by the name of *Dysclasite*, [δυς κλαω], as expressive of its remarkable tenacity and difficult frangibility. It will, of course, be arranged with the Zeolites.

The Secretary read an extract from a letter, giving a short description of the Stalactitic Caves recently discovered in the county of Tipperary, and exhibited various illustrative drawings.

Several additional specimens were exhibited from Burdiehouse Quarry; and Dr Hibbert read a short notice relative to the position of the limestone there, and the relation it bears to the mountain-limestone of Muirhouse and the neighbourhood. His observations were to the effect that, by examining some sections of the strata between Burdiehouse and Loanhead, he had now satisfied himself that the limestone of Burdiehouse lies *beneath* the great bed of mountain limestone formerly described by him as traversing the country from Joppa towards the Pentland Hills. The order of the strata between them is as follows:—*Burdiehouse limestone*—shale and thin beds of the same limestone,—sandstone and shale,—sandstone, coal blaes, ironstone bands, and thin seams of coal—*Mountain limestone*—limestone blaes—*Coal measures*.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1833–4. No. 4.

January 20.

Sir THOMAS MAKDOUGAL BRISBANE, K. C. B. President, in the Chair.

The following Donations were presented :—

Proceedings of the Royal Society, No. 13, and Statement of the Receipts and Payments of the Royal Society between Nov. 29. 1832 and Nov. 29. 1833.—*From the Society.*

Researches on Spherical Geometry, Polar Triangles, &c. By T. S. Davies, Esq.—*From the Author.*

Bulletin de la Société Géologique de France. Tome III. Feuilles, 17–24.—*From the Society.*

Memoirs of the Royal Astronomical Society. Vol. VI.—*From the Society.*

Astronomical Observations, made at the Royal Observatory at Greenwich in October, November, and December 1832, and January, February, and March 1833. By John Pond, Esq.—*From the Author.*

Observations of Nebulæ and Clusters of Stars, made at Slough with a twenty feet reflector, between the years 1825 and 1833. By Sir J. F. W. Herschel, K. H.—*From the Author.*

On the Absorption of Light by Coloured Media, viewed in connexion with the Undulatory Theory. By Sir J. F. W. Herschel, K. H.—*From the Author.*

Supplement to Dr Bradley's Miscellaneous Works, with an Account of Harriat's Astronomical Works. By Professor Regaud. —*From the Author.*

Mémoire sur le Choléra-Morbus compliqué d'une Epidémie de Fièvre Jaune, qui a regné simultanément à la Nouvelle-Orléans en 1832. Par M. Michel Halpheu, Docteur en Médecine. —*From the Author.*

Astronomische Nachrichten. Nos. 241 to 250.—*From Professor Schumacher.*

On the Influence of Colour and Heat on Odours. By James Stark, M. D.—*From the Author.*

Beiträge zur Petrefactenkunde. Von Hermann Von Mayer.—*From the Author.*

The following communication was read :—

On the Principle of Vital Attraction and Repulsion, with some applications to Physiology and Pathology. By Dr Alison.

The object of this paper was, to state and estimate the scientific value of a variety of facts, which have been recorded by various physiologists ; and many of which have been verified by personal observation, in proof of the proposition,—That the fluids of living bodies, or in immediate contact with them, are in many instances liable to movements,—dependent on the vitality of those bodies, but independent of any vital contractions of their solids,—and which can hardly be conceived to be effected otherwise than by certain *attractions* and *repulsions,* peculiar to the living state.

Five classes of observations, perfectly distinct from one another, were stated in proof of this general proposition.

I. The first are those made on the regular progressive movements of juices (made visible by whitish globules) in many kinds of vegetables, to which the name of *Rotation* has been given in the case of the cellular plants, such as the Chara and Caulinia, and that of *Cyclose* in the case of cellular plants with emitting juices, such as the different species of Ficus,—movements which go on nearly uniformly, under considerable variations of temperature, and of other external circumstances, while life continues ; and which are not only unattended with any visible contractions of the parietes of the cells or vessels containing the fluid, but are of such a nature, as no contractions of these parietes appear capable of producing, as appears particularly from the elaborate inquiries of Schultze, Amici, Nisbet, and Cassini. This conclusion is the more important, as it is probably applicable to nearly all the movements, peculiar to life, in the fluids of vegetables, although the observations on which it rests can be satisfactorily made on those only which contain opaque globules.

II. The second set of facts are those connected with the *visible currents,* which take place in water, in contact with many living bodies ; as ascertained, *first,* By the observations of Dutrochet and of Dr Grant on living sponges ; *secondly,* By those of Dr Sharpey, M. Quillot, and M. Raspail, on many aquatic animals, chiefly mollusca and the larvæ of reptiles ; and, *lastly,* By those of M. Raspail, and of many others, on certain animalcules, chiefly of the genus Vorticella. In all these instances, facts seem to be established, which are altogether inconsistent with the supposition of the movements depending merely on contractions or vibrations of any living solid textures.

III. The third class of facts adduced on this subject consists of those which show, that, in the fœtal state of animals, different parts are successively developed from the semi-fluid matter of the ovum ; and the particles of that matter must therefore have been much and variously moved before the heart acts, or any contractile vessels have been formed; and farther, that the human ovum itself, during the time when it is surrounded on all sides by the shaggy chorion, must draw its nourishment from the semi-fluid matter contained in the uterus, through the filaments of the chorion, without the aid of any contracting vessels in these filaments. These points appear established by the observations of Prevost and Dumas, Breschet, Velpaeu, Raspail, and others.

IV. The author considers the existence of attractions and repulsions, peculiar to the living state, among certain of the particles of the blood of animals, to be established by due consideration of the following facts :

1. By the phenomena of the coagulation of healthy blood, and the utter absence of any contemporaneous mechanical or chemical change, adequate to explain the change of aggregation of the particles of the fibrin, on which that process depends.

2. By the great retardation of that process, when blood (although its circulation is arrested) is confined within a healthy living texture.

3. By the great acceleration of that process, when the living texture, in which blood is contained, is severely injured.

4. By the total suspension of that process, when death is produced by a sudden and violent cause, especially by a cause which at the same time destroys the power of contraction after death in muscular fibres.

5. By the different modifications of that process, which are observed in inflammation.

6. By the phenomena which are observed in those portions of blood, which are extravasated in inflamed parts.

In proof of these points, the author refers partly to personal observation, and partly to the works of Hunter, Hewson, Thackrah, Scudamore, Prater, Schræder van der Kolk, Velpeau, Gendrin, Royer-Collard, and Kaltenbrunner.

V. The last set of observations, adduced in support of the general principle, are those which, in reference to more complex questions in physiology, are the most important, viz. those which indicate that the blood circulating in the capillary vessels of living animals, and examined by the microscope, exhibit a variety of movements, and changes of movement, which no visible or conceivable vital contractions of the heart and arteries are adequate to explain.

Most of these facts, as to the capillary circulation, were accurately described, and the conclusion, which appears inevitable from them, as to the existence, in the living state, of a peculiar cause of movement inherent in the blood itself, or at least independent of any impulse from contracting solids, was stated and carefully limited by Haller. In regard to the rest, the author refers, not only to personal observations, but chiefly to the authority of Dollinger, Wedemeyer, and Kaltenbrunner in Germany, and of Quillot and Leuret in France.

The analogies which may be traced, between the principle which seems thus established, and other ascertained laws both of living beings and of inorganic matter; and the applications which may be made of it, to the explanation of the more complex phenomena of the living body in health and disease, were reserved for a future communication.

February 3.

Sir T. M. BRISBANE, President, in the Chair.

The following Donations were presented:—

1. Transactions of the Society of Arts, Manufactures, and Commerce, vol. XLIX.—*By the Society.*
2. Entomologia Edinensis, or a History and Description of the Insects found in the neighbourhood of Edinburgh. By James Wilson, Esq., and the Rev. James Duncan.—*From the Authors.*

The following communications were read :

1. Notice of some recent discoveries in Organic Chemistry By William Gregory, M.D.

The author in this paper communicated to the Society an account of Creazote, a new organic principle lately discovered by M. Reichenbach, which possesses remarkable antiseptic properties, and is the source of the antiseptic power of wood-smoke, empyreumatic pyroligneous vinegar, and other empyreumatized substances; also of a very volatile fluid, lately put into his hands by Mr Enderby of London, which is obtained by the destructive distillation of caoutchouc, and possesses in a higher degree than any other menstruum the property of dissolving that substance ; and lastly, of three new crystalline bodies which have lately been discovered by M. Robiquet, and other French chemists, in opium, and which are named Narceïne, Meconine, and Codeïne. Specimens of the several substances were exhibited.

The author stated, more particularly in regard to the last of these principles, that although in common with the two other newly discovered principles of opium, it constitutes an extremely small proportion of that drug, it may be obtained in a tolerably large quantity from the muriate of morphia of commerce, which appears to contain about a thirtieth of codeine.

From experiments made on various healthy individuals with codeine, obtained in this manner, he is led to infer, that in the doze of three, four, or five grains, it is distinctly stimulant in its action, and to suspect that it may be in part the cause of the disagreeable exciting effects produced by opium in some particular constitutions.

2. On the Structure, Position, and other particulars of a Fossil Tree found in Craigleith Quarry in the month of October last. By H. T. Maire Witham, Esq.

The author describes this fossil tree as lying at an angle of sixty degrees and a half, with its direction between S. E. by E. 10°, and N. W. by W. 10°. The strata in which it is imbedded dip at an angle of 20° towards the S. E. This tree differs from that which was found in the same quarry in 1830, in being much less flattened, indeed nearly cylindrical ; and this difference appears to be accounted for by its almost vertical position, in consequence of which, the pressure of the surrounding medium would act in an equal degree all round the stem.

About fourteen feet of the stem have been exposed, and the thickest part measures three feet in diameter. The internal structure consists of uniformly elongated cellules, with medullary rays or plates, and the concentric circles, if any exist at all, are very indistinct. In the transverse section, the woody tissue presents the appearance of a regular radiating series of four-sided or subhexagonal cellules, with the usual medullary lines intervening. Two of the walls of the elongated cellules, those facing and parallel to the medullary plates, are regularly reticulated with two, three, or more series of contiguous subhexagonal areolæ.

The areolæ in both *Peuce* and *Pitus* are separated and roundish, whereas in the *Pinites* they are subhexagonal and continuous. This is the case with the fossil plant under consideration, which must therefore be referred to the last mentioned genus.

The constituents, according to an analysis by Dr Walker, are carbonate of lime 50.36, carbonate of iron 24.65, carbonate of magnesia 17.71, coal, silica, and a little water 6.15.

February 17.

JAMES RUSSELL, Esq. V. P., in the Chair.

The following Donations were presented :—

History of the Berwickshire Naturalist's Club, instituted September 1831.—*From the Club.*

Mémoires de la Société Géologique de France. Tome I. Part 1.—*From the Society.*

Mémoires de la Société de Physique et d'Histoire Naturelle de Génève. Tome II. Part 2. Tomes III. & IV.—*From the Society.*

Mémoires de l'Académie Royale des Sciences de l'Institut de France. Tome XII.—*From the Institute.*

The following Communications were read :—

1. Analysis of Coprolites from the Limestone of Burdie-House. By Arthur Connell, Esq.

These coprolites, as well as the limestone where they are found, contain a trâce of animal matter, as ammonia is disengaged at a red heat.

Muriatic acid dissolves the greater part with slight effervescence. Ammonia throws down from the solution a copious gelatinous precipitate of phosphate of lime ; and in the remaining fluid, oxalate o ammonia throws down oxalate of lime. The matter left undissolved by the muriatic acid is inflammable, leaving a small siliceous residue, and appears to be bituminous matter derived from the matrix. There is no magnesia, sulphur, nor fluorine.

The analysis of two coprolites, measuring from two inches to two inches and a half in length, and containing each a few fish scales, gave the following numerical results.

Phosphate of lime with a little oxide of iron.	85.08	83.31
Carbonate of lime, ...	10.78	15.11
Silica, ...	0.34	0.29
Bituminous matter, ...	3.95	1.47
	100.2	100.00

The proportion of phosphate of lime, appears thus to be pretty uniformly 5-6ths of the whole. The variation in the proportion of carbonate of lime may probably be influenced by the matrix, from which also the bituminous matter is derived. The limestone, when dissolved in muriatic acid, leaves a dark bituminous matter, in the proportion of 2.5 per cent.

2. Notice relative to the Polyzonal Lenses belonging to the Commissioners of the Northern Light-houses. By Alan Stevenson, Esq.

These lenses, which were exhibited to the Society by Mr Stevenson, are three in number. One, a plano-convex lens, two feet six inches square, was made by M. Soleil at Paris, under the superintendence of the late M. Fresnel. Another is a double-convex circular lens of flint-glass, three feet in diameter, which was constructed by the Messrs Gilbert of London, at the suggestion of Sir David Brewster. The third is a circular plano-convex lens. two feet six inches in diameter, cast in one piece as originally proposed by Buffon. This lens has been executed for the first time by the Messrs Cookson, plate-glass-makers, Newcastle.

The author, with the assistance of Mr John Adie jun., made a numerous set of observations, to determine the relative value of these lenses, and for this purpose ascertained, *first*, the mean focal distance of the central lens, and the several concentric rings of each, comparing the results with the focal distance of its aggregate surface; and *secondly*, the mean diameter of the spectra produced in the focus, by the central lens and several zones separately, comparing this result also with the spectrum formed by the whole compound lens. The general results are as follows :—

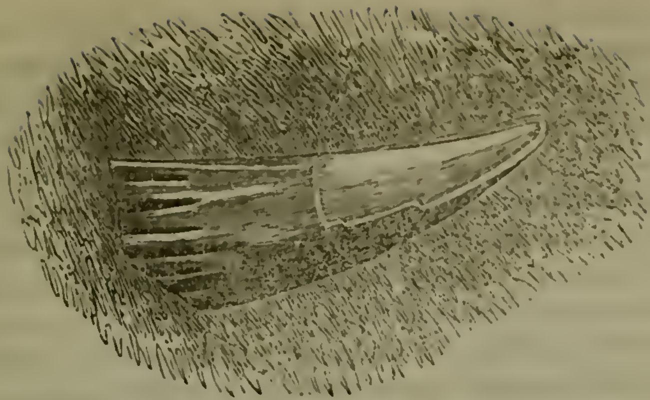
FRENCH.	Focal Dist. Feet.	In.	Diam. of Spec. In.
Mean for central lens and 5 rings severally, .	2	11.65	0.66
Aggregate surface of whole lens, . . .	3	0.25	0.70
Difference,	0	0.60	0.04
NEWCASTLE.			
Mean for central lens and 5 rings severally, .	2	11.97	0.57
Aggregate surface of whole lens, . . .	3	0.75	0.75
Difference,	0	0.78	0.18
LONDON.			
Mean for central lens and 4 rings severally, .	3	1.90	0.84
Aggregate surface of whole lens, . .	3	3.00	1.25
Difference,	0	1.10	0.41

The conclusion at which he arrives is, that the Newcastle lens is scarcely inferior to the lens made in Paris ; and that the Messrs Cookson are undoubtedly entitled to the merit of having successfully combated the difficulties which attend the making of polyzonal lenses in one piece,—difficulties previously considered insurmountable, but which they have overcome at the first attempt. The author expects that some of the particulars of the method by which they effected their purpose will be communicated to the British Association at their meeting at Edinburgh in September next.

3. Additional notice relative to the Freshwater Limestone in the vicinity of Edinburgh, belonging to the Carboniferous Group of Rocks. By Dr Hibbert.

In this paper, Dr Hibbert explained the progress which had been made, since he first pointed out the existence of plants as well as of fish and saurian animals, in the fresh-water limestone of Burdiehouse, towards a farther investigation of these animal remains.

The following is a representation of the first saurian relic discovered in the limestone of Burdiehouse by the author :—



The collection of specimens has been subsequently carried on by the Royal Society of Edinburgh, through their General Secretary Mr Robison.

The more important animal relics, which the limestone quarry has since yielded, are various kinds of fish, some of them referrible to the extinct race of the Palaeoniscus, large scales, evidently saurian, exhibiting a most brilliant lustre, and presenting in remarkable abundance what seem to be the epiphyses of vertebræ, numerous fragments of bones much broken, and teeth which, in their internal structure, give evidence of the dentition that is peculiar to animals more or less resembling the Crocodile, or Gavial.

a *b* *c*

The above figures represent the section of a tooth, obtained by Mr Robison, which had been accidentally broken in a longitudinal direction.

a shews the base of the tooth.

b is the reverse side of the same, in which a small internal cavity may be observed, indicative of a newer replacing tooth in an incipient state of growth.

c is the larger fragment of the tooth in which the newer tooth, of a conoid form, (protruded from its alveolus) is contained.

The cavities of the new tooth, and of the intermediate space of the old tooth, are at present filled with earthy substance.

The author then proceeded to point out other localities in which beds of fresh-water limestone crop out.

At East Calder, and to the south-west of Mid Calder, the limestone which is there quarried appears, like that of Burdiehouse, to have a fresh-water origin. Its strata have undergone great derangement, and dip in various directions. In one of the quarries of East

Calder, where a good section is exposed, the lowest rock is said to be sandstone, above which the following strata may be enumerated in an ascending order:—A yellowish coarse limestone, 16 feet thick;—limestone, 43 feet thick, in which vegetable remains are contained, such as are usually found in coal-fields, and, along with these, scales of Saurian reptiles;—nine feet of a very bituminous shale, part of which burns readily, mixed with ironstone;—shale (named Blaes) 16 feet;—and, at the top of the series, an alluvial covering of clay, sand, &c. in which large boulders occur.

Another site, where a fresh-water limestone crops out, is Kirkton, situated a mile or more east of Bathgate. Very interesting phenomena are here exhibited. The chemical action under which the deposit was elaborated, appears to have been so powerful as to have caused such miscellaneous earthy matters as are found to enter into the composition of an impure limestone, like that of Kirkton, to separate into laminæ, and to assume a sort of striped or ribb ned disposition, resembling what the author has occasionally noticed in Auvergne, where tertiary strata have come into contact with volcanic rocks. The strata, for instance, of Kirkton quarry, are composed of distinct and alternating thin laminæ, some of them being of remarkable tenuity, variously consisting either of pure calcareous matter, of translucent silex, resembling common flint, or of a mixed argillaceous substance, approaching porcellanite in its character, or of ferruginous, or even of bituminous layers; and the surface of the two latter description of laminæ has often a sort of blistered appearance, as if from the effect of heat. Frequently also, in the purer limestone, a globularly concretional structure is observable. The whole of the strata of Kirkton quarry shew a kind of warping or curvature, which is to be traced no less in small detached specimens of the rock than in the contortions or wavings which are exhibited among the strata upon a large scale.*

All these appearances, in connexion with the remarkable circumstance, that greenish-coloured beds of trap-tuff of igneous origin, originally perhaps ejected in the form of a hot tufaceous mud, are interposed among the strata in divers places, one of which has acquired the thickness of nine feet, lead to the conclusion, that the calcareous beds of Kirkton in their elaboration were in immediate contiguity with some volcanic focus, and that in their original de-

* This limestone is extensively quarried for burning, and the Author has understood, that, although very impure, it possesses qualities which particularly recommend it to the use of the agriculturist. These are well deserving of further investigation.

velopment they must have exhibited the phenomena of hot springs charged with earthy matters, principally calcareous, such as are familiar to the geologist at the present day, in districts where the volcanic agency is still in activity.

From this fresh-water limestone the author collected several plants, viz. Ferns, &c. of the same kind as are usually found in the carboniferous group of rocks. No remains of fish, as far as he could learn, have yet been detected in the deposit, nor, considering the circumstances under which the limestone was formed, could they perhaps be reasonably expected; but he is inclined to suspect that relics of some amphibious animal allied to the tortoise have been occasionally discovered.

The upper strata of this deposit are either alternated with, or surmounted by, beds of argillaceous shale, mixed with seams of ironstone. The whole of the strata dip to the west or north by west, and are succeeded, as far as can be learned from the covered state of the ground, by alternating beds of sandstone and shale, which, at the distance of less than half a mile from Kirkton quarry, underlie thick limestone beds containing marine shells and corallines. Lastly, all the beds of this vicinity seem to have been surmounted by masses of feldspar rock, occasionally columnar.

The inference to be drawn from these observations, is, that the fresh-water deposit of Kirkton, like that of Burdiehouse, has an earlier date of origin than the marine limestone of the district, and that important geological changes, probably of a gradual nature, had contributed to depress the lacustrine deposits which had thus been formed, beneath the level of some subsequent invading ocean.

March 3.

Sir THOMAS MAKDOUGAL BRISBANE, K. C. B. President, in the Chair.

The following donations were presented:—

Letter to his Grace the Duke of Hamilton and Brandon, respecting the Parochial Registers of Scotland. By James Cleland, LL. D., &c.—*From the Author.*

Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland Society of Scotland. No. 24.—*From the Highland Society of Scotland.*

Print of the Statue of Sir Joseph Banks, Bart., G. C. B.—*From the Committee for conducting its execution.*

The following Communications were read:—

1. On a New Register Anemoscope. By Dr Traill.

The author's object was to obtain an instrument which might register the changes of the wind in the absence of the observer. For this purpose he connected a vane with a vertical axis, at the lower end of which the horizontal revolution was changed to a vertical revolution by bevelled wheels; and the axis of the vertical wheel carried an index and pencil; which described on a vertical dial of slate, or of polished porcelain, all the changes experienced by the vane above. In this manner, however, the instrument registered the changes occurring during only one revolution of the vane. In order to obtain the registration of a greater variety of changes,—when the wind has blown all round the compass more than once, the following addition was made. "Each bevelled wheel containing 42 teeth, a pinion of 21 leaves was fitted to the axis of the vertical wheel, which pinion plays in the teeth of a smaller wheel with 42 teeth also provided with a pinion of 21 leaves. This last moves a second small wheel of 42 teeth, which again turns round the axis of the primary vertical wheel. The last small wheel moves a second index which turns round the dial-plate once, while the vane and primary index make four complete revolutions. The second index carries a stud, which moves in either direction a pair of hands concentric with the indices, but not attached to their axis. This stud, then, will carry one of the hands through 90 degrees, while the vane has made one complete revolution; or the hands are capable of indicating four entire revolutions of the vane. The face of the instrument has three concentric graduations. The interior is the rhumbs of the mariner's compass; the second has the degrees of a circle; and the outer scale has four series of 360 degrees."

2. On the force of the Latin Prefix *ve* or *vac*. By the Rev. John Williams.

The author, after describing shortly the history of the philology of the Latin language, and alluding to the corruptions which were introduced into the science during the dark ages, proceeded to show that the prefix *ve* or *vac* must always be regarded either as an adjective signifying small, or an adverb having the force of the Latin *parum* or *minus*.

The term is to be found, in the opinion of the author, in most of the cognate languages of the great Caucasian branch of the human race, and still remains in Scotland under its Latin form *ve*, for the Latin V was undoubtedly pronounced like our W, [*ve, wee.*]

The words explained were the following. VE-CORS a small heart, in opposition to largeness of heart, synonymous with wisdom. VE-SANUS, not sound, *parum sanus,* insane. VE-DIUS, Pluto, the god of darkness, *parum dius,* not luminous. VE-JOVIS, the small jovis, *parum juvans,* not aiding. VE-PALLIDA, not pale, *parum pallida,* flushed. VESCUS and VESCULUS, having little to eat, *parum escæ.* Ve-SBIUS, the local and ancient name of Vesuvius, hardly extinct, *parum σβεστος,* a name given to it by the Greeks, on their first arrival on the Campanian coast, when Ischia, called by them Inarine, was the active scene of the volcano. VE-SICA, a small sack. VE-SPA, a small σφηξ, in opposition to the hornet. VE-SPERA, the period when objects become less distinct,—*parum spicere,*—in opposition to the morning-star, *lucifer.* VE-STIBULUM, a small standing-place between the street and the house-door,—*parum stabulum.* VE-STIGIUM a small impression, a small point, *vestigium temporis,* a point of time. VE-GRANDIS, not well grown, *parum grandis.*

3. Dr D. B. Reid exhibited some experiments on the heating power of the radiant caloric from the lime-ball light of Mr Drummond,—and illustrated, by means of the same light, the transparency of flame.

March 17.

JAMES RUSSELL, Esq. Vice-President in the Chair.

The following communications were read:—

1. Notice of Experiments on the Diminution of Intensity sustained by the Sun's rays in passing through the Atmosphere. By Professor Forbes.

This subject, though in itself deeply interesting, and leading to conclusions of much importance for elucidating many obscure questions connected with the constitution of the Universe, has hitherto received but little attention. *Bouguer* attempted to fix the actual amount of diminution approximatively, by comparing the moon's light with that of wax candles at different ascertained elevations; and in this way obtained data, from which he inferred, that about a fifth part of the entire rays of the sun is absorbed in traversing the atmosphere vertically. *Lambert* concluded, that the loss sustained is much greater. By observing at two altitudes of the sun, the difference of temperature indicated by a thermometer in the shade and exposed to the sun's rays, and, determining by theory the proportion of air traversed at these altitudes, he inferred the loss at a vertical incidence to be $\frac{6}{10}$ths of the whole. On these slender foundations some philosophers have ventured to found most important conclusions on various subjects of transcendental speculation ;—such as the temperature of the sun's surface, and the temperature of planetary space.

Facts, however, of much greater value may be looked for, since the invention of Sir John Herschel's actinometer. Proceeding like Lambert on the principle, that the heating and illuminating powers of the sun's rays are proportional, this instrument measures the light by measuring the heat they produce. But, avoiding the great defect of Lambert's method, viz. the assumption, that the stationary condition of the thermometer is proportioned to the heating cause, a law which would only hold, if the cooling influence on the thermometer were invariable ; Herschel proposes to ascertain, by an extremely delicate thermometer, *first*, the velocity of heating in the sun's rays, or the number of degrees passed through in a given short space of time, and then, *secondly*, the rate of cooling in the shade. The algebraic difference of these expresses the excess of one effect over the other. These data will obviously supply the means of measuring the true intensity of the sun's rays ; since the velocity of changing temperature is known by Newton's law to be the measure of the producing cause.

Having made these preliminary explanations, the author proceeded to observe, that, at the request of Sir John Herschel, he had made some observations with two instruments entrusted to him by that gentleman during his visit to the Continent in 1832. Twenty series of observations were made on six different days in Swizerland at various altitudes, the comparative observations being made by Professor Kamtz of Halle in the overland of Berne. The columns of air varied from 5000 to 7000 feet. On one day, observations were made every hour from sun-rise to sun-set. Every observation indicated increased radiation at the higher station, and the general diminution appeared to be not less than $\frac{1}{3}$th for the thickness just mentioned, which is a far greater proportion than was assigned even by Lambert.

The author found, by an extensive series of experiments made at the Observatory of Paris, that, in favourable circumstances, the numerical estimate of radiation by Herschel's instrument may be relied on to $\frac{1}{100}$th of its amount.

2. On the application of the Microscope to the examination of the minute phenomena of chemical action. By the Rev. Edward Craig. Communicated by Dr D. B. Reid.

Dr Reid read a notice by the Rev. Edward Craig, of some modes which he had adopted for examining by the microscope, the phenomena of chemical action, by means of which, the most minute changes of appearance attendant on the contact of the smallest visible quantities of substances may be observed. The method was described to be:

1. The laying two or more substances on two thin flat plates of glass, and bringing them in contact with each other; so that the whole matter is spread in one thin level between the two glasses; and the several processes of union, decomposition, and crystallization may be accurately watched in a field of view of $\frac{1}{5000}$th of an inch.

2. By using longer glasses which project beyond the port-object, and applying a small spirit-lamp underneath, the processes of boiling and evaporation may be observed.

3. By using only one glass-plate and a lens of smaller power, so that it may be raised above the vapours which would rise and condense upon it, the galvanic battery may be applied, and its effect on substances seen.

4. By laying a thin plate of tourmaline on the port-object, beneath the object to be examined, and a similar plate above the object-glass, crystals may be examined microscopically in polarized light.

These methods of observation seem to present facilities for the incipient processes of analysis, which may be a guide to subsequent experiments of a more measured kind.

3. On a Register Barometer for indicating Maxima and Minima. By Dr Traill.

The author gave an account of a new, easy, and economical method of ascertaining the maximum and minimum of the oscillations of the barometer during the absence of the observer. It consists of two tubes, the diagonal and rectangular barometer of the author, fixed in the same frame. A piece of thick iron wire is introduced into the upper part of the former, and a similar piece into the horizontal arm of the latter. These pieces of wire are pushed before the mercurial columns, and when the mercury recedes, they remain behind, like the index in Rutherford's thermometer. That in the diagonal barometer will give the maximum, the wire in the rectangular barometer will indicate the minimum. The portions of steel are to be replaced at the extremities of the mercurial columns, for a fresh observation, by means of a magnet. The author has constructed an instrument on these principles, and found it to work well.

April 7.

Sir T. M. BRISBANE, President, in the Chair.

The following donations were presented :—

List of the Fellows of the Royal Society. Nov. 30. 1833.

Address delivered at the Anniversary Meeting of the Royal Society, on Saturday, Nov. 30. 1833, by His Royal Highness The Duke of Sussex, K. G., &c. &c. &c., the President.

Philosophical Transactions of the Royal Society of London, for the year 1833, part 2.

Proceedings of the Royal Society, 1832–33, No. 14.

Astronomical Observations made at the Royal Observatory at Greenwich, in April, May, June, July, August, and September 1833. By John Pond, Esq. Astronomer-Royal.

Supplements to the Greenwich Observations for the years 1830–32. By John Pond, Esq. Astronomer-Royal.

Catalogue of 1112 Stars, reduced from observations made at the Royal Observatory at Greenwich, from the years 1816 to 1833. —*From the Royal Society.*

Nouveaux Mémoires de l'Académie Royale de Bruxelles. Tomes 2, 3, 4, 5, and 7.

Mémoires de Prix de l'Académie Royale de Bruxelles. Tomes 2, 3, 5, 6, 7, 9.

Notices et Extraits des Manuscrits de la Bibliothêque dite de Bourgogne, rélatifs aux Pays-Bas; publiés par l'Académie Royale des Sciences et Belles-Lettres, pour faire suite a ses Mémoires. Par le Baron de Reiffenberg. Tome 1, part 1.

Rapport à Monsieur le Ministre de l'Intérieur sur les Travaux de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles depuis le mois de Juillet 1830.

Bulletin de l'Académie Royale des Sciences et Belles-Lettres de Bruxelles, 1833–34. Nos. 15–19.—*From the Royal Academy of Brussels.*

Statistique des Tribunaux de la Belgique, pendant les années 1826–30. Par MM. A. Quetelet, Directeur de l'Observatoire de Bruxelles, et Ed. Smits, Directeur du Bureau de Statistique. —*From the Authors.*

Recherches sur les Degrés successifs de Force Magnétique qu'une Aiguille d'Acier reçoit pendant les Frictions multiples qui servent à l'aimanter. Par M. Quetelet.—*From the Author.*

Astronomische Nachrichten. Nos. 251–257.—*From Professor Schumacher.*

Essai sur quelques Zodaiques apportés des Indes. Par M. de Paravey.

Etudes sur l'Archéologie. Par M. de Paravey.—*From the Author.*

Planum et Statuta Societatis Eruditæ Hungaricæ.

Annalium Societatis Eruditæ Hungaricæ volumen primum.—*From the Hungarian Literary Society.*

The Second Fasciculus of Anatomical Drawings, selected from the collection of Morbid Anatomy in the Army Medical Museum at Chatham.—*From Sir James Macgrigor, Bart.*

The following communications were read :—

1. Remarks on the Remains of an Oak dug from a Peat-moss near Lanfyne, Ayrshire. By Thomas Brown, Esq.

The oak described in this paper is believed by the author to have fallen into a small isolated lake, which had been subsequently filled up by the growth of aquatic plants, so as to form a peat-moss, in which the upper part of the tree has been completely preserved, with its bark entire. The tree had grown 500 feet above the level of the sea. The trunk was 48½ feet long, without any appearance of root. As it must therefore have been actually even longer, and the remains of other oaks were found near, it must have grown in a wood, probably forming a part of that division of the Caledonian forest, which, previous to the 14th century, covered Avondale and the upper part of Ayrshire. It must have contained 534 feet of measurable timber. The author conjectures, that the destruction of the forest commenced during the wars of the succession about the year 1300, and the contests between Edward I. and II. and Baliol and Bruce; for a number of silver pennies of the two Edwards had been found in the neighbourhood, but no coins of a later date. It is probable that these had been deposited by English soldiers soon before the battle of Bannockburn in 1314.

The author annexed some remarks on the remains of an undescribed Roman camp in the neighbourhood; and on a cairn of stones which had formerly been heaped on the spot where the battle between Robert Bruce and Aymer de Valence was fought in 1307.

Some observations were also made on the small size and present neglected state of our oak-woods in Scotland, and on the idea that the oak is excellently suited to the moist climate of the west of Scotland.

2. Analysis of Levyine. By Arthur Connell, Esq.

A few years ago, this mineral was described as a new species by Sir David Brewster, on account of peculiar optical properties ascertained by himself, and its crystallographic characters, as determined by Mr Haidinger. Berzelius, however, inferred from the analysis of a specimen sent to him by Sir David Brewster, that it is merely a variety of chabazite, its chemical constitution appearing to be, Silica 48, Alumina 20, Lime 8.35, Magnesia 0.4, Potash 0.41, Soda 2.75, Water 19.30. But, from a subsequent explanation, it seemed probable that Berzelius had analyzed not the true levyine, but a mixture of this and chabazite, constituting the specimen which was sent. The author therefore considered it desirable to execute a new analysis of the mineral in question, which he has found to yield the following results :—

Silica, . . .	46.33
Alumina, . .	22.47
Lime, . . .	9.72
Soda, . . .	1.55
Potash, . . .	1.26
Oxide of Iron, .	0.77
Oxide of Manganese,	0.19
Water, . . .	19.51
	101.77

The specific gravity is 2.198, the fundamental crystalline form a rhomb 79° 29′, as stated by Mr Haidinger, while that of Chabazite is 94° 46′. Sir David Brewster found the crystals to possess one axis of double refraction, like other rhombohedral crystals, while the optical properties of chabazite are very anomalous. It is impossible, therefore, to consider the two minerals to be the same, without disregarding several marked differences.

April 21.

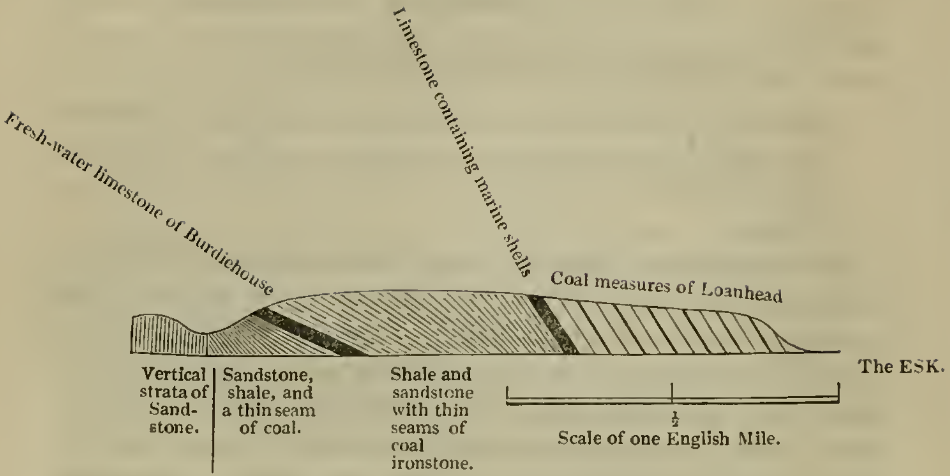
Sir THOMAS BRISBANE in the Chair.

The following Communications were read :—

1. Summary of the Discoveries hitherto made in the Ossiferous Beds of the Basins of the Forth and Clyde. By Dr Hibbert.

The author gave a summary of the discoveries which had taken place during the course of the session relative to the ossiferous beds of the basins of the Forth and Clyde. The additional information contained in his paper comprised, in the first place, an account of the older class of strata upon which the carboniferous group of rocks (in which saurian remains had been found) were supposed, in an unconformable position, to rest. Some of these were referred to a system of beds, which geologists consider as of a newer transition class, intermediate to grauwacke schist and coal strata. Thus, it was found that a peculiar hard and gray sandstone, containing mica, and occasionally alternated with siliceous schist,—which in Shetland succeeds to clay-slate; which, near Loch Ness, succeeds to a transition granite; and, on the north of the Tay, to grauwacke schist,—was thrown up on the south of the Forth, near North Berwick, in the form of immense severed beds or fragments, shewing that this transition-rock (an important one in the series of Scottish strata) is to be regarded as in some places fundamental to the coal measures of the district. This older grey sandstone is also alternated, either with aluminous strata of the same general character, or with a hard sandstone of a reddish colour.

The carboniferous deposits inclosing saurian and other remains which rest in an unconformable position upon these strata, were formerly shewn to contain inferior beds of sandstone, shale, and freshwater limestone, together with very thin seams of coal and ironstone; and to be succeeded, first, by a limestone containing marine shells, encrinites, corallines, &c., and afterwards by extensive coal measures which formed the upper beds of the series. This is shewn in the following general section of the strata connected with the limestone of Burdiehouse.



In arguing from these appearances, the author considered that, at the commencement of the Carboniferous epoch, the coal beds of the Forth and Clyde did not, agreeably to received theories, indicate an Archipelago of islets, like those of the Pacific, little elevated above the level of the sea, but, on the contrary, an unbroken expanse, bounded on the north by the elevated ranges of the Grampians, and on the south by the high ridge of grauwacke schist which runs from St Abb's Head to the Mull of Galloway; and that while the higher lands might have encouraged the growth of coniferæ, the ferns, equiseta, and other monocotyledonous plants of our coal-fields, flourished amidst marshes, or on the borders of fresh-water lakes, tenanted by entomostraca, conchifera, and fish. and to which resorted various saurian animals. This land, as had been previously remarked, appears to have undergone a depression, probably of a gradual nature, by which it became liable to the inroads of the sea. Eventually, however, (as the extensive coal strata lying above the marine limestone sufficiently indicate), the land became once more elevated above the ocean, and again afforded a soil to the Flora of tropical climates.

The author next remarked, that he had found a fresh-water deposit, like that of Burdiehouse and Calder, to extend to Fifeshire, where it existed as a thinner bed; and that, in addition to the coprolites and fish discovered more than a year ago by Lord Greenock and Mr Trevelyan in the iron-stone nodules of Wardie, Mr Robison, General Secretary of the Royal Society, had procured saurian remains from the coal-field of Greenside near Glasgow, and had discovered large coprolites in the shale which is associated with the sandstone of Craigleith quarry.*

Some remarks were made upon the remains of saurian animals, which had been more recently obtained for the Royal Society's Museum from the quarry of Burdiehouse, chiefly through the exertions of Mr Robison, and to which new acquisitions are daily adding. Among these, three distinct kinds seem to have been ascertained. The larger animal, the author thinks, rather approaches in character to the Steneosaurus of M. St Hilaire; but he suspects, at the same time, that such marks of difference exist, as must eventually authorize the assignment of the Edinburgh σαυρος to an entirely new genus. The other remains were supposed to resemble most those of the two kinds of Pterodactyli described by Cuvier. Bones also which appear to have belonged to a Trionyx have been discovered.

Lastly, the author adverted to prior notices of the actual discovery of saurian remains in the carboniferous group of rocks. Whitehurst, who wrote in the year 1778, and Pilkington, in his history of Derbyshire 1789, have each spoken of the remains of crocodiles and alligators which had been discovered in the limestone of Ashford in Derbyshire, from which locality the author has in his possession a specimen of fresh-water limestone, like that of Burdiehouse, containing plants. Four years afterwards, namely, in the year 1793, saurian remains like those of Burdiehouse, found in a bed above a seam of coal, were actually figured by the Rev. Mr Ure in his History of Rutherglen near Glasgow, though he was not aware of their real character. And very lately the discovery of a saurian vertebra in the mountain-limestone of Northumberland, by the Rev. Charles Vernon Harcourt, has been recorded by Mr Lyell in his Principles of Geology.

The author, in concluding, expressed his reluctance to allude to other occasional notices which had been published, regarding the discovery of similar remains, on account of their having been mistaken for those of fish. But, if found necessary, he will complete the history.

2. Account of the Dissection of a Young Rorqual, or short Whalebone Whale, (the Balæna Rostrata of Fabricius); with a few Observations on the Anatomy of the Fœtal Mysticetus. By Dr Knox.

In February 1834, a young Whalebone Whale was taken near the

* Dr Fleming has, within these few days, found, at Clackmannan, an interesting relic, exhibiting large scales in a natural state of juxta-position (not imbricated), which will, of course, be described by himself.

Queensferry, in the Frith of Forth. After being exhibited for a short time by the proprietors, it was dissected by the author as carefully as time and circumstances would permit. The term Rorqual is employed throughout this memoir in the sense employed by M. Cuvier, as designating " Whalebone Whales, with longitudinal folds under the throat and chest." He thinks the present specimen quite distinct, specifically from the " Great Rorqual," (the Balæna boops, jubarte, musculus, &c.), and not as M. Cuvier seems to think it, a mere variety. Among other distinctions, the Great Rorqual has 13 dorsal, and 43 lumbar, sacral, and caudal vertebræ; while the individual now under consideration has only 11 of the former, and 36 of the latter. There are, therefore, at least two species of Rorquals inhabiting the North Seas, viz. the Great Rorqual, and the one now under consideration, a specimen of which was described by Fabricius (Balæna rostrata); another dissected by Hunter, and a third casually observed by James Watson, Esq., who sent a drawing of the same to Dr Traill, by whom it was communicated to Mr Scoresby.

The author had not leisure to examine the osteology with sufficient care; the following results have, in the mean time, been attained.

Internal and External Character.—Eight distinct bristles, arranged in perpendicular rows, were found in the extremity of the snout, in both jaws. The lower part of the mouth is a huge pouch, which, in the Great Rorqual, must at times contain a vast volume of water. The tongue was free towards the apex; and the inside of the mouth of a pale rose or vermilion colour.

The whalebone was about $2\frac{1}{2}$ inches in length, varied from a pale rose colour to a dull-white, and 614 large external plates were counted. No vestiges of teeth were found in either jaw; but it is not improbable that they exist in the fœtus of this species, as well as in that of the Mysticetus, in the lower jaw of which, lying imbedded below the gum, a series of teeth was discovered by M. Geoffroy St Hilaire several years ago; and in which the author of this paper has since observed them in the *upper jaw.*

Brain and Nervous System.—The cranium, besides containing the brain and its membranes, incloses a very large mass of a vascular substance, closely resembling an " erectile tissue." This forms an exception to the hitherto uniformly observed law of coincidence, at least in the Mammalia, between the configuration of the inner table of the skull and the contained brain. The erectile tissue filled a large proportion of the interior of the cranium, also three-fourths of the spinal canal, where it surrounded the spinal marrow and nerves; being in some places nearly two inches in thickness. The whole cerebral mass, comprising two inches of the spinal chord, weighed $3\frac{1}{2}$ pounds; while the cerebellum, pons, and two inches of the chord, weighed only three-fourths of a pound.

Respiratory Organs.—The mode of breathing, and the structure of the nostrils, was precisely as in the Great Rorqual. Two bolster-like substances filled the nostrils, which are withdrawn from them at the moment of breathing by muscles provided for that purpose. There are turbinated bones in the nose and olfactory nerves, as large at least as the human. The author thinks it impossible for water to be habitually spouted through the nostrils. The Whalebone Whales have complex nostrils, and smell and breathe precisely as the higher orders of the Mammalia.

The *Stomach,* composed of four compartments, contained no food. The middle tunic of the *ureter* was composed of distinct longitudinal muscular fasciculi.

The author then proceeded to consider, at some length, a question which has lately arisen relative to the structure and functions of the abdominal glands of the Cetaceæ, and which has been six or seven times before the French Institute in the course of the late and present session,—viz. Whether these glands are mammiferous? M. St Hilaire conceives that they are not mammæ, and do not secrete milk, but that they are probably similar to those of the *Ornithorynchus paradoxus,* which he thinks are sexual, specific, and odoriferous, but not mammiferous.

The author first observed, that the question ought, in strictness, to be limited to the Whalebone Whales among the Cetacea; because the great group of the *Delphinus* was proved to be mammiferous long ago by Mr Watson, an extract of whose observations is given in "Scoresby's Greenland." He next stated, that his own observations left, in his opinion, no doubt whatsoever, that the similarly situated glands in the *Balæna rostrata* are also true mammæ. An elaborate anatomical examination shewed that they resembled the lactiferous glands of other mammalia in their structure. A cursory examination of the fœtal *Mysticetus,* led to the same conclusion in regard to that genus; and the author was farther informed by a former pupil, Mr Auld, that in the young Mysticetus harpooned, he had seen a fluid of a cream colour and consistence, and oleaginous taste and smell, issue abundantly from the mouth; and, in the full-grown females, he had forced out several pounds of a similar fluid from the orifices of the glands by pressure of the foot on the abdomen.

The specimen of Balæna rostrata examined by the author was 9 feet 11 inches in length, 3 feet from snout to ear, and 4 feet 8 inches in girth at the termination of the plicæ and folds.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1834–35. No. 5.

December 1.

Sir THOMAS MAKDOUGALL BRISBANE, K.C.B., President, in the Chair.

The following Donations were presented :—

An Essay on the Deaf and Dumb; showing the necessity of Medical Treatment in Early Infancy; with Observations on Congenital Deafness. By John Harrison Curtis, Esq.—*By the Author.*

The Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland, for September 1834.—*By the Highland and Agricultural Society of Scotland.*

Reports of the Scarborough Philosophical Society for 1831, 1832, and 1833.—*By the Society.*

Bulletin de la Société Géologique de France. Tome iv. Feuilles 10–24; and Tome v.—*By the Society.*

Archiv fur Chemie und Meteorologie, herausgegeben vom Dr K. W. G. Kastner. Bands 1, 2, 3, 4, 5, 6, and Band 7, Heft 1. —*By the British Association.*

Quelques Observations de Physique Terrestre. Par MM. Aug. De La Rive, and F. Marcet.—*By the Authors.*

Esquisse Historique des Principales Découvertes faites dans l'Electricité depuis quelques Années. Par M. Auguste De La Rive. —*By the Author.*

Notice Biographique sur M. le Professeur G. De La Rive.—*By the Author.*

Bulletins de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Nos. 19–24.—*By the Society.*

Annales de l'Observatoire de Bruxelles, publiées par le Directeur, A. Quetelet. Part I.—*By the Author.*

Astronomische Beobachtungen auf der Königlichen Universitäts Sternwarte in Königsberg. Von F. W. Bessel, for 1830.—*By the Author.*

Astronomische Nachrichten. Nos. 258–264.—*By Professor Schumacher.*

Transactions of the Royal Irish Academy. Vol. xvii. Part 1.

Asiatic Researches—Transactions of the Physical Class of the Asiatic Society of Bengal. Vol. xviii. Part 2.—*By the Society.*

A Treatise on Insects, being the article Entomology, from the 7th Edition of the Encyclopædia Britannica. By James Wilson, Esq.—*By the Author.*

Nova Acta Regiæ Societatis Upsaliensis. Vol. x.—*By the Society.*

The Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 1.—*By the Society.*

Transactions of the Royal Asiatic Society. Vol. iii. Part 3.—*By the Society.*

A Manual of Mineralogy, comprehending the more recent Discoveries in the Mineral Kingdom. By Robert Allan, Esq.—*By the Author.*

Transactions of the Zoological Society of London. Vol. i. Part 2; and

Proceedings of the Zoological Society of London. 1833; Part 1.—*By the Society.*

The American Journal of Science and Arts, conducted by Benjamin Silliman, M.D., LL.D. For April and October 1834.—*By the Editor.*

The Climate of London deduced from Meteorological Observations made in the Metropolis, and at various places around it. By Luke Howard, Esq. 3 vols.—*By the Author.*

Proceedings of the Fifteenth Anniversary Meeting of the Hunterian Society, held on the 4th February 1834, with the Report and List of Officers and Members.—*By the Society.*

A Practical and Pathological Inquiry into the Source and Effects of Derangements of the Digestive Organs. By William Cooke, Esq.—*From the Author.*

Fauna Americana, being a Description of the Mammiferous Animals inhabiting North America. By Richard Harlan, M.D.—*From the Author.*

Proceedings of the Geological Society of London. Nos. 33, 34, and 35.—*From the Society.*

Report of the Managers of the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, in relation to Weights and Measures.—*From the Institute.*

Bulletins de la Société d'Encouragement pour l'Industrie Nationale, 1833 and 1834: January to April.—*From the Society.*

Mémoires d'Institut Royal de France—Académie des Inscriptions et Belles Lettres. Tome x.—*From the Institute.*

Conjectures concerning the Origin of Alphabetic Writing. By Thomas Stephens Davies, Esq.—*From the Author.*

Transactions of the Linnean Society of London. Vol. xvii. Part 1. —*From the Society.*

Memoirs of the Royal Astronomical Society. Vol. vii.—*From the Society.*

Transactions of the Cambridge Philosophical Society. Vol. v. Part 2. —*From the Society.*

Nautical and Hydraulic Experiments, with numerous Scientific Miscellanies. By Colonel Mark Beaufoy, F.R.S. Vol. i.—*By the Editor.*

Transactions of the American Philosophical Society, held at Philadelphia, for promoting Useful Knowledge. Vol. iv. New Series, Part 3.—*From the Society.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin, 1832.—*From the Academy.*

An Engraving of the Royal William Yard, Plymouth. By J. Rennie, Esq.—*From J. Rennie, Esq.*

Mémoires de la Société d'Agriculture, from 1814 to 1833. 25 Tomes.—*From the Society.*

Rapport au Conseil Supérieur de Santé sur le Choléra Morbus Pestilentiel. Par Alexandre Moreau de Jonnès.—*From the Author.*

Statistique de l'Espagne. Par Alexandre Moreau de Jonnès.—*From the Author.*

Histoire Physique des Antilles Françaises. Par Alexandre Moreau de Jonnès.—*From the Author.*

Origines Biblicæ; or Researches on Primeval History. By Charles Tilstone Beke, Esq. Vol. i.—*From the Author.*

Population Abstracts of Great Britain. 3 vols.—*From J. Rickman, Esq.*

Proceedings of the Royal Society. No. 15.

Transactions of the Royal Society of London, 1834. Part 1.—*From the Society.*

Elements of Chemistry, including the recent Discoveries and Doctrines of the Science. By Edward Turner, M.D., F.R.S.L. and E. Fifth edition.—*From the Author.*

Astronomical Observations made at the Royal Observatory at Greenwich, under the direction of John Pond, Esq., Astronomer Royal, for the years 1831 and 1832; January to September.—*From the Royal Astronomical Society.*

Observations Sommaires, sur les Canaux Navigables, et les Chemins de Fer, et sur les avantages que la France peut obtenir de sa Canalisation, notamment pour la prosperité de son Agriculture. Par M. Huerne de Pommeuse.—*From the Author.*

A Cameleon, a Fly Fish, and a Lantern Fly, preserved in spirits.—*From John Gordon, Esq.*

The following Communications were read:—

1. On Phosphuretted Hydrogen Gas. By Thomas Graham, Esq., Glasgow.

It is well known that chemists have usually admitted the existence of two gaseous compounds of phosphorus and hydrogen,—one spontaneously inflammable, the other not so. Of late, *Rose* of Berlin has ascertained that both gases are identical in composition, and has consequently been led to infer that the existence of two phosphuretted hydrogens, differing so much in properties, and yet similarly composed, constitutes an example of isomerism among gaseous bodies.

Mr Graham, however, shows in his paper that this inference is not borne out by the facts of the case,—that there are not two phosphuretted hydrogens,—and that the spontaneous inflammability of the gas obtained by heating together phosphorus, lime, and water, is an accidental property, which may be removed by a variety of agents, without altering the constitution of the gas, and which may also be restored to such gas, as well as communicated to that which is not in the first instance spontaneously inflammable.

The agents which exercise the most remarkable power in destroying the property of spontaneous inflammability are, *in the first instance*, various other gases, such as hydrogen, sulphuretted hydrogen, olefiant gas, nitric oxide gas, carbonic acid, nitrogen, ammonia, or muriatic acid gas, which, in a proportion varying from a twentieth of a volume to five volumes, will at once take away the property in question;—*secondly*, certain porous bodies, more especially charcoal;—*thirdly*, various acids, such as sulphuric, arsenious, phosphorous, and phosphoric acids;—*fourthly*, solution of caustic potass and potassium; —*fifthly*, alcohol, ether, naphtha, and the various essential oils. These substances produce their effect sometimes in most minute proportions, commonly in a very short space of time, and without necessarily occasioning any change in the volume of the gas, or any other alteration whatever, except simply the loss of the property of kindling spontaneously on its coming in contact with the air.

The only agent which the author has found to possess the power of restoring spontaneous inflammability to gas which has been deprived of that property, by keeping or otherwise, is nitrous acid vapour. A large proportion of this vapour has no such effect, but a small proportion, varying between a thousandth and a ten-thousandth of the gas, will immediately communicate the property of kindling spontaneously in the air, even to the phosphuretted hydrogen prepared by heating hydrated phosphorous acid, which variety of gas is well known to be always naturally destitute of this remarkable character.

Gas which has been rendered spontaneously inflammable in this way is similarly acted on by keeping, by other gases, by acids, by potassium, and by the hydrocarburets, as the common phosphuretted hydrogen, prepared from lime and phosphorus.

The author concluded his observations by stating, that the analogous action of nitrous acid, and the circumstance that the agents which take away the property of inflaming spontaneously are chiefly deoxidating substances, would lead to the conjecture that this property is owing to the accidental presence of a minute trace of a compound of oxygen and phosphorus not hitherto known, but analogous in composition to nitrous acid among the compounds of oxygen and nitrogen. On account of the extremely minute proportion in which it exists in the spontaneously inflammable phosphuretted hydrogen gas, he was unable to insulate it. But an important additional reason for believing in its existence appears to the author to be the fact, that while the compounds of phosphorus and of nitrogen severally with oxygen coincide in composition in other respects, an oxide of phosphorus has not yet been discovered which coincides in composition with nitrous acid among the oxides of nitrogen.

2. On the Fossil Fishes of the Limestone of Burdiehouse. By Dr Hibbert.

In this paper the author gave an account of a communication received by him from M. Agassiz, Professor of Natural History at Neuchâtel in Switzerland, relative to the remains of fishes which had been discovered in the limestone of Burdiehouse, and which had been submitted to his examination. As many of the fish discovered would be explained in his "Recherches sur les Poissons Fossiles," an opinion upon a few only was requested.

The genus found in greatest abundance had been referred by Dr Hibbert to the Palæoniscus, which view was confirmed by M. Agassiz, who, in pointing out its distinction from the Palæoniscus angustus of Autun, which it most resembled, regarded it as a new species. This very characteristic fish of the limestone of Burdiehouse, Dr Hibbert has named Palæoniscus Robisoni, in honour of Mr Robison, General Secretary of the Royal Society of Edinburgh. Another fossil fish of a new and extraordinary genus, received the name of Eurynotus crenatus. A third, which was the first animal relic discovered by Dr Hibbert in the quarry of Burdiehouse, was named, at his request, the Pygopterus Bucklandi.

The bony rays, of immense dimensions, and beautifully configurated, in the possession of the Royal Society of Edinburgh, M. Agassiz refers to a new genus of fish; and he proposes to name the individual to which they belong the Gyracanthus formosus. He is also inclined to refer to the same individual certain teeth found in another locality near Edinburgh. This genus belongs to his Placoidan order, and to the family of Cestraciontes, so named from their approach to the Cestracion of New Holland. With regard to the alleged Saurian character of the teeth, scales, and some of the large bones discovered in the quarry of Burdiehouse, M. Agassiz was induced to consider them as *Sauroid*, rather than exactly Saurian, and to assign them to a large sauroid fish, akin to the extant Lepidosteus. In the form of its teeth, and in a very near resemblance of its scales to those of a reptile, the Lepidosteus agrees with Crocodilian families. Nor does this general correspondence fail, even with regard to the internal structure of the animal. M. Agassiz has described the result of an investigation of the swimming bladder of a specimen of the Lepidosteus spatula, preserved in spirits, from the dissection of which he was enabled to demonstrate not only that it is a real lung, but that it even approaches closely to the structure of the lungs of reptiles, having characters in common with the lungs of salamanders, and of the reptiles improperly called doubtful reptiles. The lung or swimming bladder of the Lepidosteus is not only cellular, but has also a trachea, which extends the whole length of its anterior surface, and communicates with a glottis, surrounded by ligaments, intended to open and shut it, constituting an apparatus even more complicated than what is found in many reptiles. M. Agassiz also adds, that the heart has not the appearance of that of a common fish ; it is destitute of the inflation named bulbus aorticus, so characteristic of fish, and hence has much more the aspect of the heart of a reptile.

With this fish, in its well-marked external characters, M. Agassiz has compared the sauroid relics discovered at Burdiehouse, and, in this inquiry, he has been assisted by the entire head of a large fossil fish, preserved in the museum of Leeds. From the aid thus derived, he has been enabled to establish a new genus under the name of Megalichthys. With regard to the scattered and disjointed bones found at Burdiehouse, it is conceived that they indicate a distinct species, to which M. Agassiz has some time since given the name of Megalichthys Hibberti. To the remains of another species of the same genus discovered near Glasgow, and distinguished by a greater flatness of its teeth, M. Agassiz is disposed to assign the appellation of Megalichthys fulcatus.

In concluding the account of this investigation, Dr Hibbert made some observations on the importance in geology of selecting for purposes of close comparison and analogy, animals subsisting in recent times, which may be adjudged to bear the nearest affinity to races long since extinct. In the present instance, the discrimination and talents of M. Agassiz had been enabled to rescue from obscurity a sauroid fish dwelling among the lakes and rivers of the most thermal regions of America, and to render it elucidative of one of the earliest states of our planet, when, in the language of this naturalist, fish united in their particular organization the character of reptiles belonging to that class of animals which only appeared in far greater numbers during a later epoch.

December 15. 1834.

JAMES RUSSELL, Esq., Vice-President, in the Chair.

The following Donations were presented :—

Mémoires de l'Académie Impériale de St Petersbourg, (Sciences Mathématiques, &c.). Tome ii. Livraisons 5 et 6.

Mémoires de l'Académie Impériale de St Petersbourg, (Sciences Politiques, &c.). Tome ii. Livraisons 2, 3, 4, 5.

Mémoires de l'Académie Impériale de St Petersbourg (par divers Savans.) Tome ii. Livraisons 1, 2, 3.

Recueil des Séances publiques de l'Académie Impériale de St Petersbourg, tenues en Decembre 1826, Decembre 1827, and Decembre 1833.

Transactions of the Royal Society of Literature of the United Kingdom. Vol. 2.—*From the Society.*

Mémoires de la Société de Physique et d'Histoire Naturelle de Geneve. Tome vi.—*From the Society.*

The following Communications were read :—

1. General Remarks on the Coal Formation of the Great Valley of the Scottish Lowlands. By Major-General Lord Greenock.

In this paper the author stated, that although there is sufficient evidence in the mechanical origin and organic contents of the beds (some of them of extraordinary thickness and extent) which form the coal-measures, to prove the pre-existence of much larger tracts of dry land, in connection with each other, than could possibly have been afforded by the older portions of the present countries; such proofs are altogether wanting when we endeavour to restore, in imagination, what might have been the probable extent of that land, the greater part of which may now lie buried beneath the ocean, or have since been covered by more recent deposits. It appears, however, to have been clothed with a luxuriant tropical vegetation, and sufficiently elevated to have given rise to the rivers and torrents, by which the materials for composing the coal strata had been carried down into the lakes or estuaries, where to all appearance they were deposited.

The circumstances in which the large fossil trees are seen imbedded in the strata of the coal-measures, and other similar phenomena, have led the author to suppose, that these rivers and their estuaries may have been of greater magnitude than would probably have been the case if they had been situated in small islands, according to the opinion of many geologists. The intermixture of terrestrial and marine remains in the same beds, is a strong evidence in favour of their fluviatile origin; and the fact frequently observed, of these beds being covered by, or alternating with, others containing only marine remains, may, with great probability, be referred to changes in the relative level of the land and sea that may have taken place while these deposits were forming.

In the author's opinion, it is still doubtful whether any beds have yet been discovered in this series which may be considered to be exclusively of fresh-water origin, unless an exception should be found in the limestone noticed by Mr Murchison at Ponterburg in Shropshire. M. Agassiz has shown, that neither the Burdiehouse limestone, nor any of the other beds of the Scottish coal-fields with which we are at present acquainted, is of that character; nevertheless the limestone at Burdiehouse is a very remarkable deposit; and the discoveries of Dr Hibbert with reference to that locality, are of the highest geological importance.

The author then proceeded to describe the limits within which the coal appears to have been deposited in the Scottish Lowlands, which, with the exceptions pointed out by him, may, according to Williams, be indicated by a line drawn from the mouth of the Tay, passing through Stirling, to the northern extremity of Arran; and another nearly parallel to it from St Abb's Head on the east coast to Girvan on the west. Although coal may not have been equally distributed in every part of this district,—the deposition of the vegetable matter from which it was derived, having probably been more or less influenced by local circumstances, which may also have caused occasional varieties in the mineral structure and organic contents of the associated strata,—yet, in the opinion of the author, there are sufficient grounds to justify the conclusion, that the whole series originally constituted one great formation, the strata of which it is composed appearing to have been deposited continuously, more or less, in a horizontal position at the bottom of the sea, that must then have covered at least the whole of that portion of the Lowlands, forming either a strait or channel between two islands, or perhaps a vast estuary in which the rivers of the neighbouring primeval countries discharged their waters. The ripple-marks observable on the surface of most of these beds give much additional probability to this supposition.

This original continuity of the beds occupying the carboniferous district, appears to have been subsequently interrupted by the intrusion of the igneous rocks and hills so universally prevalent in that formation, by which they have been separated into the fields or basins where they are now found. The effects of Plutonic action, by which these hills were produced, seem to have been the chief agents employed in modifying the external surface of this important district, and occasioning those chemical changes and combinations in the interior of the earth, by which, when elevated above the waters, it was destined to become a more suitable habitation for the human race.

The Pentland, Campsie, and Ochil hills, as well as many others of a similar description within the limits specified, afford striking examples of the effects produced by their intrusion among the coal strata, at periods subsequent to the consolidation of the latter, of which some instances were noticed by the author. In fact, the whole country occupied by the Scottish coal-measures, displays more or less the influence of such igneous hills, or of the dykes connected with them. A certain degree of parallelism may be traced between the principal ranges, their general bearing being from the eastward of north to the westward of south, which corresponds with the general strike of the fossiliferous strata; but they often appear to have been protruded through the surface without any order or regularity, and the dykes are found to proceed in every direction from the principal masses.

The author farther remarked, that rivers, estuaries, or portions of the sea, now flow through or cover strata of this coal formation, which, from the appearances on their opposite shores, were in all probability, once continuous. The connection between the Lothian coal-fields and that of Fifeshire is very apparent, both in the general direction of the strata, as seen by their outcrop on the opposite shores of the Frith of Forth, and in the number and thickness of the beds of coal in each, which exactly correspond. The appearance of the carboniferous series in Arran, and at Campbelton in Kintyre, as well as the indications of its existence at Ballycastle, and other places on the Irish coast, within the prolongation of the lines before adverted to, seems fully to establish the geological connection in this, as well as in most other respects, between the west of Scotland and the north-east of Ireland.

In regard to the age of the Scottish coal-measures as compared with those of England, the author observed that no formations of a more recent date than the coal series have been met with in the Scottish Lowlands, for the red sandstones of that district do not appear in any instance to have been identified with the new red sandstone of England. Professor Sedgwick and Mr Conybeare have stated some strong reasons, which incline him to refer these Scottish coal-measures to the lower beds of the carboniferous limestone group; and Mr De la Beche has been led by similar considerations to the conclusion, that at the period when the carboniferous limestone of the south of England was produced in the sea, there was probably dry land in the part of the European area not far to the northward of the present Tweed, and that a gradual rise of the land was effected, by which means terrestrial vegetation travelled farther to the south, so that its remains became abundantly entombed in that direction, producing the coal now found in southern England and Wales, as also in Belgium and northern France, the continuity of the whole being superficially concealed by the secondary and tertiary deposits of those countries. But, as Mr De la Beche justly observes, to trace even the probable extent of dry land over the European area at the carboniferous epoch, would be most difficult, particularly when we recollect that what we term a geological epoch may include a long series of ages.

2. On the composition of the Rangoon Petroleum, with Remarks on the composition of Petroleum and Naphtha in general. By William Gregory, M.D., F.R.S.E.

The author first adverted to the discovery, nearly about the same time, of paraffine by Reichenbach, and of petroline by Dr Christison. The former occurred among the products of destructive distillation; the latter was found in the Rangoon petroleum, and they were soon found to be identical. Reichenbach's researches on naphtha were then quoted, by which it appears that that indefatigable observer could not discover, in the kind of naphtha which he examined, any trace either of paraffine, or of any other product of destructive distillation. On the contrary, he found that naphtha to possess the characters of oil of turpentine, a product of vegetable life; and he succeeded in obtaining a precisely similar oil from brown coal by distillation at 212°. These facts had led Reichenbach to the conclusion that naphtha in general is not a product of destructive distillation, and, consequently, must have been separated at a comparatively low temperature. The author showed that Dr Christison's discovery of paraffine, of which Dr Reichenbach was necessarily ignorant, is inconsistent with this view; and detailed some experiments, by which he has rendered highly probable the existence in petroleum of eupion, another of the products of destructive distillation. This substance is a liquid of sp. gr. 0·655, boiling at 110°, and very fragrant. The author obtained from the Rangoon petroleum a liquid of sp. gr. 0·744, boiling at 180°, and rather fragrant. The oil of turpentine, as is well known, boils at 280°, and has a sp. gr. of 0·860; so that, at all events, the naphtha from the Rangoon petroleum is not oil of turpentine. This was farther proved by the tests of nitric acid and iodine. Similar experiments on one or two other species of naphtha led to similar results. They all yielded a liquid of sp. gr. about 760, and, consequently, could not be oil of turpentine. The kinds of naphtha tried were Persian naphtha, obtained from Dr Thomson, and commercial naphtha, sold by M. Robiquet of Paris.

The author concluded, that if the naphtha examined by Reichenbach were genuine, there must be at least two kinds of naphtha; one a product of destructive distillation, the other the oil of turpentine of the pine forest of which our coal-beds are formed, separated by a gentle heat, either before or after their conversion into coal. It is obvious that our common coal-beds have never yet been exposed to a heat sufficient for destructive distillation, since they are destroyed by a moderate heat, and we may therefore expect the petroleum of these coal-beds to be of the kind described by Reichenbach; while the Rangoon and Persian petroleums, being products of destructive distillation, must have their origin, if in coal-beds at all, in such as have been exposed to a high temperature, and must, consequently, be very different from the ordinary coal-beds. In confirmation of this view it may be stated, that Dr Christison could find no paraffine either in the petroleum of St Catharine's, or in that of Trinidad or Rochdale.

The author finally directed attention to the application of the paraffine as a material for giving light, as, when pure, it burns with a clear bright flame, like that of wax, and might doubtless be obtained at a cheap rate in the East.

January 5. 1835.

Sir T. M. BRISBANE, President, in the Chair.

The following Donations were presented:—

Astronomische Nachrichten, Nos. 265, 266, and 267.—*From Professor Schumacher.*

Distances of the Sun, and the four planets, Venus, Mars, Jupiter, and Saturn, from the Moon, calculated according to Mr Bessel's method, together with their places for every day in the year 1835. Calculated under the direction of H. C. Schumacher, Professor of Astronomy at Copenhagen, &c.—*From the Author.*

Proceedings of the Berwickshire Naturalists' Club. No. II.—*From the Club.*

Kongl. Vetenskaps Academiens Handlingar för Ar 1833.

Arsberättelser om Vetenskapernas Framsteg, afgifne af Kongl. Vetenskaps-Academiens Embetsmän, D. 31 Mars 1833.—*From the Academy.*

Series of Geological Specimens, illustrative of the Greywacke Series of Shropshire, Herefordshire, Gloucestershire, and Wales.—*Presented to the Society by Mr Murchison.*

The following Communication was read:—

On Water as a constituent of Salts. By Tho. Graham, Esq.

1. In the case of the Sulphates.

That water may act the part of a *base* in the constitution of certain hydrates of salts and of acids, had been established by the author in the case of the phosphates. The peculiarity of phosphoric acid is its capacity to unite with water as a base in several proportions, while all other acids combine with water as a base in one proportion only, so far as is yet known. By the author's discoveries in regard to phosphoric acid, the ordinary conceptions entertained of the constitution of salts were completely deranged. The salts called biphosphate of soda, phosphate of soda, and subphosphate of soda, were proved to be all tribasic salts. The common idea of a super-salt is inapplicable to any of them.

In certain salts the author has subsequently found water to exist in a different state, not possessed of a true basic function, being replaceable by a *salt*, and not by an alkaline base. To develop this new function of water, in the case of the sulphates, was the object of the present communication. In that well-known class of sulphates, consisting of sulphates of magnesia, zinc, iron, manganese, copper, nickel, and cobalt, all of which crystallize with either five or seven atoms of water, one atom proved to be much more strongly attached to the salt than the other four or six, which last generally may be expelled by a heat under the boiling point of water, while the last atom uniformly requires a heat above 400° Fahrenheit for its expulsion, and seems to be in a manner essential to the salt. The constitution of crystallized sulphate of zinc, for instance, may be expressed thus:

$$\dddot{S}\dot{Z}\dot{H} + \dot{H}^6.$$

The seven atoms of water are here divided into one atom, which is essential to the constitution of the salt, as we know it, and six atoms which are not so; and to this last quantity the name "water of crystallization" may be restricted. Now, in the double sulphate of zinc and potash, the single atom of water pertaining to the sulphate of zinc is replaced by an atom of sulphate of potash, and the six atoms of water of crystallization remain. Sulphate of magnesia combines with sulphate of potash after the same manner, and so do all the other salts of this class. The constitution of the crystallized sulphate of zinc and potash, which may be taken as the type of this family of double salts, is therefore represented by the following formula:—

$$\dddot{S}\dot{Z}(\dddot{S}\dot{K}) + \dot{H}^6;$$

which differs only from the previous formula in having the sign of sulphate of potash ($\dddot{S}\dot{K}$) substituted for the sign ($\dot{H}$) of the essential atom of water.

From a contemporaneous examination of the supersulphates, the conclusion proved to be inevitable that they also are double salts; that the bisulphate of potash, for instance, is a sulphate of water and potash, and that its formula is as follows:—

$$\dddot{S}\dot{H}(\dddot{S}\dot{K}),$$

with or without water of crystallization in addition. There is likewise a provision in the constitution of hydrated sulphuric acid for the production of such a double salt, as in the case of sulphate of zinc. Hydrated sulphuric acid of specific gravity 1·78 contains two atoms of water, and is capable of crystallizing at a temperature so high as

40° Fahrenheit. It is the only known crystallizable hydrate of sulphuric acid, and may be represented thus :—

$$\dddot{S}H\dot{H},$$

which may be compared with the formula for sulphate of zinc, without water of crystallization—

$$\dddot{S}Z\dot{n}.$$

This second atom of water present in hydrated sulphuric acid is replaceable by sulphate of potash, a salt; and the bisulphate of potash results from the substitution. But the first atom of water in the acid hydrate can be replaced only by an alkali or true base. The function of the first atom is *basic*, but a new term is required to distinguish the function of the second atom. The application of the epithet *saline* to that atom of water may perhaps be permitted, to indicate that it stands in the place of a salt. The hydrate of sulphuric acid in question contains, therefore, an atom of basic, and an atom of saline water. It is "a sulphate of water with saline water," as hydrous sulphate of zinc is "a sulphate of zinc with saline water." The bisulphate of potash is also "a sulphate of water with sulphate of potash," and corresponds with the sulphate of zinc and potash, which last is "a sulphate of zinc with sulphate of potash."

Sulphuric acid of sp. gr. 1·78 is therefore the primary salt, and gives the character of the sulphates. This acid hydrate corresponds closely with the sulphate of magnesia, which is the reason they do not combine together. Hence there are no acid or supersulphates of magnesia, zinc, &c.

Of the two atoms which hydrated sulphate of lime, or gypsum, contains, one is expelled at 212° *in vacuo*; and the other, which is the saline atom is not retained at a higher temperature than 300°. Hence sulphate of lime has less disposition to form double sulphates than the sulphate of magnesia, &c.

Professor Forbes announced the results of an Experimental investigation into the Polarization and Refraction of Heat. The reading of the paper on this subject was commenced.

19*th January*.

Dr HOPE, V.P., in Chair.

The following Donations were presented :—

Report to the Committee of the Commissioners of Northern Lights, appointed to take into consideration the subject of Illuminating the Lighthouses by means of Lenses. By Alan Stevenson, M.A., Civil-Engineer.

Bulletin de la Société Geologique de France. Tome iv. Feuilles 28, 29.

The following Communications were read :—

1. On the Refraction and Polarization of Heat. By Professor Forbes.

The First Section of this paper contains an account of a variety of experiments undertaken with the thermo-multiplier of Nobili and Melloni, the instrument exclusively employed in the subsequent researches. By a comparison of its sensibility with that of air-thermometers, the author concludes that one degree of deviation of the needle of the multiplier corresponds to an effect indicated by about one-fiftieth of a centigrade degree on the others. Without increasing the dimensions of the multiplier, by which its sensibility would be impaired, he has been enabled, by an optical contrivance, readily to measure one-tenth of one of its degrees, corresponding to one-five-hundredth of a centigrade degree. From an experiment intended to detect the heat of the lunar rays, concentrated by a polyzonal lens, thirty-two inches in diameter, and acting upon this instrument, he concludes that the direct effect of the moon upon an air-thermometer probably does not amount to *one-three hundred thousandth* part of a centigrade degree.

After mentioning his repetition of M. Melloni's experiments upon the refraction of heat, the author proceeds, in the Second Section, to give an account of his own researches on the action of tourmaline on heat. At first he found (as it afterwards appeared M. Melloni had done) that no more heat was stopped when the tourmaline plates had their axes crossed, or transmitted least light, than when they were parallel, or transmitted most. He afterwards detected a fallacy in his mode of operation, and proved the polarization of heat, whether luminous or obscure, by tourmaline.

The Third Section treats of the polarization of heat by refraction and reflection. The former method the author found by far the most convenient, employing thin plates of mica, arranged at the polarizing angle, and through which even dark heat was very freely transmitted. The results were so marked that they were verified in a great variety of ways, and with heat from sources extremely different, as that of an argand lamp, and of water below 200° Fahr. The polarization of non-luminous heat by *reflection* was also established, though with much less ease and simplicity. In this form it was announced by Berard about twenty years ago, but hitherto his experiment does not appear to have been repeated with success.

The Fourth Section considers the modifications which polarized heat undergoes by the action of doubly refracting crystals. The analogies here are derived entirely from those of light. Very numerous experiments are quoted to show that the effects are quite analogous, even when the source of heat is water under the boiling point. The doubly refracting substance used to depolarize was generally mica. Out of 157 recorded experiments on depolarization, with three different mica plates, only one gave a neutral and one a negative result. Yet, of these 157 experiments, no less than 92 were made with heat unaccompanied by any visible light. One very striking experiment is quoted in illustration of the marked nature of the effects. When the polarizing and analyzing plates were situated so as to transmit least heat to the pile, and a thin film of mica was interposed between the plates in such a position as would depolarize light under similar circumstances, the film was found to *stop* more heat than it *depolarized*, or the needle moved toward zero; but if a mica film much *thicker* (so much thicker as to stop *more than twice* as much common heat as the first) was similarly placed, that film *depolarized* more than it stopped, and the needle moved in the opposite direction to the former one. The investigation of the laws of depolarization given in this section are hardly capable of abridgment.

The following are the general conclusions:—*

1. Heat, whether luminous or obscure, is capable of Polarization by Tourmaline.
2. It may be polarized by Refraction.
3. It may be polarized by Reflection.
4. It may be depolarized by Doubly Refracting Crystals. Hence—
5. It is capable of double refraction, and the two rays are polarized. When suitably modified, these rays are capable of interfering, like those of light.

* These conclusions were stated nearly in these words (except the 6th) to the Royal Society on the 5th January.

6. The characteristic law of polarization in the case of light holds in that of heat; viz., that the intensities in rectangular positions of the polarizing and analyzing plates are complementary to each other.
7. As a necessary consequence of the above, confirmed by experiment, heat is susceptible of circular and elliptic polarization.
8. The undulations of obscure heat are probably longer than those of light. A method is pointed out of deducing their length numerically.

2. Supplementary Notice on the Chemical Analysis of the Animal Remains of Burdiehouse. By Arthur Connell, Esq.

Since the author's former communication to the Society, he has analyzed a portion of a bony fin-ray from the limestone belonging to a fossil fish which has been designated by M. Agassiz, Gyracanthus formosus.

The constituents were found to be—

Phosphate of Lime, with a little Fluoride of Calcium,		53·87
Carbonate of Lime,		33·86
Siliceous matter,		10·22
Potash and Soda, partly as Chlorides,		·71
Bituminous matter,		·54
Phosphate of Magnesia,	trace	
Animal matter,	trace	
		99·20

He has also analyzed a portion of the fossil scales embedded in the limestone. These scales belong to a fossil genus of fish, to which the name of Megalichthys has been given by M. Agassiz, and which is supposed to approach in character to the Lepisosteus, or Lepidosteus of Agassiz. The scales were about three-fourths of an inch long by somewhat less in breadth, and possessed a fine lustre, and the usual delicately punctured surface. They were found to contain—

Phosphate of Lime, with a little Fluoride of Calcium,		50·94	
Carbonate of Lime,		11·91	
Siliceous matter,		33·10	36·58
Water,		3·48	
Potash and Soda,		·47	
Bituminous matter,		·12	
Phosphate of Magnesia,	trace		
Animal matter,	trace		
		100·02	

It is remarkable that the composition of these scales is very analogous to that of the scales of the recent Lepisosteus, if we suppose the perishable animal matter in the latter to be replaced by infiltration by the hydrated siliceous matter in the fossil scales. In those of the recent Lepisosteus, Chevreul found—

Phosphate of Lime,	46·20
Carbonate of Lime,	10·00
Gelatinous Animal matter,	41·10
Phosphate of Magnesia,	2·2
Fatty matter,	·10
Carbonate of Soda,	·10
	100·

The result of the analysis of the bony rays of the Gyracanthus may also be compared with the constitution of certain recent fish bones. Those of the pike, as determined by Dumenil, consist of—

Phosphate of Lime,	55·26
Carbonate of Lime,	6·16
Animal matter,	37·36
Traces of Soda, and loss,	1·32
	100·

If we suppose the animal matter to be replaced partly by siliceous matter and partly by carbonate of lime, the composition of the recent and of the fossil bones becomes very similar.

The ratio of the phosphate of lime to the carbonate of lime in the Coprolites, according to the analysis formerly communicated to the Society, does not differ much from the proportions in the above analysis of recent fish bones. The Coprolites may therefore be viewed as aggregated masses of fish-bone earth, the animal matter having decayed almost without any substitution, from fecal matter not possessing that structure and solidity which seem usually essential to the proper process of mineralization by infiltration. Since his former communication, the author has found a trace of fluoride of calcium in the Coprolites.

It is remarkable that the limestone matrix itself contains a very decided trace of animal matter, doubtless derived from the great quantity of animal remains which have been entombed in it.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1835. No. 6.

Monday, 2d February 1835.

Sir THOMAS MAKDOUGALL BRISBANE, K.C.B.
President, in the Chair.

The following Donation was presented *:—

Transactions of the Royal Irish Academy. Vol. xvii. Part 1.—
By the Academy.

The following Communication was read:—

On the History of the Arch. By Dr Traill.

Dr Traill stated, as the result of a careful examination of the passages in ancient authors, supposed to prove the early use of arches by the Greeks, that we must abandon all hope of solving this disputed point, by a reference to those authors; and he instanced the danger of inferences from such uncertain data, by comparing the description of the Treasury of Minyas, given by Pausanias, with the still remaining kindred edifice, the Treasury of the Atridæ at Mycenæ. He also noticed the loose sense in which the ancient Greeks employed the terms θολος, ψαλις, ʼαψις.

* The Donations for the 19th January and 2d February have been inadvertently transposed.

He next examined the evidence of the ancient use of arches, derived from existing monuments. He shewed the existence of true arched conduits in two very ancient Grecian edifices, the ruins of the Temple of Apollo Didymæus, in the territory of Miletus, and that of Apollo Delphineus at Athens; but he pointed out reasons why the Greeks never used the arch as a conspicuous member of their architecture, though these examples shew that they were not ignorant of the principle of the arch.

In reviewing the specimens of early Italian art, he shewed that the arch was well understood by the ancient Etruscans. He contended, from ancient authorities, and the peculiarity of the masonry, that in the Emissary of the Alban Lake, the Cloaca Maxima at Rome, the substructions of the Temple of Tarpeian Jove, and probably also in the body of the Pantheon itself, we have genuine specimens of very ancient Etruscan art, in which arches form conspicuous members; and he shewed that, in the walls of Cortona, Fesulæ, and Volterra, in the ruins of the Theatre of Arezzo, in the Piscina of Volterra, and in the sepulchres of Perugia and Tarquinii, we have undoubted and very ancient specimens of Etruscan arches. In the temples of Egypt we have no examples of any arch, one of the arches figured in Belzoni's tenth plate being evidently Saracenic, and the others a mere hole, with a rounded top, cut in a wall; but the author exhibited specimens of both round and pointed arches, lately delineated by Mr George Hoskins junior, in the ancient royal tombs of Naputa and Meroe, which shew that arches were perfectly understood by the singular people of ancient Ethiopia.

The author next shewed that the pointed arch was long employed in eastern architecture before it was known in western Europe; a position which he illustrated by a collection of sketches from various authors.

He concluded this Essay by some observations on the extraordinary architecture of the ancient inhabitants of the table land of *Anahriac*, or Mexico, in which arches are distinctly visible; as may be seen in the designs of Dupaix, published in the magnificent work of Aglio; though the domes in the stupendous tombs of that people are constructed on the same principle as the Treasury of Atreus at Mycenæ.

Monday, 16th February.

Dr HOPE, V. P. in the Chair.

The following Donations were presented:—

Records of General Science. By Robert D. Thomson, M. D. with the assistance of Thomas Thomson, M. D., F.R.S. L. and E. No. I. for January 1835.—*By the Author.*

Bulletin de la Société Géologique de France. Tome iv.—Feuilles 28–29.—*By the Society.*

Recherches sur l'Année Vague des Egyptiens. Par M. Biot.—*By the Author.*

Descriptive and Illustrative Catalogue of the Physiological Series of Comparative Anatomy contained in the Museum of the Royal College of Surgeons in London. Vol. ii.—*By the Royal College.*

On account of extraordinary business, no paper was read.

Monday, 2d March 1835.

Sir THOMAS M. BRISBANE, K. C. B., President, in the Chair.

The following Donations were presented:—

The Quarterly Journal of Agriculture: and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland, No. 28, for March 1835.—*By the Highland Society of Scotland.*

The American Almanac and Repository of Useful Knowledge for 1835. And

Transactions of the American Philosophical Society, held at Philadelphia, for promoting Useful Knowledge. Vol. v. Part 1. (New Series.)—*By the American Philosophical Society.*

Mécanique Céleste, by the Marquis de La Place, Peer of France, &c. Translated by Nathaniel Bowditch, LL.D. Vol. iii.—*By the Translator.*

Carte Physique de l'Isle de Teneriffe, levée sur les lieux, par Leopold de Buch, en 1814.—*By the Author.*

Carte des Côtes de France, sur laquelle on a indiqué la position et la nature des diverses especes de Feux établis ou a etablir sur ces côtes.—*By Mons. Fresnel.*

The following Communication was read:—

On the Anatomy of the Char. By Dr Knox.

This brief communication stated the results obtained from the examination of the state of the Char which are caught in the Lakes of Cumberland, particularly in relation to their food and habits of living. This subject the Author promised to resume in another paper.

Dr Gregory exhibited the apparatus by which Dobereiner effects the conversion of alcohol into acetic acid by the action of platinum.

Monday, 16th March 1835.

The Right Hon. LORD GREENOCK, Vice-President, in the Chair.

The following Donations were presented:—

Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce, for the Session 1833–34; being Part 1. of Vol. 50.—*By the Society.*

Bulletin de la Societé Géologique de France. Tome vi. Feuilles 1–4.—*By the Society.*

Correspondence Mathématique et Physique de l'Observatoire de Bruxelles, publiée par le Directeur A. Quetelet. Tome viii. Livraison 4.—*By the Author.*

Nouveaux Mémoires de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome viii.—*By the Society.*

Bulletin de l'Académie Royale des Sciences et Belles Lettres de Bruxelles, 1834. No. 25.—*By the Academy.*

Memorie della Reale Accademia della Scienze di Torino. Tome xxxvii.—*By the Academy.*

Description des Nouvelles Montres a Seconde, à l'usage des Ingénieurs, des Physiciens, des Médecins, &c. composés par Henri Robert.—*By the Author.*

Philosophical Transactions of the Royal Society of London, for the year 1834. Part 2.

Proceedings of the Royal Society. Nos. 17, 18.

List of the Fellows of the Royal Society, 1834–35.

Report on the Adjudication of the Copley, Rumford, and Royal Medals: and Appointment of the Bakerian, Croonian, and

Fairchild Lectures. By James Hudson, Assistant Secretary and Librarian.—*By the Royal Society.*

Astronomical Observations made at the Royal Observatory at Greenwich, in the months of April to September 1834. By John Pond, Esq., Astronomer Royal.—*By the Royal Society, London.*

The following Communications were read:—

1. The first part of a paper on the Ruins of Babylon. By Dr Traill.

2. On the application of the Hot Air Blast in the Manufacture of Cast-Iron. By Dr Clark, Aberdeen.

The author first gives a general account of the process of manufacture of cast-iron previous to the recent improvements, stating the quantities of the various materials put into the furnace, namely, of the Ore, the Fuel, and the Flux. He next states the method suggested first by Mr Neilson of Glasgow, and tried at the Clyde Iron-Works, for increasing the product of the furnaces with the same expense of materials, which consists in previously heating the air thrown into the furnace, in order to accelerate combustion. The method is found to produce a vast saving both in the fuel and the flux, although a certain portion of fuel has, of course, to be separately consumed for the purpose of heating the air, which is done by causing it to trăverse a recurved pipe placed within a suitable furnace. During the first experiments, in 1830, the air was heated to 300° Fahrenheit. In 1831, Mr Dixon of the Calder Iron-Works thought of substituting raw coal for the coke which had hitherto been employed for fuel, at the same time that the air was still farther heated to 600° Fahrenheit, and with complete success. The result is, that *three times as much iron is now made by the use of a given weight of coal as formerly.* The following are the results of the experiments made at the Clyde Iron-Works.

In 1829,	111 tons of iron were produced from	403 of coke, or	888 of coal.
1830,	162	376 .	886
1831,	245	.	554

Dr Clark endeavours to point out the source of advantage thus obtained, from the enormous quantity of air which is thrown into a furnace in full action, which is not less than six tons weight in a minute, and which, therefore, must exercise the most important influence upon the mean temperature of the furnace.

Monday, 6th April.

Sir THOMAS M. BRISBANE, President, in the Chair.

The following Donations were presented :—

On the Vegetation and Temperature of the Faroe Islands. By W. C. Trevelyan, Esq.—*By the Author.*

Natuur en Scheikundig Archief, intgegeven door G. J. Mulder. 2 vols.

Leerboek voor Scheikundige Werktingkunde door G. J. Mulder. Vols. i. and ii. Part 1.—*By the Dutch Government.*

A List of Test Objects, principally Double Stars, arranged in Classes, for the trial of Telescopes in various respects as to Light, Distinctness, &c. By Sir J. F. W. Herschel.

A Second Series of Micrometrical Measures of Double Stars, chiefly performed with the seven feet Equatorial at Slough, in 1831, 1832, and 1833. By Sir J. F. W. Herschel.—*By the Author.*

On the Satellites of Uranus. By Sir J. F. W. Herschel.—*By the Author.*

In consequence of extraordinary business, no Communications were read.

Monday, 20th April.

Sir THOMAS M. BRISBANE, President, in the Chair.

The following Donations were presented :—

Voyage autour du Monde, entrepris par ordre du Roi, exécuté sur les Corvettes de S. M. l'Uranie et la Physicienne. Par M. Louis de Freycinet. 2 tomes 4to ; and Atlas, folio.

Voyage autour du Monde, exécuté par ordre du Roi, sur la Corvette de Sa Majesté La Coquille. Par L. J. Duperrey. 1 Atlas, in folio.

Voyage de la Corvette L'Astrolabe, exécuté sous le Commandement de M. Jules Dumont D'Urville. 1 Atlas, in folio.

Voyage autour du Monde, exécuté sur la Corvette la Favorite, commandée par M. Laplace. 1 Atlas, in folio.

Le Pilote du Bresil, par le Baron Roussin. 1 vol. 8vo ; and Atlas, in folio.

Description Nautique des Côtes de la Martinique. Par M. P. Monnier. 1 vol. 8vo ; and Atlas, in folio.

Pilote de l'Ile de Corse. Par M. Hell. 1 Atlas, in folio.

Pilote Français 3 Atlas, in folio.

Exposé des Travaux Rélatifs à la Reconnaisance Hydrographique des Côtes Occidentales de France. Par M. Beautemps-Beaupré. 4to.

Mémoires sur les Attérages des Côtes Occidentales de France. Par M. le Saulnier de Vanhello. 4to.

Collection de 66 Cartes et Plans *.

Table des Positions Géographiques. Par M. Daussy.—*By the Author.*

Catalogue des Préparations Anatomiques laissées dans la Cabinet d'Anatomie Comparée du Muséum d'Histoire Naturelle. Par G. Cuvier.—*By Madame Cuvier.*

Nouvelles Annales du Muséum d'Histoire Naturelle, 1834. Tome iii. Livraison 3.

The Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 3.—*By the Society.*

Hints on the Trisection of an Angle, and Duplication of the Cube in Elementary Geometry. By Nasmyth Morrieson, W. S.—*By the Author.*

Chart of the Chinese Sea. By Captain Horsburgh, Hydrographer to the Hon. East India Company.—*By the Author.*

The following Communications were read :—

1. The conclusion of Dr Traill's paper on the Ruins of Babylon.

The author, after noticing the ancient writers who have left us any description of Babylon, mentioned the short accounts of *Benjamin of Tudela*, of *Rauwolf*, *Pietro della Valle*, *Pere Emmanuel*, *Niëbuhr*, and *Beauchamp*, from which little information is to be derived, compared to what may be gathered from a succession of British travellers ; among whom, first in point of time and importance, is Claudius James Rich, late British consul at Bagdad, whose steps have been successively followed by Kinneir, Ker Porter, Buckingham, Keppel, and Mignam.

He next gave a general description of the ruins, and a more detailed one of the *Kasr*, the *Mujellibah*, the *Embankment*, and the *Birs Nemroud*. The first he considered as the ruins of Nebuchadnezzar's palace ; the second as belonging to the palace, or to its

* All the above were presented by the French Government.

hanging gardens; the Embankments, with the hill of Amran, he believed to be a part of the defences of the city toward the river; and the Birs Nemroud, he considered with Rich as the ruins of the tower of Belus. He discussed at some length the arguments advanced by Rennell and Mignan against this latter opinion, chiefly founded on the account of Ctesias, that there were two palaces, one on each bank of the river, and that the principal one was on the *western* bank, and that the tower of Belus was on the opposite side. Ctesias being the only original writer who mentions two palaces, and his account not being confirmed by Herodotus, or any other ancient authority, and the glaring inconsistencies of his narrative in other respects entitling him to little credit, when he is not confirmed by other authors, it was concluded that we had no good reason to believe that two palaces had existed, far less that the most considerable was on the western bank of the river, especially as no remains, which can at all be regarded as the ruins of a palace, exist on that side; while in the Kasr we have remains of a pile, sumptuous in its material, of the finest furnace-baked brick, and magnificent for its extent, occupying a central position among the conspicuous ruins on the eastern bank, and enclosed on their sides by immense embankments, answering to the description left us by Herodotus of the strong interior wall which surrounded the palace.

The author next endeavoured to shew, that the Birs Nemroud answers better than any other of the remains to the description of the tower of Belus.

He next shewed, that the remains of reeds found between the courses of sun-dried bricks, correspond to Herodotus's description of reeds being used in the lower part of the Babylonian structures, —*δια τριῆκοντα δομων πλινθου*—"for thirty courses of brick," not as our translators have made it, "*between every thirtieth course.*"

Lastly, he examined the varying accounts of ancient authors with regard to the extent of the walls of ancient Babylon, and shewed, that if we adopt the least circuit given to them, that of Ctesias and Diodorus Siculus, it would make the circuit of the city 41 miles, while that of Herodotus would give a circumference of 55 miles,—either of them vastly greater than any idea we can form by comparison with the largest of modern cities: but the author observed, that there is every reason to believe that the vast area was not filled with houses, but contained fields and orchards interspersed; which is not only probable from what we know of modern Asiatic cities, but may be inferred from ancient authors, and especially from some remarks of Aristotle, who states that Babylon was rather "a community than a city" like the Peloponnesus. If we confine the city to the limits assigned by Diodorus, it will not include all the existing remains; whereas the limits assigned by Herodotus include all those venerable ruins in the vicinity of Hillah, that still astonish us by their stupendous dimensions.

2. On the Expansibility of different kinds of Stone. By Mr Alex. J. Adie, Civil Engineer.

This paper contains the results of an extensive series of experiments made upon different kinds of stone, as well as upon iron and upon brick, porcelain, and other artificial substances. The instrument employed was a pyrometer, of a simple construction, capable of determining quantities not greater than $\frac{1}{30,000}$ of an inch. The length of the substances generally employed was 23 inches. The general result of these experiments is, that the ordinary building materials of stone expand but very little differently from cast-iron, and that, consequently, the mixture of those materials in edifices is not injurious to their durability. The experiments from which the expansibility of the substances was numerically determined, were made between the limits of ordinary atmospheric temperature and that of 212°; steam being introduced for that purpose between the double casing of the instrument.

The following results were obtained for the fractional expansion of the length, for a change of temperature of 180° Fahr.:—

Table of the Expansion of Stone, &c.

	Decimal of length for 180° Fahr.
1. Roman Cement,	.0014349
2. Sicilian White Marble,	.00110411
3. Carrara Marble,	.0006539
4. Sandstone from the Liver Rock of Craigleith Quarry,	.0011743
5. Cast-iron from a rod cut from a bar cast 2 inches square,	.00114676
6. Cast-iron from a rod cast half an inch square.	.001102166
7. Slate from Penrhyn Quarry, Wales,	.0010376
8. Peterhead Red Granite,	.0008968
9. Arbroath Pavement,	.0008985
10. Caithness Pavement,	.0008947
11. Greenstone from Ratho,	.0008089
12. Aberdeen Gray Granite,	.00078943
13. Best Stock Brick,	.0005502
14. Fire Brick,	.0004928
15. Stalk of a Dutch Tobacco-pipe,	.0004573
16. Round rod of Wedgewood Ware (11 inches long),	.00045294
17. Black Marble from Galway, Ireland,	·00044519

Monday, 27th April.

Sir THOMAS M. BRISBANE, President, in the Chair.

The following Communications were read :—

1. On the Action of Voltaic Electricity on Alcohol, Ether, and Aqueous Solutions. By Arthur Connell, Esq.

The author was led into the following investigations, from observing that when alcohol, holding a minute quantity of pure caustic potash, as $\frac{1}{500}$ part, in solution, was acted on by a moderate voltaic power, as a small battery of fifty pairs of two-inch plates, evident marks of decomposition were exhibited, by an evolution of gas from the negative pole, and none from the positive. The experiment recalled to the author's recollection a statement made a few years ago by Dr Ritchie (Phil. Trans. 1832), that when alcohol not holding any substance in solution, was acted on by a powerful battery, gas was given off at the negative pole, which Dr Ritchie stated to be olefiant gas. The author therefore thought, that the elastic fluid evolved in his experiment might be olefiant gas; but on examining it by chlorine, and in the voltaic eudiometer, it proved to be hydrogen, mixed, when collected from alcohol in contact with atmospherical air, with a variable proportion of the constituents of atmospheric air, which had been dissolved by the liquid, but quite pure when the alcohol was exposed to the vacuum of an air-pump and then acted on in a close tube. The same result was obtained when alcohol of sp. gr. .7928 at 66° F. was employed as with alcohol of .830. When the experiment was made on alcohol containing $\frac{1}{200}$ of potash in a small tube, with poles of platinum-foil placed side by side at a short distance from one another, and seventy pairs of four-inch plates were used, the liquid became extremely hot, and even boiled, and became gradually reddish; and some carbonate of potash was precipitated; but it was only when the action was very energetic that the carbonic acid was formed. Small quantities of other soluble substances, such as chloride of calcium and boracic acid, produced the same effect as potash in causing an evolution of gas, but to a much less extent. It was then found that if alcohol, sp. gr. .7928, holding nothing in solution, was acted on by 216 pairs of four-inch plates in a small tube with platinum-foil poles, brought within $\frac{1}{20}$ or $\frac{1}{30}$ of an inch of one another, gas was evolved, as before, from the negative pole, and none from the positive; and the gas proved to be hydrogen, as before, mixed with a small quantity of atmospheric air derived from the liquid. The alcohol, after the action, was found to contain a minute quantity of resinous matter.

The effect of the presence of minute quantities of foreign substances is to increase the conducting power, as is shewn by an increased action on the galvanometer. The alcohol is thus rendered more easily decomposable.

The action in these cases is conceived to consist in the voltaic decomposition of water contained in the alcohol, apparently as a constituent, when absolute alcohol is acted on; the hydrogen being evolved at the negative pole, and the oxygen being absorbed by the fluid, conformably to those instances of absorption of oxygen which are known to occur in the case of the acetous fermentation, in that of an alcoholic solution of potash exposed to the air, and in other instances. The formation of carbonic acid during the voltaic action corresponds to that of acetic and formic acids in the other instances alluded to, but shews a more powerful oxidation.

The positive gas could, in certain circumstances, be made to appear in addition to the negative, as, by diluting the alcohol with an equal bulk of water, or by dissolving $\frac{1}{100}$ of potash in alcohol of sp. gr. .840; and also by arrangements producing certain electrical effects, as by reversing the battery after it had been some time in action, and also by performing the experiment in metal vessels instead of those of glass or porcelain.

When alcohol, sp. gr. .796, holding a minute quantity of potash dissolved, was compared with water holding the same quantity of potash in solution, by passing the same current of electricity through both solutions, in the arrangement called by Mr Faraday the Volta-electrometer, it was found that the same quantity of gas was evolved from both negative poles, showing that in both solutions water was the subject of decomposition. The conclusion from the whole is, that water, as such, enters into the constitution of alcohol.

Pure ether, rectified over chloride of calcium, was exposed to the action of 216 pairs of 4-inch plates, without the slightest symptom of decomposition, or action on a galvanometer, consisting of a single magnetic needle 7 inches long, in the centre of 30 circuits of insulated copper-wire. Neither was it decomposed when it held corrosive sublimate, chloride of platinum, or chromic acid, in solution. The author therefore concludes, that ether does not contain water as a constituent.

Assuming it to be proved that alcohol is a hydrate, the author considers it most probable that it is, as Liebig supposes, a hydrate of ether; but he conceives that the non-action of the pile on ether is unfavourable to Liebig's view, that ether is the oxide of an unknown radicle, because on that view it ought to suffer decomposition.

The author was farther led to examine the evidence for Mr Faraday's principle of the definite action of the electric current, in so far as regarded solutions; and found it fully established with respect to water, as was shown by the constant quantity of hydrogen evolved from various acid, alcaline, and saline solutions. He conceives, however, that in solutions of the hydracids, the acid is not directly decomposed, and that those cases are merely additional instances of the definite decomposition of water. This he found, by connecting the diluted acid with the negative side, and water, pure, or acidulated with sulphuric acid, with the positive side, making the communication between the liquids by moistened asbestus; in which circumstances, hydrogen and oxygen were evolved at the two poles, but no chlorine or iodine was drawn towards the positive side in either liquid; and it was only after a long time, when some of the hydracid itself had passed into the positive liquid, that chlorine or iodine appeared in very minute quantity by a secondary action. When the battery was reversed, and the hydrogen made positive, the oxygen was no longer evolved, and the chlorine or iodine appeared immediately as secondary products. Analogous experiments showed that the decomposition of the haloid salts was a secondary effect.

The author found, that when iodic acid was freed from water, by keeping it fused in a tube till water was quite expelled, and then acting on it by the pile in a fused state, the galvanometer was deflected; but as the heat of fusion was alone sufficient to decompose it, this may not be a true example of voltaic action, and consequently may not be an exception from the supposed limitation of electric action to substances composed of a like number of atoms of their constituents.

2. A Review of some of the more important Physical Truths contained in the writings of the Greek Philosophers, preparatory to an attempt to show that the more ancient language of Greece was based upon the Truths of Natural Philosophy. By the Rev. Archdeacon Williams.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1835–36. No. 7.

Monday, 7th December 1835.

Dr HOPE, V. P. in the Chair.

The following Candidates were elected Members of the Society:

James Moncrieff, Esq. Advocate.
John Stewart Wood, Esq.

The following Donations were presented:

An Account of the Rev. John Flamsteed, the first Astronomer-Royal; compiled from his own manuscripts, and other authentic documents never before published. To which is added his British Catalogue of Stars. By Francis Baily, Esq. Vice-President of the Royal Astronomical Society.—*By the Lords Commissioners of the Admiralty.*

Memoirs of the Royal Astronomical Society. Vol. viii.

Astronomical Observations made at the Royal Observatory at Greenwich, under the direction of John Pond, Esq.—for 1829, part 5; 1833, part 5; 1834, parts 1, 2, 3, 4; and 1835, part 1.—*By the Royal Astronomical Society.*

Observations sur le Choléra Morbus qui a régné à la Nouvelle Orleans en 1833 et en 1834, par M. Michel Halphen, M. D.—*By the Author.*

Considerations sur la Nature et le Traitement du Choléra Morbus, suivres d'une instruction sur les preceptes Hygieniques contre cette Maladie. Par le Chevalier J. R. L. de Kirckhoff, M.D. —*By the Author.*

Bulletin de la Société de Geographie. Deuxieme serie. Tomes i. ii.—*By the Society.*

Bulletin de la Société d'Encouragement pour l'Industrie Nationale. Mai à Decembre 1834, et Janvier à Mars 1835.—*By the Society.*

Leerboek voor Scheikundige Werktuigkunde, door G. J. Mulder. Vol. ii. part 2.—*By the Author.*

Tijdschrift voor Natuurlijke Geschiedenis. Uitgegeven door J. Van der Hoeven, M. D., en W. H. de Vriese, M. D. Vol. i. parts 1, 2, 3.—*By the Editors.*

Geological Report of an Examination made in 1834 of the elevated country between the Missouri and Red Rivers. By G. W. Featherstonhaugh, Esq.—*By the Author.*

Index to the first Eighteen Volumes of the Asiatic Researches, or Transactions of the Society instituted in Bengal for inquiring into the History and Antiquities, the Arts, Sciences, and Literature of Asia.—*By the Society.*

Mémoires d'Agriculture, d'Economie Rurale et Domestique, publiés par la Société Royale et Centrale d'Agriculture. Pour l'année 1834.—*By the Society.*

Memoirs of the American Academy of Arts and Sciences. (New Series.) Vol. i.—*By the Academy.*

Voyage autour du Monde par les Mers de l'Inde et de Chine, éxécuté sur la Corvette de l'Etat La Favorite pendant les années 1830, 1831, et 1832, sous le Commandement de M. La Place, Capitaine de Frégate. 4 tomes.

Voyage de Decouvertes de l'Astrolabe éxécuté par ordre du Roi pendant les années 1826–27–28–29, sous le Commandement de M. J. Dumont d'Urville, Capitaine de Vaisseau. 2 tomes. *Par le Ministre de la Marine de France.*

The Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 4.

Transactions of the Royal Asiatic Society of Great Britain and Ireland. (Appendix to Vol. iii.)—*By the Society.*

Memorias da Academia Real das Sciencias de Lisboa. Vols. i. to xi. part i.

Noticias para a Historia a Geografia das Naçoes Ultramarinas, publicada pela Academia Real das Sciencias. Vols. i. to iv. part 1. *By the Royal Academy of Lisbon.*

Sur l'Homme et le Dèveloppement des ses Facultés, ou Essai de Physique Sociale; par A. Quetelet, Secretaire Perpétuel de l'Academie Royale de Bruxelles, &c. 2 tomes.—*By the Author.*

The Journal of the Asiatic Society of Bengal. Edited by James Prinsep, Esq. F. R. S. Vol. iii.—*By the Editor.*

A Grammar of the Tibetan Language in English. By Alexander Csoma de Körös.

A Dictionary, Tibetan and English. By Alexander Csoma de Körös.—*By the Author.*

Arsberättelse om Framstegen i Fysik och Kemi afgifven den 31 Mars 1833 af Jac. Berzelius, K. V. Acad. Secret.

Kongl. Vetenskaps-Academiens Handlingar för Ars 1827, 1828, and 1831.

Arsberattelser om Vetenskapernas Framsteg, afgifne af Kongl. Vetenskaps Academiens Embetsman 1828 and 1831.—*By the Academy.*

Report of the Fourth Meeting of the British Association for the Advancement of Science, held at Edinburgh in 1834.—*By the Association.*

American Journal of Science and Arts. Conducted by Benjamin Silliman, M. D., LL. D. April 1835.—*By the Editor.*

Catalogue of the Works in Medicine and Natural History contained in the Radcliff Library.—*By Dr Kidd, Librarian.*

Proceedings of the Geological Society of London. Nos. 37. and 38.

Transactions of the Geological Society of London. (Second Series.) Vol. iii. part 3.—*By the Society.*

A Catalogue of 606 principal Fixed Stars in the Southern Hemisphere. By Manuel J. Johnston, Lieutenant St Helena Artillery.—*By the Author.*

The Cyclopædia of Anatomy and Physiology. Edited by Robert B. Todd, M. B., &c. Part 1.—*By the Editor.*

Le Régne Mineral raméné aux Methodes de l'Histoire Naturelle, par L. A. Necker, de l'Academie et de la Société de Physique et d'Histoire Naturelle de Geneve. 2 tomes.—*By the Author.*

Mémoires de la Société de Physique et d'Histoire Naturelle de Geneve. Tome vii. p^tle^. 1.—*By the Society.*

Natuur-en Scheikundig Archief. Uitgegeven door G. J. Mulder. Jaargang, 1835. Stuk 1.—*By the Author.*

Lettres Cosmologiques, par M. le Comte E. de Montlivault.—*By the Author.*

Nova Acta Physico-Medica Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum. Vol. xvii. part 1.—*By the Academy.*

Quarterly Journal of Agriculture; and Prize Essays and Transactions of the Highland and Agricultural Society of Scotland; for June, September, and December, 1835.—*By the Society.*

A Treatise on Poisons, in relation to Medical Jurisprudence, Physiology, and the Practice of Physic. By Robert Christison, M. D., F. R. S. E., Professor of Materia Medica in the University of Edinburgh, &c. &c.—*By the Author.*

Annual Report of the Council of the Yorkshire Philosophical Society, for 1834.—*By the Society.*

Report of the Directors of the Manchester Mechanics Institution, and Proceedings at the Annual Meeting of the Members, held on 26th February 1835.

Catalogue of the Library of the Manchester Mechanics Institution, with the Rules, and a Sketch of the Objects and Advantages of the Institution.—*By the Institution.*

Journal of the Bahama Society for the Diffusion of Knowledge. May 1835. No. 1.—*By the Society.*

Annual Reports of the Leeds Philosophical and Literary Society for 1833–4 and 1834–5.—*By the Society.*

Maps of the Ordnance Survey of Great Britain, published by the Board of Ordnance. Nos. 1, 2, 13, 34, 35, 36, 37, 41, 42, 43, 44, 45, 46, 47, 48, 53, 54, 55, 56, 57, 58, 61, 62, 64, 65, 69, 70, 73, 83, 84, 85, 86.—*By the Board of Ordnance.*

The following Communications were read:—

1. On the Poisonous Properties of Hemlock, and its lately discovered alkaloid, Conia. By Dr Christison.

The author commenced by stating, that he had repeated the greater part of the analysis of hemlock lately executed by Professor Geiger of Heidelberg, and had obtained precisely the same results. According to his analysis, hemlock contains a peculiar principle, alkaloidal in its nature, but differing from the previously discovered alkaloids in its form, which is that of an oily-like liquid, volatile at a moderate elevation of temperature, and capable of being readily distilled over with water. It neutralizes acids, without however forming crystallizable salts. It contains a considerable proportion of azote. It quickly undergoes decomposition when exposed to the air, giving out ammonia, and becoming a dark, resinous-like substance.

The discoverer inferred, from a few experiments chiefly made on birds, that this principle, which may be termed *Conia*, from the genus of plant whence it is obtained, possesses active poisonous properties; that it produces coma, convulsions, and depressed action or even paralysis of the heart; and that its poisonous qualities are greatly impaired by combination with acids. The author, however, has been led to conclude, from an extensive set of experiments on the higher orders of animals,—that the effects of Conia on the body are increased rather than diminished by neutralization with an acid, such as the muriatic; that it does not produce coma when administered either free or combined; that it does not act at all on the heart; that it possesses a local irritant action, and that its remote action consists simply in the production of swiftly increasing paralysis of the muscles, ending fatally by asphyxia from palsy of the muscles of respiration. He farther found it to be a poison of exceeding activity, scarcely inferior indeed in that respect to hydrocyanic acid. Two drops applied to a wound, or introduced into the eye of a dog, rabbit, or cat, will sometimes occasion death in ninety seconds; and the same quantity injected in the form of muriate into the femoral vein of a dog killed it in three seconds at farthest. The author added various reasons for doubting the probability of any chemical antidote being discovered; and suggested artificial respiration as the most probable remedy, founding on an experiment in which the heart was maintained in a state of vigorous action for a long time by artificially inflating the lungs.

An abstract was then given of a set of comparative experiments made with extract of hemlock; from which he inferred that the action of hemlock is identical with that of Conia. Very powerful extracts were used, which had been prepared with absolute alcohol from the leaves or seeds. The effects ascribed by some toxicological authors to hemlock were not observed; but simply paralysis, with intermittent slight convulsions. From this identity of action it may be concluded, that Conia is really the active principle of hemlock, or at least contains it in large quantity, and is not the product of chemical action and new arrangements of elements.

Some remarks were appended as to the probable nature of the State-poison used in ancient times, particularly in Athens, for despatching criminals; which has commonly been held to be a preparation of the same plant with the modern *Conium maculatum.* The author shewed, from the descriptions of the Greek κωνειον and Roman *cicuta,* that this plant could not be the modern *conium* ; that the account given by Plato of the effects of the state-poison in the case of Socrates is wholly at variance with the description by Nicander and others of the action of the κωνειον; that the effects ascribed to the poison in Plato's narrative are such as no poison whatever which is known at present can produce ; and that consequently either Plato's description is an embellished narrative, or the ancients were familiar with a poison of most remarkable and peculiar properties, with which modern toxicologists are no longer acquainted.

2. The reading of a paper on the Geology of Auvergne, by Professor Forbes, was commenced.

Monday, 21st December 1835.

Dr HOPE, V. P. in the Chair.

The following Donations were presented :

Address delivered in the Hall of Marischal College, Aberdeen, 5th November 1835, on occasion of his Installation as Lord Rector of the University, by John Abercrombie, M. D. Oxon and Edinburgh, V. P. R. S. E. &c. &c.—*By the Author.*

Astronomische Nachrichten. Nos. 268. to 288.—*By M. Bessel.*

Natuur-en Scheikundig Archief. Uitgegeven door G. J. Mulder. 1835, stuk iii.—*By the Editor.*

Proceedings of the Royal Society of London. Nos. 19. and 20.

Transactions of the Royal Society of London, 1835. Part 1.—*By the Royal Society.*

Geometrical Investigations concerning the Phenomena of Terrestrial Magnetism. By Thomas Stephens Davies, Esq. F. R. S. L. & E.—*By the Author.*

Proceedings of the Geological Society of London. Nos. 40. and 41.—*By the Society.*

Bulletin de l'Academie Royale des Sciences et Belles Lettres de Bruxelles. 1834, Nos. 25, 26, 27 ; and 1835, Nos. 1, 2, 3.

Annuaire de l'Academie Royale des Sciences et Belles Lettres de Bruxelles.—*By the Academy.*

Annuaire de l'Observatoire de Bruxelles pour l'an 1835. Par le Directeur A. Quetelet.—*By the Author.*

A Treatise on Insects. By James Wilson, Esq. F. R. S. E.

A Treatise on Fishes. By James Wilson, Esq. F. R. S. E.—*By the Author.*

De l'Influence de la Lune sur l'Atmosphere Terrestre, déterminée par les Observations Meteorologiques. Par M. Eug. Bouvard. —*By the Author.*

Memorias para a Historia das Navagaçoes e Descobrimentes das Portuguezes. Par Joaquim José Da Costa De Macedo.—*By the Author.*

A Collection of Specimens from the Volcanic District of Auvergne. —*Collected and presented by Professor Forbes.*

The following Communications were read :—

1. Notes on the Geology of Auvergne, particularly in connection with the Origin of Trap-Rocks and the Elevation Theory. By Professor Forbes. Concluded.

The *first* part of this paper (which accompanied a series of geological specimens from Auvergne, presented to the Society) relates to several specific points which tend to assimilate the evidence for the igneous origin of trap-rocks generally, with that afforded by the volcanic district of Central France. The altered character of the stratified deposits with which igneous rocks have been intermixed, is one of their most striking features; yet we occasionally find cases where this evidence is far from being so obvious as might be expected; and this dubious character, which is particularly remarked in the hill of Gergovia, near Clermont, forms an admirable parallel to some cases in trap districts where a like want of alteration occurs.

The mineral character of the rocks of Auvergne admits of almost perfect identification in a majority of cases with that of undoubted trap-rocks; and we may employ the formations of Central France as a medium of comparison between trap-rocks generally, and modern volcanos, from which the formations of the Monts Dôme are undistinguishable. The trachytes of the Mont Dor and Cantal find their counterparts in the districts of the Siebengebirge and Laacher-Lee. Various points of structure were noticed as important, especially the columnar forms of lavas, geologically speaking, modern, which has been often referred to; and more remarkably the union of the tabular, with the polygonal columnar structure, exhibited in the undoubtedly igneous trachytes, basalts, and phonolites of the Mont Dor, which are sometimes so extensively slaty as almost to assume the appearance of stratified rocks. The very remarkable passage of one rock into another differing in mineral character and structure was also pointed out, and hence the difficulty of pronouncing conclusively upon the relative age of such rocks.

The *second* part of the paper referred to Von Buch's Theory of Elevation-Craters, and professed to give simply the impression made upon the author's mind by an examination of the specific cases of the groups of the Cantal and Mont Dor, which have been quoted as examples in support of that theory. Various views of the subject were presented, from which the author is disposed to conclude decidedly in favour of the Elevation Theory in these particular cases. The arguments were drawn chiefly from the forms and magnitude of the valleys, and the relation of the beds of igneous rock to one another, in which the valleys are formed. The author expresses some doubt as to the utility of the calculations entered into with regard to this question by MM. Elie de Beaumont and Dufrenoy, and especially as regards the complicated system of the Mont Dor, of which he considers it almost hopeless to unravel the manifold revolutions. In general, however, he coincides in the conclusions arrived at by those authors.

2. Notice of a New Compound of Sulphur, which is probably a Sulphuret of Nitrogen. By Dr Gregory.

This substance, obtained among the products of the reaction of chloride of sulphur on a solution of ammonia, is a solid, colourless, insoluble in water, soluble in alcohol, crystallizing in cubes. It is characterized by producing a fine, but fugitive purple colour, when brought into contact with potash and alcohol.

Dr Gregory obtained from it between 92 and 93 per cent. of sulphur, and from 6 to 7 per cent. of nitrogen.

3. On another New Compound of Sulphur, analogous to the Mercaptan of Zeise. By the same.

The remarkable substance termed by its discoverer, Mercaptan, may be viewed as alcohol, the oxygen of which has been replaced by sulphur, as in the following formulæ :

$$C_4\ H_6\ O_2 = \text{Alcohol.} \qquad C_4\ H_6\ S_2 = \text{Mercaptan.}$$

The pyroxylic spirit of Dumas and Peligot being extremely analogous to alcohol, Dr Gregory examined whether this analogy extended to the production of a compound analogous to Mercaptan; and, by substituting pyroxylic spirit for alcohol, he obtained this compound, which, although in most of its properties closely resembling mercaptan, is distinguished from it by a greater degree of volatility, boiling at 70° F., while mercaptan boils at 185° F. The following formulæ exhibit the composition of the pyroxylic spirit, according to Dumas and Peligot, and the probable composition of the new liquid :

$$C_2\ H_4\ O_2 = \text{Pyroxylic Spirit.} \qquad C_2\ H_4\ S_2 = \text{New Liquid.}$$

The new liquid has, like mercaptan, a most insupportable alliaceous odour, and exercises an action on red oxide of mercury similar to that from which the name Mercaptan is derived.

4. On a curious Phenomenon observed in the Island of Cephalonia, and on the proximate cause of Earthquakes in the Ionian Islands. By Dr John Davy. Communicated in a letter to Professor Forbes.

Dr Davy communicates the description of certain streams of sea-water which appear to be constantly flowing into the interior of the earth, by four openings, near the town of Argostoli, in Cephalonia. These are now applied as sources of mechanical power. Dr Davy views this curious fact as probably related to the very remarkable local earthquakes which affect the Ionian Islands, and which appear to be disconnected with any volcanic appearances, or even the occurrence of trap-rocks. Dr Davy conceives that these phenomena may be attributable to the absorption of this quantity of sea-water constantly received into the land by the marly beds which occur in Cephalonia. This absorption, Dr Davy concludes from direct experiment, may produce an enlargement of the volume of the marl. This supposition is supported by the remarkable fact, that, in the Ionian Islands generally, these earthquakes occur entirely in the low and marly parts of those islands, and never in those parts connected with solid rock.

Monday, 4th January 1836.

Sir THOMAS M. BRISBANE, President, in the Chair.

The following Donations were presented :—

Mémoires de la Société Geologique de France. Tome i. part 1.

Bulletin de la Société Geologique de France. Tome vi. Feuilles 5–20.—*By the Society.*

Nouvelles Annales du Museum d'Histoire Naturelle. Tome iv. Liv. 2 and 3.—*Par les Editeurs.*

The following Communications were read :—

1. Some Observations on Atmospherical Electricity. By Dr John Davy, F. R. S. Communicated by Professor Forbes.

This paper, tending to establish the chemical action of atmospherical electricity, is based upon experiments made in Malta between October 1834 and March 1835. The mode of operating was the following: A tube of glass containing a wire of copper was elevated six feet in all above a turret in Dr Davy's house in Valletta, which rose just fifty feet from the street. It was not in the highest part of the town, and was overtopped by other buildings. To the lower part of the copper-wire was attached one of gold. The communication to the ground was effected through the medium of another copper-wire, connected with a leaden cistern. Between these two portions of the line of communication from the sky to the ground was interposed the decomposing apparatus, consisting of a tube containing iodide of potassium mixed with starch, and into which two platinum wires were inserted, until within one-fourth inch of being in contact. It was found that, with this arrangement, decomposition was generally going forward even in fine weather,—that it increased in windy or cloudy weather, and especially during the continuance of the sirocco or S. E. wind. During thunder storms, showers of hail, and also of rain, the effect was notably increased.

A deposition of iodine was frequently observed on *both* wires, which Dr Davy attributes to successive changes in the electrical state of the passing clouds. Dr Davy was only once able to obtain distinct indications of the decomposition of water ; in that case a strong solution of salt was employed, and fine sewing needles coated with sealing-wax, except at the points, were used as conductors. That these effects were not owing to any electro-chemical action at the junction of the copper and gold conductors was proved by substituting gold throughout.

Dr Davy very rarely succeeded in affecting a galvanometer by atmospheric electricity; nor did he succeed in changing the colour of chloride of silver by the light of the most brilliant thunder storms, as Mr Brande is believed to have done by voltaic electricity.

On the whole, Dr Davy coincides with Mr Faraday in considering atmospheric electricity as intermediate in its nature between common electricity and that of the pile.

2. Essay towards establishing the Primary Properties of Parallel Lines. By Mr W. Nichol.

The object of the author in this paper was to find a new method of avoiding Euclid's assumptions in the theory of parallel lines. This he endeavours to do by proving that lines making equal angles with a given line cannot recede from one another; but he does not effect this without the introduction of the consideration of infinitely small spaces.

Monday, 18th January 1836.

Right Hon. LORD GREENOCK, V. P. in the Chair.

The following Candidates were elected Members of the Society:—

William Paul, Esq.
Robert Paul, Esq.

The following Donations were presented:

The American Journal of Sciences and Arts, conducted by Benjamin Silliman, M. D., LL. D. Vol. xxix. No. 1. (October 1835.)—*By the Editor.*

Flora Batava. Nos. 100, 101, 102, and 103.—*By the King of Holland.*

Neue Wirbelthiere zu der Fauna von Abyssinien gehörig entdeckt und beschrieben von Dr Eduard Rüppell. 4 parts.—*By the Author.*

The reading of the following paper was commenced :—

1. Observations and Experiments on the coloured and colourable matters in the Leaves and Flowers of Plants, particularly in reference to the Principles upon which Acids and Alkalies act in producing Red and Yellow or Green colours. By Dr Hope.

Professor Forbes shewed a specimen illustrative of the star-like fractures of horizontal strata, as assumed in the theory of Elevation Craters. It was a stratum of crystallized chloride of calcium, which had been accidentally fractured and elevated in Dr Christison's laboratory by the sudden disengagement of steam beneath during crystallization.

Mr Robert Allan mentioned some remarkable facts respecting the disengagement of light during crystallization, communicated to him by Professor Rose of Berlin.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1836. No. 8.

Monday, 1*st February* 1836.

Sir THOMAS M. BRISBANE, President, in the Chair.

The following Donations were presented :

No. 52. of the Map of the Ordnance Survey of Great Britain ; published by the Board of Ordnance.—*By the Board.*

Proceedings of the Berwickshire Naturalists' Club. No. 3.—*By the Club.*

The following Communications were read :

1. On the Mathematical Form of the Gothic Pendant. By Professor Forbes.

The author commenced, by stating the general proofs of the knowledge of the principles of equilibrium displayed by Gothic architects in the structures (especially) of the pointed style. The adaptation of their edifices was to the combined ends of elegance and strength. The extension of this principle to the case of the Gothic pendant is the chief object of this paper. Sufficiency in point of strength, without redundancy of material, is considered by the author as the primary source of architectural beauty; which he has demonstrated to be the case when the depending Gothic drop is generated by the revolution of the logarithmic curve round its axis. The condition of maintenance of a depending body is, that the increment of the section may be in a constant ratio to the increment of weight of the body to be sustained. This is shewn to be attained in the case of bare support, when the modulus of the logarithmic curve is equal to twice the modulus of cohesion of the substance of which the pendant is composed, in feet. Under these circumstances, the depending mass would be just within the limit of disruption, but its strength would be uniform throughout, and the tendency to separation would at no one point be greater than at another. It is not imagined that the Gothic architects could have had a mathematical knowledge of a curve, which was not attained till long after, but the degree of *tact* by which the eye is guided in the selection and adaptation of symmetrical forms seems quite capable of explaining such an approximation to theory, which, it is believed, has not before been noticed. Thus, a depending cylinder appears overloaded at its inferior extremity, a cone towards its middle, and so of all figures which are not concave outwardly.

2. On the occurrence of the Megalichthys Hibberti in a bed of Cannel Coal in the west of Fifeshire; with Observations on the supposed Lacustrine Limestone of Burdiehouse. By Leonard Horner, Esq. F.R.SS. L. & E., and F. G. S.

In a fragment of this kind of coal there was accidentally found a very fine specimen of a tooth, which the author considers to belong to the *Megalichthys Hibberti* of Agassiz. It is similar to some of those found in the limestone of Burdiehouse by Dr Hibbert, and is almost identical with that figured at p. 183 in Dr Hibbert's Memoir, in the 13th volume of the Society's Transactions; being about two inches long, and seven-eighths of an inch at the base, longitudinally striated, and covered with a shining enamel.

The coal in which it was found was brought from Halbeath, about two miles eastward of Dunfermline. It forms one of the regular coal-measures, being associated with sandstones, shales, clays, and beds of coal of ordinary qualities; the shells abounding with impressions of plants. The strata are subject to great disturbances, there being five faults in the space of half a mile. There are no trap-dikes, but there is an overlying mass of trap, which the author believes to be connected with a deep-seated dike; and it is probably to the intrusion of this igneous rock that the disturbances in the stratification are to be ascribed.

The occurrence of remains of the same sauroid fish that is found in the limestone at Burdiehouse leads the author to inquire, whether there be any analogy between the two deposits: he thinks they are similar; not, however, that he believes there is a freshwater formation at Halbeath, but because he is of opinion that there is no ground for considering that such a formation exists at Burdiehouse, or that the strata there offer any exception to the usual phenomena presented by coal formations; that the bed of limestone is not, as Dr Hibbert maintains, of lacustrine origin, but presents only such characters as may be sufficiently accounted for on the supposition of the coal-measures having been deposited in an estuary, which is now the commonly received theory of the formation of coal deposits in general.

Dr Hibbert rests its lacustrine character on the absence of marine shells; and, in connection with that circumstance, on the abundance of land plants; the presence of what he conceives to be freshwater fishes; and a great profusion of the shells of what he calls a Cypris, one of those microscopic entomostraca which inhabit fresh water.

The author, on the other hand, maintains that the absence of marine shells is no proof, because it constantly happens that we find beds of limestone in which not a trace of an organized body can be found, alternating with others nearly wholly composed of them. That the same genera, and many of the same species of plants, are found throughout the whole of the carboniferous series, from the old red to the new red sandstone; that there is no gronnd for considering any of the fishes to have belonged to fresh water, but that, on the contrary, they are met with in the zechstein of Germany and the magnesian limestone of England, and frequently in other regular coal-formations; and that the shells of entomostraca are by no means a conclusive proof, as the shell of the Cytherina, which lives in sea water, cannot be distinguished from that of the Cypris.

3. Professor Forbes verbally communicated to the Meeting, that he had succeeded in proving the Circular Polarization of Heat, whether accompanied or unaccompanied by Light; when polarized heat is made to undergo two total reflections within a rhomb of rock-salt, the plane of total reflection being inclined 45° to the plane of primitive polarization.

Monday, 15th February.

Dr HOPE, V. P. in the Chair.

The following Donations were presented:

The American Almanac and Repository of Useful Knowledge for the year 1836.—*Presented by the American Philosophical Society.*

Historical Account of Bills of Mortality, and the Probability of Human Life in Glasgow and other large Towns. By James Cleland, LL.D. &c. &c.—*By the Author.*

Proceedings of the Geological Society of London. No. 42.—*By the Society.*

Description of a Bronze or Cast-iron Columnal Light-House, with reference to a model of one-fourth the full size, designed for the Wolf Rock, situated between the Island of Scilly and the Land's-End. By Captain Samuel Brown, R. N.—*By the Author.*

Report respecting the Construction of Low-water Piers on the North and South Shores of the Frith of Forth, for the Fife and Mid-Lothian Ferries.—*By James Anderson, Civil-Engineer.*

Report on the present state of Leith Harbour, and the practicability of rendering available its Wet Docks, by means of a Deep-water Entrance, and a communicating Dock or Ship Canal. By James Anderson, Civil-Enginner.—*By the Author.*

The award of the Keith Prize to Professor Forbes having been announced by the Council on the 18th January, the medal was presented by the Vice-President, accompanied by an address to the following effect.*

The prize founded by our late estimable associate Mr Keith, whose ingenious contrivances for self-registering thermometers and barometers are recorded in our Transactions, is, by the regulation of his Trustees, to be adjudged biennially for the most important discovery communicated to the Royal Society, or in the event of such being wanting, for the best paper which shall have been presented to the Society in the space of two years on

* Printed by order of the Council.

a scientific subject. The Council, in discharge of the powers vested in them, have awarded unanimously the Keith prize for the last biennial period, to Professor Forbes, for his paper "On the Refraction and Polarization of Heat," which they consider to come under that class of communications, which contain discoveries important to science.

The Vice-president then observed, that the subject of heat is one so important to man, and so intimately connected with a variety of natural phenomena, that it has not failed to command no small degree of attention in all ages. That an intimate connexion subsists between Heat and Light, and that much discordance of opinion has subsisted respecting the nature of both. He next stated the various opinions entertained concerning them, and particularly respecting heat, and in historic order presented the views of Bacon, Boyle, Boerhaave, Stahl, and Black, and adverted to the discoveries of Black respecting latent and specific heat, and the successive labours of Irvine, Crawfurd, Wilke, Magellan, Lavoisier and Laplace, Dulong and Petit, in the same field.

Heat presents itself in two very different conditions; first when combined with matter, pervading bodies slowly, either by communication and conduction through and among its particles, or by the movements of the particles themselves; secondly, when radiated, moving through elastic fluids or empty space with vast velocity.

The first of these had been studied by the philosophers already named, and not long after by Rumford. To the second of these, viz. radiant heat, the subject of Professor Forbes's discovery called upon him more especially to allude, and to present a brief historic view.

The radiation of cold, and its reflection by metallic mirrors, was known to Baptista Porta in the sixteenth century; and observations were made on the radiation of heat, by the Florentine academicians, towards the middle of the seventeenth century, and by Marriotte in 1682. About the middle of the 18th century, Lambert published his works on pyrometry and photometry, which contained some of the first accurate experiments on this subject; and the facts of the difficult transmission and reflection of heat by glass, was pointed out by the Swedish chemist Scheele. Pictet of Geneva extended his experiments on the radiation and the reflection of the heat derived from boiling water, and our venerable associate Professor Prevost of the same place, established the doctrine of the mobile equilibrium of heat, in 1802. The triumph of this theory was found in the beautiful experiments of Dr Wells, on dew, in 1813.

Meanwhile, the experiments of Rumford and Leslie were corroborating and extending these general views, even although the doctrines of radiation were denied by the latter philosopher in all his writings. The passage of radiant heat through solid substances, such as glass, and through fluids, such as water, had long been admitted, in the case where light accompanied heat. But in the case of non-luminous heat, it was strenuously denied by Leslie, and others. The experiments of De la Roche proved that such was the fact, at least in the case of heat derived from terrestrial sources, and at the same time luminous. But this subject has received a vast enlargement by the recent experiments of Melloni, who has shewn that substances differ surprisingly in their permeability to heat, and that while some, such as alum, stop almost every incident ray, others, as rock-salt, transmit almost the whole of the heat, and that from whatever source derived.

The connection of light with heat, was too obvious and important to be overlooked. To Sir W. Herschel the world is indebted for the first great step in this curious inquiry. He examined the thermometric qualities of the spectrum formed from the sun's rays by a common prism of glass; and in 1800 announced the curious fact, that the heating power increases, not only from the violet to the red end of the spectrum, but *even beyond the latter*, indicating the existence of dark calorific rays. These experiments, though at first denied by some authors, were afterwards fully confirmed, and some anomalies which they presented, explained, by Robison, Englefield, Berard, Seebeck, and Melloni.

Heat, then, even unaccompanied by light, appears to be capable both of reflection and refraction. But new modifications of light, discovered of late years, require us to investigate how far the analogy may be pursued. In 1802, Dr Young announced his remarkable discovery of the interference of the rays of light, or the power of two luminous rays, properly disposed, *to produce darkness* by their union. About the year 1808, Malus, a most eminent French philosopher and mathematician, discovered the remarkable modification which light undergoes by reflection from certain substances at certain angles. This modification may be easiest conceived by stating the fact, that light so reflected becomes incapable of undergoing a second reflection in certain positions of the reflecting surface, when common light would be reflected.

The corresponding experiment in the case of heat was tried by Berard, along with Malus, about the year 1811, and an account of them was published in 1817, in the *Memoires d'Arcueil.* They found, that when the solar beam was twice reflected in the manner just stated, the heat and light refused simultaneously to be reflected in certain positions of the second reflector. The same experiment was repeated with incandescent bodies, with the same result; and even, as stated by Berard, with bodies having temperatures beneath that of visible incandescence. These experiments were probably discontinued in consequence of the death of Malus, and the details were never published, if, indeed, they were ever carried to any great extent. The result has been, that Berard's conclusion seems not to have been generally adopted by the scientific world. The polarization of heat has remained amongst the doubtful facts in science. It has been adopted in scarcely any systematic works, whether British or foreign; and, of late years, direct evidence seemed to be entirely against it. Professor Powell of Oxford, repeatedly and fruitlessly, attempted to obtain Berard's result. Nobili of Florence (whose recent loss science has to deplore) attempted it likewise with the aid of his thermo-multiplier, an instrument admirably adapted for the measurement of small quantities of heat; and Melloni having failed to polarize even luminous heat by tourmalines, concurs in the conclusions of Powell and Nobili. The Vice-President then observed, that it was under these circumstances that the subject was undertaken by Professor Forbes, who, by means of arrangements differing from any that had before been used, has succeeded in completely establishing the polarization of heat under all the circumstances in which light is polarized, namely, by Reflection, Transmission, and Double Refraction, and that it is for the establishment of these facts that the Keith Prize has been awarded by the Council.

Dr Hope then stated that, in the ordinary case of the publication of papers, the Society holds itself in no degree responsible for the truth of the facts stated therein ; but, in the adjudication of prizes, the case is different; and that, with regard to them, the Council are bound to be satisfied of the truth of the statements for which they award their prize. Several members of the Council had seen and satisfied themselves of the accuracy of Mr Forbes's leading experiments before the Keith Prize was awarded ; and, some days ago, he deemed it right to request Mr Forbes to shew him the more important of these experimental demonstrations. This he succeeded in doing in a way which left upon his mind not the slightest doubt as to the truth of his results; the variations of temperature being so obviously displayed, as to prevent the slightest ambiguity as to the true source from which they are derived. The instrument employed in the research is the thermo-multiplier, of which the invention is due to Nobili, though it has been greatly improved for experimental purposes by Melloni. Professor Forbes has likewise increased greatly its power of indicating the more delicate effects by employing a telescopic apparatus, which enables him to measure a quantity of heat, perhaps not exceeding *one-fifteen hundredth* part of a degree of Fahrenheit.

That the Society may fully understand the nature of the proofs afforded by Mr Forbes's experiments, reference must be made to the correlative facts observed in the case of light.

When light undergoes reflection from glass at an angle of 56°, its physical character is found to be thus far altered, that it refuses to be a second time reflected by another plate of glass placed to receive the ray at the same angle of 56°, if the plane of incidence on the second glass be perpendicular to the plane of incidence on the first. The light is then wholly transmitted by the second plate. If the plane of incidence be the same for the two plates, complete reflection takes place at the second plate. This illustrates polarization by *reflection.*

If a number of glass plates be used, and light *transmitted* obliquely through such a bundle of plates, it is in like manner found, that the emergent light is wholly transmitted by a second similar bundle placed parallel to the first, but is almost wholly reflected, and therefore *not* transmitted, when the second bundle is placed so that whilst the ray falls upon it at the same angle as upon the first, the plane of incidence on the second bundle being perpendicular to the plane of incidence upon the first bundle. This is polarization by *transmission* or *refraction.*

Lastly, It was observed before the close of the 17th century by Huyghens, that certain bodies, as Iceland spar, endowed with the property of double refraction, alter at the same time the character of the light in the two refracted rays. So that, if two sections similarly cut from a crystal of Iceland spar be placed upon one another in *conformable* positions, or the respective positions which they occupied on the crystal, the two rays will proceed through the second slice as they did through the first, and be refracted according to the same laws. But if the second slice be placed *unconformably* upon the first, or turned round a quarter of a circle, the ray, which at first was ordinarily refracted, is now extraordinarily refracted; and the ray, which at first was extraordinarily, is now ordinarily refracted. Now, it has been found that some crystals, such as tourmaline, possess the property, first, of dividing these rays, *and then of suppressing or absorbing one of them;* the result of which is, that when two tourmalines, cut as we have supposed, are placed *conformably,* the ray which was not suppressed by the first slice, still makes its way through the second; but, when placed *unconformably,* the ray transmitted by the first plate is wholly suppressed by the second. In the latter case, therefore, not a ray of light can penetrate the two plates. This is polarization produced by *double refraction.*

Now, all these modes of polarization have been recognised by Mr Forbes in the case of heat, and even in the case of heat wholly unaccompanied by light. The Vice-President announced that he had witnessed this in the most satisfactory manner in the case of heat polarized by reflection and transmission, for which purposes, instead of glass, (which permits scarcely any non-luminous heat to penetrate it), Mr Forbes employs plates of mica, divided by a peculiar process into extremely thin laminæ.

But the analogies which he has established between light and heat do not stop here. It has been found in the case of light, that, when the two reflecting plates before spoken of, or the two crystals, are placed in *unconformable* positions, so that little or no light reaches the eye, we may, by interposing between the plates or the crystals a thin lamina of a doubly refracting substance (such as mica) in a certain position (relatively to its internal structure), cause a portion of light, which before was incapable of reaching the eye, to become capable of so doing. In other words, the polarized light, which at first was incapable of reflection or transmission at the second plate or crystal, now becomes capable of it; it has lost, to a certain extent, its character of polarization, or it is said to be depolarized.

Dr Hope stated, that he had seen this to be most completely effected in the case of heat, by Mr Forbes. A lamina of mica is interposed between the bodies used to polarize heat unconformably placed. When the lamina of mica has a certain position, no effect is produced beyond stopping a small portion of the heat, which would otherwise reach the thermometer; but when this interposed lamina is turned 45° in its own plane, a portion of the heat which before was incapable of reaching the thermometer in consequence of its polarization, is now capable of doing so, and the influx of heat is instantly indicated. The most striking exemplification of this result is found in the fact, which excited so much interest when communicated more than a year ago to the Society, that in certain cases the mere interposition of a piece of mica (in the proper situation), will cause an immediate indication of increased temperature, the mica *depolarizing* more heat than it *stops*. Since depolarization takes place only in consequence of double refraction, we have here another undoubted proof of the double refraction of heat.

The Vice-President terminated his general and rapid sketch, in which he alluded to the brilliant discoveries of Brewster, Arago, and Fresnel, respecting the polarization of light, by observing, that it would be needless for him to point out the important bearing of these facts on the question of the nature of heat, and its connection with light. He concluded in the following terms:—"It now only remains for me to present to Professor Forbes the medal which has been awarded to him for these discoveries. I believe that I shall be joined cordially by every member of the Society who now hears me, in the fervent wish that it may be the will of the Almighty Ruler, that his life may be long protracted, with vigour of mind and health of body to pursue the career in which he has made an advancement so honourable to himself, and reflecting lustre upon those great establishments, the University and the Royal Society, with which he is connected. I cannot doubt that he will persevere in this happy path with the same ardour and success which have hitherto accompanied his researches. Indeed, we have a gratifying proof that his zeal will not be impaired, nor his success less brilliant, from the discovery in the same field announced by him at the last meeting of the Society, of the Circular Polarization of Heat."

Monday, 7th March.

Sir T. MAKDOUGALL BRISBANE, President, in the Chair.

The following Donations were presented:

Descriptions of the Inferior Maxillary Bones of Mastodons in the Cabinet of the American Philosophical Society, with Remarks on the Genus Tetracaulodon, &c. By Isaac Hays, M. D.—*From the Author.*

Catalogue of Fossil Fish in the Collections of Lord Cole and Sir Philip Grey Egerton, arranged alphabetically, with references to the localities, strata, and published descriptions of the species. By Sir Philip Grey Egerton.—*From the Author.*

Treatise on the more obscure Affections of the Brain, on which the nature and successful treatment of many chronic diseases depend. By A. P. W. Philip, M. D., F. R. S. L. & E., &c.—*From the Author.*

Memoires de l'Académie Impériale des Sciences de St Petersbourg. (Sciences Mathematiques). Tome iii. Livrs. 2, 3, 4, 5, 6.

Memoires de l'Académie Impériale des Sciences de St Petersbourg. (Sciences Mathematiques et Physiques). Tome i. Livr. 1, 2.

Do. do. (Sciences Politiques, &c.) Tome ii., liv. 6; et tome iii. liv. 1.

Do. do. (Memoires présentés pars divers Savans). Tome ii. Livrs. 4, 5, et 6.

Recueil des Actes de la Séance publique de l'Academie Imperiale des Sciences de St Petersbourg, tenue le 29. Decembre 1834. —*From the Imperial Academy.*

The following Papers were read:

1. On the Non-Hellenic portion of the Latin Language. By the Venerable Archdeacon Williams.

The line of argument went to shew, that the Umbri were one of the most ancient nations of Italy. That they, through their colonies or entire tribes, entered deeply into the composition of the primitive population of Rome. That, according to ancient authorities, these Umbri were the descendants of the "Veteres Galli." That these Veteres Galli were of the same race and blood as the present Cumbri of Wales, Cornwall, and Brittany. That hence it is probable, that the ancient language still preserved among these may have entered easily into the composition of the language of the Romans. That the names of rivers, mountains, cities, lakes, districts, &c. in central Italy, and in all the countries over which the Sabellian tribes, and their cognate race the Veneti, diffused themselves, is likely to convert this probability into certainty. That the question concerning the ancient population of Italy has never yet been satisfactorily treated; that it never can be, unless the examiner is well acquainted not only with the language, but also the literature of Greece and Rome, and with at least one type or form of the several Teutonic and Celtic languages. That a slight acquaintance with other forms is also very desirable. That the writer professes to be conversant with Greek, Roman, and Cumbrian literature, and to a certain extent with the Anglo-Saxon, and that he knows something of the Gaelic and Basque tongues. That no examination of indexes can avail, owing to the peculiar character of the Cumbrian tongue, in which a person ignorant of the principles of its grammar might suspect that there was nothing fixed, while, on the contrary, it is the most fixed and indestructible of all languages. That the vocabularies of the Latin and Cumbrian languages are strikingly similar, although their grammars are radically different. That the work of comparing the two languages etymologically would be easy, had it not been for the long stay of the Romans in Gaul and Britain, which must be supposed to have made a deep impression upon the language of the natives. That nevertheless much Latin words exist, to the primary meaning of which the Cumbrian scholar alone possesses the key, and that a long list of words belonging to such a class must prove that some cognate branch of his language must have entered into the original composition of the Latin tongue. That the strength of the proof must depend upon the extent of the induction.

2. On the Sources and Composition of the different kinds of Gamboge. By Dr Christison.

3. On the Botanical Origin of Gamboge. By Dr Graham.

Gamboge was first made known by Clusius about the commencement of the seventeenth century, as a concrete juice from China. About the middle of the same century, Bontius conceived he had traced it to a particular species of *Euphorbia*, growing in Java and in Siam; from the latter of which countries the whole gamboge of commerce was at that time obtained. About the close of that century Hermann announced that gamboge was produced by two species of trees growing in Ceylon, which have been since often confounded together, but which are now designated by the names *Garcinia Gambogia*, and *Stalagmitis Gambogioides*. About the middle of last century, gamboge was referred by Linnæus to the former of these plants, and his reference was generally admitted. But about thirty years later, Professor Murray of Göttingen conceived he had traced it satisfactorily from the specimens collected by Koenig in Ceylon, and information obtained by the same botanist in Siam, to a new species which he called *Stalagmitis gambogioides*.

Dr Graham shows, from specimens and drawings sent from Ceylon, both by Mrs Colonel Walker to himself, and by David Anderson Blair, Esq. to the late Dr Duncan, that the plant producing Ceylon gamboge is neither *Garcinia gambogia*, as Linnæus thought, nor *Xanthochymus ovalifolius*, as conjectured by Dr Wight and Mr Arnott, nor *Stalagmitis gambogioides*, according to Murray and Koenig, but is a species described by Lamarck and Gärtner under the name of *Garcinia* or *Mangostana morella*, although it differs from all of these genera in the structure of its stamens, and, therefore, probably ought to be considered a new genus among those producing a gambogioid juice.

Dr Christison proved, that, at the present time, Ceylon gamboge is not an article of European commerce, and that the whole gamboge of the markets of this country comes, as in the time of Bontius, from China. After mentioning the analysis of fine gamboge made by Braconnot in France and John in Prussia, he stated the following as the mean composition of the several varieties of gamboge he has hitherto examined:—

Pipe gamboge of Siam:

Resin, ...	72.2
Arabin, ...	23.0
Moisture, ...	4.8
	100.0

Cake gamboge of Siam:

Resin, ...	64.8
Arabin, ...	20.2
Fecula, ...	5.6
Lignin, ...	5.3
Moisture, ...	4.1
	100.0

Ceylon gamboge sent by Mrs Colonel Walker:

Resin, ...	70.2
Arabin, ...	19.6
Fibre of wood and bark, . .	5.6
Moisture, ...	4.6

Ceylon gamboge, adhering to a specimen of the bark sent by Mr David Anderson Blair:

Resin, ...	75.5
Arabin, ...	18.3
Cerasin, ...	0.7
Moisture, ...	4.8
	99.3

The proportion of the gum to the resin varied somewhat in each variety, but never differed more than 2 per cent. from the means given above.

The author added, that he had found the resin to be the active principle of gamboge.

He inferred from the composition of the different kinds of gamboge, and other circumstances detailed in his paper, that the cake gamboge of Siam is not entirely a natural production, but a manufactured article: that Ceylon gamboge, if freed from incidental fibrous matter, corresponds almost exactly with Siam gamboge: that, therefore, they are probably produced by the same plant: that Ceylon gamboge possesses precisely the same medicinal properties: and that this variety, if more carefully collected, may, in all probability, be applied with equal advantage to every economical purpose which is at present served by the finest pipe gamboge of Siam.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1836. No. 9.

Monday, 21st March 1836.

Rev. Dr. CHALMERS, Vice-President, in the Chair.

The following gentlemen were duly elected Ordinary Fellows of the Society:

1. David Rhind, Esq.
2. James Anderson, Esq.

M. Dulong, formerly Perpetual Secretary of the Royal Institute of France, was elected an Honorary Member of the Society, in room of M. Stromeyer, of Göttingen, deceased.

The following Donations were presented:

The Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. No. 31. for March 1836.—*From the Highland Society.*

Catalogue of Recent Shells in the Cabinet of John C. Jay, M. D., Member of the Lyceum of Natural History, New York.—*From the Author.*

Thirteenth Report of the Whitby Literary and Philosophical Society, presented at the Annual Meeting, October 31. 1835 — *From the Society.*

The British and Foreign Medical Review, or Quarterly Journal of Practical Medicine and Surgery. Edited by John Forbes, M. D., F. R. S., and John Conolly, M. D.; January 1836 No. 1.—*From the Editors.*

Descriptive and Illustrated Catalogue of the Physiological Series of Comparative Anatomy of the Royal College of Surgeons in London. Vol. iii. Part 1.—*From the Royal College of Surgeons in London.*

The following Communications were read:

1. Observations and Experiments on the Coloured and Colourable Matters in the Leaves and Flowers of Plants, particularly in reference to the Principles upon which Acids and Alkalies act in producing Red and Yellow or Green By Dr Hope, V. P. R. S. E., F. R. S. [Continued from 18th Jan.]

After premising some general remarks respecting the object of research, and enumerating the various authors who had written upon the subject, Dr Hope explained various terms which were to be used in the discourse. To the various coloured matters presented by the leaves and flowers of plants, De Candolle had applied the denomination of Chromule, which term he meant to adopt.

There resides in the same parts of plants, in addition to the chromule, some matter probably destitute of colour, which becomes red by the action of acids, and yellow or green by the action of alkalies. To it Mr Ellis gave the name of colourable matter, which the author changes to Chromogen. When an acid, added to a vegetable infusion, causes a red colour, and an alkali a yellow or green, it has been the universal opinion that both sets of agents act upon one and the same colourable principle. The leading object of this paper is to shew that the Chromogen, or colourable principle, is not an individual substance; and that there are two distinct principles, one which forms the red compound with acids, which he denominates Erythrogen; and another, which affords a yellow compound with alkalies, which he calls Xanthogen.

To establish that opinion, Dr Hope made many experiments on the leaves and flowers of plants, with various reagents, principally water, alcohol, acids, and alkalies: and has exhibited the results in the compendious form of tables. The first table presents the result of experiments on the leaves of many plants; and the general result from them, in regard to the special object of inquiry, is, that in addition to the green Chromule, denominated Chlorophyle by many writers, they all contain Xanthogen, and that none of them, excepting those which have some tint different from the green, contain Erythrogen.

The second table exhibits the result of the action of the reagents upon white flowers, all of which, to the number of about thirty, gave proofs of their containing Xanthogen, but no Erythrogen nor tinted Chromule of any kind.

The third table displays the results with yellow flowers, from which the general inferences are, that the yellow Chromule varies in its nature in different flowers; that all those subjected to experiment contained Xanthogen, and none of them Erythrogen.

The fourth table exhibits the experiments with red flowers, and affords the general conclusions, that while the red chromule shews considerable variety of character, red flowers contain both Xanthogen and Erythrogen in abundance.

The fifth table exhibits the results with twenty blue flowers, and presented the general observations, that the blue Chromule varies in its character in different blossoms, particularly in shewing very different degrees of solubility in water and alcohol, and in some producing coloured, and in others colourless, solutions in both menstrua; and that they contain both the colourable principles of Xanthogen and Erythrogen.

The sixth table relates to ten orange flowers, which equally shews that the orange Chromule differs much in one plant from another, and that they contain both colourable principles.

The seventh table relates to twenty purple flowers, and afforded the same conclusions as the preceding.

The eighth table exhibits the experiments made upon the tinted Chromule found in other parts of plants, beside the corolla of the flowers, *e. g.* the calyx, bractea, the coloured leaves of plants, fruits, and surface of the roots, all which comported themselves as the corresponding coloured Chromules of the flowers do.

Litmus presented a solitary example, but a very interesting one in this inquiry, of a substance abounding largely in Erythrogen, but containing no Xanthogen.

A table was also presented, exhibiting the general facts relative to the power of sulphurous acid in decolorizing the Chromules of plants. This acid, whether employed in its gaseous or liquid form, does not decolorize the Chlorophyle of leaves. It does not affect white flowers. It did not decolorize any one of about a score of yellow flowers submitted to its action. Of thirty or forty red flowers it decolorized all, with the exception of two or three. Of twenty blue flowers, two, the *Commelina cœrulea,* and the blue *Centaurea Cyanus,* resisted its blanching power. It decolorized some of the orange-coloured flowers, but rendered others of them of a bright yellow: it decolorized all the purple flowers that were tried, with the exception of purple *Centaurea Cyanus,* which it rendered blue, and the purple *Scabiosa atropurpurea,* which it reddened. It affected the tinted Chromule occurring in other parts of plants than blossoms; it completely blanches the internal leaves of the red cabbage, which are of a bright purple red, while it renders the external bluish-purple leaves green. It turned to green various leaves, which possessed red tints, whether general over the whole leaf, as the red beet, or partially diffused, as in some species of Dracæna. It decolorizes some fruits, while others resist its action.

Along with the general facts, the various hypotheses respecting the origin of the different Chromules, and sources of the differences amongst them, the autumnal coloration of leaves, &c., were brought under consideration.

Lastly, a detail was given of the influence of light in the production of different Chromules, shewing that it is indispensable for the production of the Chlorophyle of leaves, and the tinted Chromules formed during the autumnal coloration of the same parts; and that it is not indispensable for the formation of some of the finest tints of flowers and fruits, if essential for any.

The paper terminated with the following general conclusion: That there exist in plants two distinct colourable principles, two species of Chromogen, one which generates red compounds with acids, and denominated Erythrogen; and another which forms yellow compounds with alkalies, called Xanthogen. That these two principles occur together in red and blue flowers, and in the leaves of a few plants which exhibit the former of these tints; that all green leaves, all white and all yellow flowers, and white fruits, contain Xanthogen alone; that Litmus abounds in Erythrogen, but has no Xanthogen; that the Chromules of different tints may be generally considered distinct vegetable principles, or compounds having their own proper hue; sometimes intimately blended, or chemically combined with Chromogen; at other times having no connexion with it; that they are also occasionally, but not frequently, compounds of Chromogen with acids or alkalies.

The second part of the paper will comprehend an inquiry into the special character and properties of the two colourable principles, the Erythrogen and Xanthogen.

2. On Dyspnœa, and other Sensations experienced on the summit of Mont Blanc. By Martin Barry, M. D. Communicated by Dr Alison.

Thirst and loss of appetite were the first symptoms experienced by Dr Barry at a height of about 14,000 feet; but it was not till he reached a height 1000 feet greater, that exhaustion and fatigue supervened. A tendency to fainting was felt, and a total indifference to the main object of the journey. After a few minutes of rest, these sensations disappeared, but were again perceived on proceeding a few steps. On the summit (15,666 feet above the sea; Barom. 17.052, Detached Therm. 30°) no particular lassitude was felt while the author performed his experiments. After the descent the author did not suffer from a state of collapse.

It was shewn, that of those who have ascended Mont Blanc and other high mountains, some have suffered more, others less,—that there have been differences in this respect, not only among individuals of the same party at the same time, but in the same person at different times; how far referrible to the condition of the system, and how far to atmospheric changes, is still uncertain.

Respiration, and even continued muscular exertion, which necessarily accelerates the breathing, are possible in very attenuated air, as among the inhabitants of lofty regions; but by any great and sudden change of density, whether of increase or diminution, this function becomes embarrassed.

There is reason to believe that the quantity of oxygen *absorbed* by the lungs does not always bear the same ratio to the quantity *received* into their cells. At least, if the evolution of animal heat is directly as the oxygen *absorbed;* for on this supposition the air at Chamoni having a density = 27, that on the summit of Mont Blanc = 17, and the temperature at the upper station being many degrees below that at the lower, the absorption of oxygen must have been, not relatively alone, but also absolutely greater, from the rarer than from the denser air.

The occurrence of hæmorrhages in the ascent of high mountains has been a frequent, but very variable phenomenon, and some of these have probably been simply mechanical effects of the internal and external pressures not being at first in equilibrio.

3. Mr Smith of Jordanhill made a verbal communication regarding a change in the Relative Levels of the land and sea on the west coast of Scotland; recent shells having been found even at the height of 70 feet.

4. Professor Forbes communicated the following memorandum respecting the Polarization of Heat.

" I have recently ascertained the following facts respecting heat.

" 1st, That heat polarized in any plane, and then reflected from the surface of a refracting medium, changes its plane of polarization in a manner similar to what obtains in the case of light. Thus, with a thick plate of mica, which polarized homogeneous red light most completely at an incidence of about 59°, the plane of polarization of reflected polarized heat remained on the *same* side of the plane of reflection when the incidence was *great*, and was on the *contrary side* when the incidence was *small*. The limiting angle of incidence was about 57°, which therefore should be the polarizing angle of dark heat for mica. This mode of observing the polarizing angle offers some advantages above more direct methods.

" 2dly, Metals polarize heat extremely feebly by reflection. I have carried my experiments up to 85° from silver, yet even there but a small share is polarized. The effect is, however, distinctly recognizable through a considerable range of incidences. The effects are such as would indicate the maximum polarizing angle to be even much higher; perhaps it never attains a maximum. This fact corresponds to that in the case of light, except that the maximum polarizing angle is 73° (Brewster). Did metals act on light like other bodies, we should conclude, from the polarizing angle being greater, that heat is more refrangible than light. An important remark of Sir D. Brewster's, however, shews the statement I have made to be in conformity with the views of the nature of heat which I have published. He finds the maximum polarizing angle to be *greatest* for the *least* refrangible rays.

" 3dly, Heat polarized in a plane inclined 45° to the plane of subsequent reflection at silver, has its nature changed as in the case of light, and presents the conditions of elliptic polarization, though the ellipse is much more elongated, even at great angles of incidence.

"4thly, *Two* reflections from silver increase the polarizing effect of metals. This fact has its counterpart in light. Two reflections likewise produce an increased tendency to circular polarization when the plane of reflection is inclined 45° to that of primitive polarization. This effect increases with the obliquity of incidence up to considerable angles.

"These observations have been verified in the case of heat from various sources, obscure as well as luminous."

Monday 4th April.

Dr HOPE, Vice-President, in the Chair.

The following Donations were presented:

Transactions of the Geological Society of London (second series). Vol. iv. Part 1.

Proceedings of the Geological Society of London, Nos. 42, 43 and 44.—*By the Society.*

Bulletin de la Société Géologique de France. Tome vii. Feuilles 1–2.—*By the Society.*

Tables des Positions Géographiques des Principaux Lieux du Globe; par M. Daussy.

Second Mémoire sur les Marées des Cotes de France; par M. Daussy.—*By the Author.*

The following Communications were read:

1. On Paracyanogen and its Compounds. By James F. W. Johnston, Esq.

In this paper the author shewed that pure dry bicyanide of mercury, when heated in close vessels, gave off mercury and pure cyanogen only, yet that there remained always in the retort a portion of a black substance of variable density and lustre. He then proceeded, by a new series of analyses, to confirm what he had stated several years ago, that this black substance is identical in composition with cyanogen, being, like that gas, represented by the formula NC_2. To this solution he gives the name of Paracyanogen. He then stated that the black substance deposited in strong prussic acid, by a solution of cyanogen in water, in alcohol, in solution of caustic ammonia or caustic potash, after heating to redness, had the same composition. The black matter from solution of cyanogen in alcohol may be obtained in large quantity, by saturating the same portion of alcohol with cyanogen gas day after day as the odour of the gas disappears; a pint of alcohol being capable of absorbing the whole of the cyanogen given off by four or five pounds of bicyanide of mercury, becoming black and thick like treacle. The deposit collected on the filter dissolves readily in solution of caustic potash, and is precipitated by acids of a dark brown colour. In this state it appears to have the composition represented by $H+N_2C_3$. When heated to redness in close vessels, it gives off carbonate of ammonia, and leaves paracyanogen, according to the formula

$$HN_2C_3 + 2\,HO = NC_2 + (H_3N + CO_2).$$

The paracyanogen dissolves in sulphuric acid giving a dark brownish-red solution, from which water precipitates it unchanged. Boiled in the acid, carbonic and sulphurous acids are given off, and a partial oxydation of the paracyanogen takes place. Nitric acid, either cold or hot, acts very slightly on the paracyanogen from bicyanide of mercury, but dissolves readily in the cold, that prepared by the other processes, giving a dark reddish-brown solution, from which water precipitates the paracyanogen apparently unchanged. Hot nitric acid, however, dissolves the black substance from cyanogen in alcohol, &c. with evolution of copious red fumes, giving a bright reddish-yellow, or a pale amber-yellow solution, from which water precipitates a beautiful bright yellow powder. This yellow substance is *paracyanic acid.*

This acid is chiefly characterized by its great stability. It dissolves in nitric and sulphuric acids, and is very easily decomposed, even when boiled in these menstrua. When heated in a close vessel, it gives off carbonic acid and nitrogen, and leaves paracyanogen. Another very marked character is its affinity for the oxides of mercury. A solution of the paracyanic in concentrated nitric or sulphuric acid is precipitated largely and immediately by nitrates and sulphates of mercury. The salt of mercury, too, is only partially decomposed by boiling in these acids. The salt of silver is more soluble, but may also be obtained by adding dry nitrate of silver to a solution of the acid in concentrated nitric acid. These salts constitute yellow powders more or less bright; they seem also susceptible of crystallization. From the analysis of the acid and its salt of silver, the author considers the acid to be composed of $N_4C_8 + O$. The investigation, however, is still incomplete, and this composition is only given as probable and open to correction.

Like cyanogen, *para*cyanogen seems capable of uniting with the metals to form paracyanides, though, from its insolubility in ordinary menstrua, it is not easy to obtain them free from paracyanates.

2. On the newly discovered microscopic Entozoon infesting the Muscles of the Human Body. By Dr Knox.

The author commenced his observations by remarking that this very interesting entozoon was discovered in 1833, by Mr Hilton, who first saw the cysts enclosing the worms, and supposed them to be cysticerci. Shortly thereafter, Mr Paget discovered the worm itself. Further information was given in two excellent memoirs by Dr Farre and Mr Owen; and to the views of the former of these gentlemen the author chiefly leans.

Throughout the observations, he endeavours to shew, that the origin of this entozoon is very obscure, and is not referrible to any known bodily ailment or mode of life. He differs also from preceding observers, both in respect to the form of the cyst, its structure, and its connexions; the form he makes out to be oval, the structure distinctly granular and not cellular, that is, not composed, as some have conjectured, out of the surrounding cellular tissue; and the connexion not *universal*, but towards the extremities. He conjectures also, that the granular structure discovered by him on the exterior of the cysts may be the germs of future individual worms and cysts.

The aged person, whose muscles after death presented these entozoon in such numbers, was quite healthy until a short period before her demise.

Monday 11*th April* 1836.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following Donations were presented:

The Statutes of the Realm. Vols. ii. to ix. and 2 vols of Indices.

Foedera, Conventiones, Litteræ, et cujuscunque Generis Acta Publica, inter Reges Angliæ et alios quosvis Imperatores, Reges, &c. Cura et studio Thomæ Rymer. 3 vols. in 6.

The Parliamentary Writs and Writs of Military Summons, together with the Records and Muniments relating to the Suit and Service due and performed to the King's High Court of Parliament, and the Councils of the Realm. Collected and Edited by Francis Palgrave, Esq. 2 vols. in 4.

Rotuli Scotiæ in Turri Londinensi et in Domo Capitulari Westmonasteriensi asservati. 2 vols.

Rotuli Hundredorum Temp. Hen. III. et Edw. I. in Turr. Lond. et in Curia Receptæ Scaccarii Westm. asservati. 2 vols.

Rotulorum Originalium in curia Scaccarii Abbreviatio. 2 vols.

Rotuli Litterarum Clausarum in Turri Londinensi asservati. Accurante Thoma Duffus Hardy. Vol. i.

Rotuli Litterarum Patentium in Turri Londinensi asservati. Accurante Thoma Duffus Hardy. Vol. i. pt. 1.

Calendarium Inquisitionum post Mortem sive Escaetarum. Vols. i. ii. iii. iv.

Nonarum Inquisitiones in Curia Scaccarii. 1 vol.

Placita de quo Warranto temporibus Edw. I. II. et III., in curia Receptæ Scaccarii Westm. asservata.

Placitorum in Domo Capitulari Westmonasteriensi asservatorum Abbreviatio.

Ducatus Lancastriæ. Vols. i. ii. iii.

Valor Ecclesiasticus Temp. Henr. VIII. auctoritate Regia institutus. 6 vols.

Calendars of the Proceedings in Chancery in the Reign of Queen Elizabeth; from the originals in the Tower. 3 vols.

Inquisitionum in Officio Rotulorum Cancellariæ Hiberniæ asservatarum Repertorium. 2 vols.

Rotulorum Patentium et Clausorum Cancellaria Hiberniæ Calendarium. Vol. i. part i.

Catalogue of the Harleian Manuscripts in the British Museum. 4 vols.

Catalogue of the Lansdowne Manuscripts in the British Museum, 1 vol.

Rotuli Curiæ Regis. Rolls and Records of the Court held before the King's Justiciars or Justices. Edited by Sir Francis Palgrave, K. H. 2 vols. 8vo.

Rotuli de Oblatis et Finibus in Turri Londinensi asservati tempore Regis Johannis. Accurante Thoma Duffus Hardy, S. A. S.

Fines, sive Pedes Finium: sive Finales Concordiæ in Curia Domini Regis: A. D. 1195—A. D. 1214. Edente Josepho Hunter. Vol. i.

Excerpta a Rotulis Finium in Turri Londinensi asservatis, Henrico Tertio Rege, A. D. 1216—1272. Cura Caroli Roberts. Vol. i. A. D. 1214—1246.

Rotuli Normanniæ in Turri Londinensi asservati, Johanne et Henrico Quinto Angliæ Regibus. Accurante Thoma Hardy, S.A.S.

Proceedings and Ordinances of the Privy Council of England. Edited by Sir Harris Nicolas. 10 Richard II. 1306 to 21 Henry VI. 1443. 5 vols.

General Introduction to Domesday Book, by Sir Henry Ellis, K. H., F. R. S.

Presented by the Commissioners on Public Records.

Transactions of the Society instituted at London for the Encouragement of Arts, Manufactures, and Commerce. Vol. l. part 2. *By the Society.*

The Third Annual Report of the Royal Cornwall Polytechnic Society. *By the Society.*

The following Communications were read:

1. On the Origin of the Adjective. By Professor Pillans.

The principal object of this paper was to exhibit the manner in which, in the early stages of the history of language, the adjective may be supposed to have originated from the noun. Before stating his views of this subject, the author dwelt at some length on the universal principle which influences the formation of all languages, according to which man, when he has once acquired a small stock of words, will have recourse to all manner of expedients to save himself the invention of new terms; and an instance was given in the various applications of the derivatives and compounds of the Latin word *Calx.* In following out this principle, it seemed not unlikely that when the savage met, in a new substance, with a quality which formed the distinguishing character of an object he was already familiar with, he would apply the *noun* or name of that familiar object, to express the attribute or quality as he found it to exist in that which was quite new to him; so that, supposing the plant *wormwood* to be well-known to him, and the *bitter* orange not at all, he would, on falling in with that fruit, and tasting it, exclaim, this orange is *wormwood*; and the latter term might thus come to be established as the expression of that peculiar sensation wherever it was found, and even to lose, in many cases, its original substantive application. Various examples were given from our own language, all tending to prove how apt the mind is to employ the names of objects, not only to denote the aggregate of properties which makes up the notion of that object, but occasionally also to express its predominant and distinctive quality as it exists in a different substance, which has no other attribute in common with it.

2. On Single and Correct Vision by means of Double and Inverted Images on the Retinæ. By Dr Alison.

The author began by endeavouring to state with precision the nature of the difficulty which has been long felt on this subject. Two general facts are well ascertained, and present fair objects of inquiry, 1. That images formed on corresponding points of the retinæ of the human eyes, *and on these only*, naturally affect the mind in the same manner as a single image, formed on the retina of either eye; and, 2. That impressions made on different points of the retina of the eye, are naturally followed by inferences as to the relative position of the objects producing them, exactly opposite to those which follow impressions made on different points of the surface of the body.

Facts observed by Dr Reid and others, and confirmed by personal observation, appear to the author quite sufficient to shew, in opposition to the opinion of Berkeley and of Dr Brown, that these phenomena cannot be explained by reference to experience and association; and the law of visible direction, regarded by some as *an explanation*, is in fact only a general *expression* of these phenomena; and Dr Reid distinctly stated, when he laid down that law, that a farther step was to be expected, and " a more general law of vision might be discovered," if we should come to know " the structure and use of the choroid membrane, the optic nerves and brain, and what impressions are made *on them* by means of the pictures on the retinæ."

The theory of Newton, which ascribes single vision by images formed on *corresponding points of the retina*, to the circumstance of the corresponding points of the retina being connected (by means of a semi-decussation of the optic nerves at their commissure), with the *same points in the sensorium*, was next considered, and stated to be perfectly satisfactory, if the anatomical facts are as the theory supposes. The proof of the actual connexion of corresponding points of the retinæ, with the same points in the corpora quadrigemina or optic lobes (which physiological, still more than anatomical facts, point out as the true origin of the optic nerves), is still defective; but several facts stated on the subject by Wollaston, Mayo, Serres, and others, tend to support the theory.

In regard to correct vision by means of inverted and reverted images on the retina of the eye, the author stated, and endeavoured to shew by preparations, (what was first suggested to him by Mr Dick, veterinary surgeon,) that at least in the mammalia, and probably also lower in the scale of animals, the peculiar convoluted course of the *tractus optici*, and the mode of their implantation into the optic lobes, are such, that although the impressions made on *the retina* by the different parts of an object are necessarily, by the laws of optics, situated in regard to one another in the *inverse* order of those made on the surface of the body, yet the impressions made *through the retina* and optic nerves on the *optic lobes* (*i. e.* on the upper extremity of the cerebro-spinal axis) are in *the same* order as those made through the nerves of touch, on that central portion of the nervous system, on which the sensibility of all nerves depends; and therefore that the notions which we form of the relative position of the parts of objects by the senses of sight and touch will naturally correspond.

But although this seems sufficient to explain how the impressions made by any object of sight on *either optic lobe* are in the same order as those made on the sense of touch, yet in all animals which use both eyes in looking at an object, and (by reason of the partial decussation) both optic lobes in looking with one eye, another difficulty presents itself. The impressions made on *each lobe* are in the right order, but those made on the two lobes are transposed; those made by the left portion of the field of vision, even of a single eye, falling on the right side of the retina, and being transferred to the right optic lobe, and *vice versa*. The error which would thence result, the author thinks, is rectified by means of another piece of structure, the use of which has never been explained, viz. the decussation at the pyramidal bodies, whereby, as is generally believed, the whole sensation and voluntary motion of the left side of the body are placed in connexion with the right side of the brain, and *vice versa*.

Accordingly, it appears, that in those animals where the partial decussation of the optic nerves exists, making the sensations of each eye dependent on both optic lobes, (viz. in all the mammalia and birds,) the decussation at the pyramids also exists, according to the observations of Cuvier, Serres, and others; and the sensation and motion of either side of the body appear from the experiments of Flourens and others, as well as from observations of the effects of injury or disease, to be dependent on the other side of the brain; whereas in reptiles and fishes, where there is no commissure of the optic nerves, and one optic lobe only is concerned in the vision of one eye, there is no decussation at the pyramids, and no crossing effect of injury of the brain, to the opposite side of the body, has been observed.

If this speculation be well founded (and it is admitted that farther anatomical inquiries are requisite to justify a decided opinion upon it), the peculiar course and mode of implantation of the optic nerves, in most if not all animals, and the partial decussation of the optic nerves, and the decussation at the pyramids in the two higher classes, are all parts of the arrangement by which Nature brings the intimations given by the sense of Sight, which are of course partly regulated by the laws of light, into harmony with those given by the sense of Touch, which have no connexion with these laws; and enables those animals that use both eyes at once, to derive correct information as to the number and position of objects from the sensations simultaneously excited in both, notwithstanding that the images which are essential to these sensations are double, inverted, and reverted.

Monday, 18*th April* 1836.

Sir T. M. BRISBANE, Bart. President, in the Chair.

The following gentlemen were duly elected ordinary Fellows of the Society:

1. Martin Barry, M. D.
2. Robert Steuart, Esq. M. P.

The following donations were presented:

Nouveaux Mémoires de l'Academie Royale des Sciences et Belles Lettres de Bruxelles. Tome ix.

Mémoires couronnés par l'Academie Royale des Sciences et Belles Lettres de Bruxelles. Tome x.

Bulletin de l'Academie Royale des Sciences et Belles Lettres de Bruxelles. 1835. Nos. 8, 9, 10, 11, 12.

Annuaire de l'Academie Royale des Sciences et Belles Lettres de Bruxelles. 1836.—*By the Academy.*

Annuaire de l'Observatoire de Bruxelles pour l'An 1836. Par le Directeur A. Quetelet.

Compte de l'Administration de la Justice Criminelle en Belgique pendant les Années 1831, 1832, 1833, et 1834, presenté au Roi par le Ministre de la Justice. 1835.—*By M. Quetelet.*

Astronomische Nachrichten. Nos. 289 to 294.—*By M. Schumacher.*

Du Spiritualisme au xix^{me} Siècle, ou Examen de la Doctrine de Maine de Biran, par L. A. Gruyer.—*By the Author.*

Institut Royal de France pour l'An 1836.—*By the Institute.*

The American Journal of Science and Arts; conducted by Benjamin Silliman, M. D., LL. D., &c., for January 1836.—*By the Editor.*

On the Occurrence of the Megalichthys in a Bed of Cannel Coal in the West of Fifeshire, with Observations on the supposed lacustrine Limestone at Burdiehouse.—*By Leonard Horner, Esq.*

On an artificial Substance resembling Shell; by Leonard Horner Esq. With an Account of an Examination of the same; by Sir David Brewster, LL. D. With Specimen of the substance. —*By Leonard Horner, Esq.*

The following communication was read:—

Observations on the Chemical Nomenclature of Inorganic Compounds. By Dr Hope.

The object of this paper is to propose a modification of the nomenclature of inorganic compounds now in use among chemists, which shall display with accuracy the ingredients of each compound, and the atomic ratios of each ingredient.

After stating the introduction of the principle of employing a descriptive nomenclature in chemistry by Bergman, and the happy application of it by Lavoisier and his associates, and subsequently by Berzelius, he traced the various changes rendered necessary by the improved knowledge of the more intimate constitution of compounds, resulting from the discovery of combination in definite proportions, and the atomic ratios in which combinations take place, adopted by Wollaston, Thomson, Thenard, Turner, &c. He next pointed out several imperfections in the nomenclature now in use in chemical writings, and explained a modification of it which he conceived to be more precise, completely descriptive, and admitting of application to every case and proportion of combination.

He suggested, 1st, That the prefixes of proto, per, super, and sub, now in common use, should be discontinued, as unnecessary,—as possible sources of confusion—and as deviating from the sound rule, of employing numerals of the same order and language to denote a continued series of any compound.

2d, That the happy suggestion of Dr Thomson, of employing the Greek adverbial numerals to denote the number of atoms or equivalents of base, and the Latin the number of atoms of oxygen, acid, &c. should be adopted.

3d, That the interweaving of the Latin and Greek atomic numerical indications in the same word ought to be avoided as much as possible.

The following tabular views of the nomenclature of oxides, and of metallic salts, were given as specimens of the nomenclature of the more simple and more complicated combinations.

TABLE I.

Atom of Metal.		Atom of Oxygen.		Oxide.
1	+	1	...	Oxide of Metal.
1	+	2	...	Bis Oxide of Metal.
1	+	3	...	Ter Oxide of M.
1	+	4	...	Quater Oxide of M.
2	+	1	...	Dis Oxide of M.
3	+	1	...	Tris Oxide of M.
4	+	1	...	Tetrakis Oxide of M.
2	+	3	...	DisTer Oxide of M.
2	+	5	...	Dis Quinqnoxide of M.

TABLE II.

Oxide.		Acid. Sulphuric.		Compound Salt.
1	+	1	...	Sulphate of Metal.
1	+	2	...	Bis Sulphate of M.
1	+	3	...	Ter Sulphate of M.
1	+	4	...	Quater Sulphate of M.
2	+	1	...	Dis Sulphate of M.
3	+	1	...	Tris Sulphate of M.
4	+	1	...	Tetrakis Sulphate of M.

Atom of Bis Oxide.		Atom of Acid. Sulphuric.		Compound Salt.
1	+	1	...	Sulphate of Bis Metal.
1	+	2	...	Bis Sulphate of Bis M.
2	+	1	...	Dis Sulphate of Bis M.
Ter Oxide.				
1	+	1	...	Sulphate of Ter Metal.
1	+	2	...	Bis Sulphate of Ter M.
1	+	3	...	Ter Sulphate of Ter M.
2	+	1	.	Dis Sulphate of Ter M.
Dis Oxide.				
1	+	1	...	Sulphate of Dis Metal.
1	+	2	...	B`s Sulphate of Dis M.
2	+	1	...	Dis Sulphate of Dis M.
Tris Oxide.				
1	+	1	...	Sulphate of Tris Metal.
1	+	2	...	Bis Sulphate of Tris M.
2	+	1	...	Dis Sulphate of Tris M.
DisTer Oxide.				
1	+	1	...	Sulphate of DisTer Metal.
1	+	2	...	Bis Sulphate of DisTer M.
2	+	1	...	Dis Sulphate of DisTer M.

He called the attention of the Society to an apparent deviation from the principle of the nomenclature, which he adopted for the sake of abbreviation, while it cannot possibly create any confusion. When speaking of the combination of an acid, *e. g.* the sulphuric with an oxide of a metal, say iron, the atomic constitution of which is one atom of metal and one of oxygen, he calls the compound sulphate of iron, not sulphate of oxide of iron, because every chemist is aware that invariably the metal is in the state of an oxide when in union with an acid.

He concluded by inculcating the importance of chemical writers and teachers employing uniformly the same nomenclature, and expressing his hope that the modification now proposed may meet the approbation of his fellow-labourers in the Edinburgh School.

2. Mr Stark read a communication from Dr Parnell on the occurrence of the Clupea alba, or White Bait, and of the Raniceps trifurcatus, or Tadpole-fish, in the Frith of Forth. Specimens were exhibited.

Dr Parnell endeavoured to state the specific characters by which the white bait may be distinguished from the shad, the herring, the sprat, and the pilchard.

In the white bait, the tongue and roof of the mouth are furnished with three or four rows of distinct teeth; these parts in the shad are destitute of teeth.

The dorsal fin of the herring is placed half way between the point of the upper jaw, and end of the long caudal rays; the same fin in the white bait is situated much nearer the tip of the tail than to the point of the upper jaw; the body is more compressed, of a lighter colour, and the belly is much rougher to the touch, under the pectorals, than is observed in the herring.

The origin of the ventral fins, in the sprat, is placed before the first dorsal ray; in the white bait, it is situated behind the third dorsal ray.

The pilchard has its dorsal fin placed exactly in the centre of gravity, so that, when the fish is held up by the anterior rays, the body preserves an equilibrium; whereas, if the white bait be taken up by the same part, the head will be observed to dip considerably.

3. Account of a Visit to the Governor of the Chinese Frontier Town of Mai-ma-tchin, bordering with Kiachta, in Siberia. By a General Officer in the Russian Service. Communicated by Mr Robison, Sec. R. S. Edin.

Monday, 2d May 1836.

Sir T. M. BRISBANE, Bart. President, in the Chair.

The following gentlemen were duly elected Ordinary Fellows of the Society:

1. Archibald Robertson, M. D., F. R. S.
2. J. Macpherson Grant, Esq. younger of Ballindalloch.
3. Alexander Gibson Carmichael, Esq.
4. Edward Sang, Esq.
5. Rev. Professor Nichol.

The following Donations were presented:

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie uitgegeven door J. van der Hoeven, M. D., en W. H. de Vriese, M. D. Deel ii. Stuk. 4.—*By the Editors.*

A Memoir of the late Lewis David Von Schweinitz, P. D., with a Sketch of his Scientific Labours. Read before the Academy of Natural Sciences of Philadelphia, May 12. 1835.—*By Walter R. Johnson.*

A Biographical Sketch of the late Thomas Say, Esq. Read before the Academy of Natural Sciences of Philadelphia, December 16. 1834. By Benjamin H. Coates, M. D.—*By the Academy.*

Tables of Continental Lineal and Square Measures. By W. S. B. Woolhouse, Head Assistant of the Nautical Almanac Establishment.—*By the Author.*

Prepared Specimens of the following Species of Fish were presented by Dr Parnell:

Trigla Blochii.
Aspidophorus cataphractus.
Gasterosteus trachurus.
Blennius Pholis.
Zoarcus viviparus.
Belone vulgaris.
Clupea Harengus.
Clupea sprattus.
Clupea alba.
Salmo eriox.
Salmo fario—Male.
Salmo fario—Female.
Salmo salmulus.
Gadus luscus.
Platessa vulgaris.
Platessa flesus.
Platessa pola.
Microcephalus petrosus.
Platessa Limandoides.
Solea vulgaris.
Raia radiata.

The following papers were read:

1. An Attempt to ascertain the Relative Positions of the Athenian and Syracusan Lines before Syracuse, from the Description of Thucydides. By Professor Dunbar.

The object of this paper was to ascertain the position of the Athenian and Syracusan lines from the language employed by Thucydides, particularly the prepositions. The author was led to examine the account of these lines given by *Goellen* and Dr Arnold, in their editions of Thucydides, and the maps they have subjoined, and to compare them with the historian's descriptions. He pointed out the error into which both seem to have fallen, respecting the fortifications of Temnites, as it did not appear, from the historian's statement, that the district was entirely inclosed, but only that part fronting Epipolæ. He also endeavoured to shew that the cross wall, built by the Syracusans, to intercept the Athenian lines in the direction of Trogilus, could not have been constructed on the south of the Temnites, as Dr Arnold supposes, but on the north of the slope of Epipolæ, and that it was not entirely destroyed by the Athenians.

The direction and nature of the third counter-work of the Syracusans he supposed were also misunderstood by *Goellen*, Dr Arnold, and other commentators and editors. It did not appear to have been carried in a direction to cut the Athenian lines of circumvallation towards Trogilus, but, after it had reached a certain length in the direction of their wall, it was then carried northwards, and *parallel* to the Athenian lines; and this appeared evident from the language employed by the historian, in his description of the battles that were fought between the lines of both parties; and the use of the preposition παρὰ in composition with the verbs οἰκοδομέω and ἔρχομαι. He also shewed that this parallel wall was afterwards carried forward to the ἐγκάρσιον τεῖχος, or cross wall. The author then described the position of the three Syracusan camps on Epipolæ, which were attacked by Demosthenes, in the night expedition to turn the Syracusan lines, and pointed out the errors into which Dr Arnold seems to have fallen, in his account of them, as also the misapplication of the term παρατείχισμα, which he thinks should be προτείχισμα, or an advanced post. He concluded by observing, that the rout of the Athenians must have commenced near the verge of the slope of Epipolæ, and not towards the bottom, as has been generally supposed.

2. Researches on Heat. Second Series. By Professor Forbes.

The author states, that in a former paper on this subject, having confined himself to the establishment of a number of new facts in the science of heat, embracing its polarization by reflection, refraction, and double refraction, and the depolarizing action of doubly refracting crystals, he proceeded, on resuming the subject, to ascertain more accurately the laws of these phenomena.

The *first* section of the paper relates to the methods of observation employed, and the examination of the values of the degrees of the galvanometer, which, for the most part, do not indicate equal increments of force. Two tables are given. By the first, the *statical* deviations of the needle are reduced, so as to be measures of the force producing them; and, by the second, the *dynamical* effect, or arc moved over by the initial disturbing action, is reduced to the final or statical effect, and thence to the true measure of heat. Several peculiarities attendant on the use of the galvanometer are likewise discussed.

In the *second* section, the observations formerly published on the polarizing action of tourmaline are confirmed, including the case where heat entirely dark was employed. Of all the observations this alone has been attended with any difficulty in the verification.

The *third* section treats of the laws of the polarization of heat by refraction or transmission. The author denies that the results given in the first series of these researches were held out as numerically accurate; and he took occasion to state verbally, that whilst an attempt has been made to depreciate the credit due to his observations, on the ground of the numerical inaccuracy of his first results, the objectors themselves seem to have fallen into a graver mistake, that of considering all kinds of heat equally polarizable at the same angle of incidence. A great number of experiments have confirmed the opinion which the author formerly entertained, that heat from non-luminous sources is less polarizable by a given plate of mica at a given angle of incidence than when accompanied by light. He has constructed polarizing mica bundles of great tenuity, by using sudden heat to split that substance into a vast number of minute laminæ. With one pair of such plates he obtained the following percentages of heat *stopped* when the planes of refraction in the two bundles were rectangular:

Sources of Heat.	Rays out of 100 polarized.
Argand lamp, ...	72 to 74
Incandescent platinum, ...	72
Heat from brass about 700°, . . .	63
Do. transmitted through glass, . .	72
From mercury in a crucible at 410°, . .	48
From boiling water, ...	44

These observations were repeatedly made, and were confirmed by others made with a different pair of mica plates. The results are shewn to agree with those obtained in the case of light; the heat at the bottom of the list being the least refrangible.

In the *fourth* section the law of polarization by reflection is discussed. A number of reflecting surfaces were tried, and split mica was preferred. The amount of polarization, by reflection at a given angle, is shewn to vary with the source of heat; and it is probable that the kinds of heat do not rank in the same order when the angle is changed. This is the case in light. The change of the plane of polarization by subsequent reflection is similar to that which occurs when light is used. (See page 130.)

The circular polarization of heat by total reflection forms the subject of the *fifth* section. It had been shewn in the former series that a suitable thickness of mica is capable of producing circular polarization ; but the more critical experiment of producing this effect by total reflection, in a plane inclined 45° to the plane of positive polarization, remained to be accomplished. This the author succeeded in doing, by using rhombs of rock-salt, or combinations of two prisms of the same substance. (See the Proceedings for 1st February 1836.) When two total reflections at 60° were employed, the appearance of polarization had almost vanished, provided that the planes of reflection and primitive polarization formed an angle of 45°. But if that angle were 0° or 90°, no change was observable in the state of polarization of the emergent light.

3. Dr Knox exhibited some specimens to prove that the teeth of the Cachalot are devoid of enamel.

When a longitudinal section of one of these teeth is made, two substances present themselves, viz. a central and a cortical ; these differ from each other both in appearance and in structure. The central substance resembles, and is no doubt analogous to the *ivory* of other teeth, but the cortical exhibits not the slightest analogy to enamel. In texture it is softer even than the ivory portion, and probably continues to grow or be deposited during the greater part of the life of the Cachalot, until it in fact at last completely encloses the central part, which can be nothing but an ossified pulp : it encloses the central portion in the manner that the ivory of the human tooth encloses the soft dentar pulp.

Sections of a great variety of teeth of the Cetacea were shewn to exhibit a similar structure.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1836–1837. No. 10.

Monday, 5th December 1836.

Sir THOMAS BRISBANE, Bart., President, in the Chair.

The following Donations were laid on the Table, as having been presented since the close of the last Session:

Bulletin de la Société Géologique de France. Tome vi. Feuilles 21–23, and Tome vii. 3–16.—*By the Society.*

Chemical Tables; exhibiting the present state of our knowledge in regard to the Chemical and Physical Properties of Simple and Compound Bodies. By James F. W. Johnston, A.M., F.R.S.E. *By the Author.*

Transactions of the American Philosophical Society, held at Philadelphia, for promoting Useful Knowledge. (New Series.) Vol. v. Part 2.—*By the Society.*

Memorie della Reale Accademia della Scienze di Torino. Tomo xxxviii.—*By the Society.*

Mémoires présentés par divers Savans à l'Académie Royale des Sciences de l'Institut de France. Tome vi.—*By the Royal Academy.*

Notices of Communications to the British Association for the Advancement of Science, at Dublin, in August 1835.—*By the British Association.*

Philosophical Transactions of the Royal Society of London. For 1835, Part 2; and for 1836, Part 1.

Proceedings of the Royal Society. Nos. 19. to 25.

By the Royal Society.

Abhandlungen der Koniglichen Akademie der Wissenschaften zu Berlin. Aus dem Jahre 1832.—*By the Academy.*

Beschreibung und Abbildung von 24 Arten kurzschwanzigen Krabben. Von Dr Eduard Ruppell.—*By the Author.*

Flora Batava. Nos. 104, 105, 106, and 107.—*By the King of Holland.*

Nouvelles Annales du Museum d'Histoire Naturelle de France. Tome iv. Livr. 4.—*By the Editors.*

Some Account of Halley's Astronomiæ Cometicæ Synopsis, which contains his investigation of the Orbits of Comets. By Professor Rigaud.—*By the Author.*

Mémoire sur les Courants de la Manche, de la Mer d'Allemagne, et du Canal de Saint George. Par P. Monnier, Ingénieur Hydrographe de la Marine.—*By the Author.*

Gregorii Barhebræi Scholia in Psalmum quintum et decimum octavum, e Codicis Bibliothecæ Bodleianæ Apographo Bernsteniano. Edita a J. T. G. H. Rhode.—*By the Editor.*

Georgii Gulielmi Kirschii Chrestomathia Syriaca cum Lexico denuo edidit G. H. Bernstein, Theologiæ Philosophiæ et Literarum Humaniorum Doctor in Univer. Liter. Vratislav. Professor. Parts 1, 2.—*By the Editor.*

Discours sur quelques Progrés des Sciences Mathematiques en France, depuis 1830. Par le Baron Charles Dupin.

Recherches relatives à l'influence du Prix des Grains sur la Population Francaise. Par le Baron Charles Dupin, President de l'Académie des Sciences. *By the Author.*

Notice sur le Baron de Prony, Pair de France.—*By the Author.*

Journal of the Bahama Society for the Diffusion of Knowledge. Nos. 11. to 14.—*By the Society.*

The Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. Nos. 34. and 35.— *By the Highland Society.*

Journal of the Asiatic Society. January to December 1835.
Do. Do. January, February, March, April, and May 1836. *By the Society.*

Jonrnal of the Royal Asiatic Society of Great Britain and Ireland. No. 5. for March 1836.—*By the Society.*

An Essay on the Primitive Universal Standard of Weights and Measures. By Captain Thomas Best Jervis, Bombay Engineers.—*By the Author.*

Arsberattelser om Vetenskapernas Framsteg, afgifne af Kongl. Vetenskaps Academiens Embetsman, d. 31 Mars 1834.

Kongl. Vetenskaps-Academiens Handlingar, for ar 1834.

By the Academy of Sweden.

Address of Earl Stanhope, President of the Medico-Botanical Society, for the Anniversary Meeting, January 16. 1836.—*By the Society.*

Memorias da Academia R. das Sciencias de Lisboa. Tome xi. Parte 2.—*By the Academy.*

Bulletin de la Société de Géographic. 20 Tomes.

Do. do. do. (2do Serie) Tomes iii. iv. v.

By the Society.

A Catalogue of 7385 Stars, chiefly in the Southern Hemisphere, prepared from Observations made in the years 1822, 1823, 1824, 1825, and 1826, at the Observatory at Paramatta, New South Wales, founded by Lieutenant-General Sir T. M. Brisbane, K.C.B. The Computations made, and the Catalogue constructed, by Mr William Richardson, of the Royal Observatory at Greenwich.—*From the Admiralty.*

Abhandlungen der Koniglichen Akademie der Wissenschaften zu Berlin. Aus dem Jahre 1834.—*By the Academy.*

A Treatise on Isometrical Drawing. By T. Sopwith, Esq. Land and Mine Surveyor.—*By the Author.*

Analyse da la partie du Traité sur la Chaleur de M. Poisson. Par A. de la Rive.—*By the Author.*

Descriptive and Illustrated Catalogue of the Physiological series of Comparative Anatomy contained in the Museum of the Royal College of Surgeons in London. Vol. iii. Part 2.—*By the Royal College of Surgeons.*

Contribution to a Natural and Economical History of the Cocoa-Nut Tree. By Henry Marshall, Deputy Inspector-General of Army Hospitals.—*By the Author.*

Verhandelingen van Het Bataafsch Genootschap der Proefondervindelijke Wijsbegeerte te Rotterdam. 12 Vols.

Nieuwse Verhandelingen, &c. 8 Vols. *By the Society.*

Bulletin de l'Academie Royale des Sciences et Belles Lettres de Bruxelles. 1836. Nos. 2, 3, 4, 5, 6, 7.—*By the Academy.*

Neue Wirbelthiere zu der Fauna von Abyssinien gehorig, entdeckt und beschrieben, von Dr Eduard Ruppell. Lieferungen 5. and 6.—*By the Author.*

Six Miscellaneous Pamphlets by Monsieur Virlet, Secretary of the Geological Society of France.—*By the Author.*

Eight Miscellaneous Pamphlets, by M. J. Girardin, Professor of Chemistry at Rouen.—*By the Author.*

Proceedings of the Geological Society of London. 1836, Nos. 45. and 46.—*By the Society.*

Bridgewater Treatise on Geology and Mineralogy, considered with reference to Natural Theology. By the Rev. William Buckland, D.D. 2 Vols.—*By the Author.*

American Journal of Science and Arts. Conducted by Benjamin Silliman, M.D., LL.D. For April.—*By the Editor.*

Annalen der Physik und Chemie, Herausgegeben zu Berlin. Von J. C. Poggendorf. 1836. Nos. 3, 4, 5, 6.—*By the Editor.*

Astronomische Nachrichten. Nos. 295. to 311.—*By Professor Schumacher.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. 1835.

Do. do. do. 1836. Nos. 1–26. Second Semestre No. 1–16. *By the Academy.*

Report to a Committee of the Commissioners of the Northern Lighthouses, appointed to take into consideration the subject of illuminating Lighthouses by means of Lenses, on the new Dioptric Light of the Isle of May. By Alan Stevenson, M.A. —*By the Author.*

The Articles America, Greece, and Physical Geography, (from the Encyclopædia Britannica). By Charles Maclaren, Esq.—*By the Author.*

Catalogue Raisonné; or Classified Arrangement of the Books in the Library of the Medical Society of Edinburgh.—*By the Society.*

A Treatise on Naval Tactics; by P. Paul Hoste. Translated by Captain J. D. Boswall, R.N. F.R.S.E.—*By Captain Boswall.*

Mémoires de l'Académie Imperiale des Sciences de Saint Petersbourg. (Sciences Politiques, &c.) Tome iii. Livrs. 2. and 3; and Tome iv. Liv. 1.

Do. do. (Sciences Mathématiques, &c.) Tome i. Liv. 3.

Do. do. (Sciences Naturelles.) Tome ii. Livrs. 1, 2.

Do. do. (Mémoires preséntés par divers Savans.) Tome iii. Livrs. 1, 2.

Recueil des Acts de la Séance Publique de l'Académie Impériale des Sciences de Saint Petersbourg, tenue le 29. Decembre 1835. *By the Imperial Academy.*

Annalium Societatis Eruditæ Hungaricæ, Volumen Secundum.—*By the Hungarian Literary Society.*

Maps of the Ordnance Survey of Great Britain. Published by the Board of Ordnance. Nos. 51. and 60.—*By the Board of Ordnance.*

Twenty Charts, forming part of the Pilote Français.—*By the Marine Depot of France.*

The following Communications were read :—

1. On an Arrangement of the Planets and Satellites, according to their Distances and Masses. By John Paterson, Esq. Schoolmaster of Douglas.

The author has suggested an empirical law, which seems to him to regulate the arrangement of the planets and satellites. Bode long ago proposed an empirical law, which he thought regulated the distances of the planets from the sun; namely, that their distances form a series, increasing by the successive powers of the number 2. Mr Paterson has propounded another similar law, in regard to their sizes; namely, that throughout the planetary system there is a regular alternating increase and decrease in size, as the planets increase in distance from the sun, or the satellites from the planets they accompany: that there is a progressive increase from the first to the third, a decrease from the third to the fifth, an increase, again, from the fifth to the seventh, and again a decrease from the seventh to the ninth. He illustrates this supposed law by referring to the respective masses of the planets, and of the satellites of Jupiter and Saturn; and he observes, that, in order to bring the whole solar system under the law, it is necessary that two new planets be still discovered between Mars and Jupiter.

The law thus conceived to exist, is deduced empirically alone; no reason is assigned why it ought to be observed in the constitution of the solar system.

2. Notice regarding the Composition and Properties of certain Concrete Juices, resembling Gamboge. By Dr Christison.

This notice is intended as a supplement to the observations read last session by the author, on the composition and sources of the different kinds of Gamboge. It is well known that Linnæus referred gamboge to the *Garcinia cambogia*, Willd.; and others have supposed that a kind of gamboge is also produced by the *Xanthochymus pictorius.* Both are natives of Ceylon, where, as appears from the former investigations of the author, a substance is produced almost or absolutely identical with Siam gamboge. It appeared, however, from the inquiries of Dr Graham, read before the Society last session, that this Ceylon gamboge is produced by an undescribed species of tree, and not by either of the species just mentioned.

Dr Christison has now been enabled to add to this investigation an account of the composition and properties of the concrete juices of the *Garcinia cambogia* and *Xanthochymus pictorius*, which were transmitted from Colombo by Mrs Colonel Walker. These concrete juices, which were sent attached to the barks that produced them, differ from gamboge in having a much paler yellow colour, and not being at all emulsive. That of the *Garcinia cambogia* also differs in not being at all purgative, at least in doses three or four times as great as the customary doses of gamboge; and its colouring resin possesses only a tenth part of the intensity of the colour of true gamboge resin. Farther, both the concrete juices in question differ essentially from gamboge in composition, in so far as both contain proportionally less gum, and one of them contains some volatile oil. Their composition was found to be as follows:—

Resin	66.0	76.5
Arabin	14.0	17.6
Volatile oil . . .	12.0	0.0
Accidental fibre . .	5.0	5.9
Loss, probably volatile oil,	3.0	0.0
	100.0	100.0

The author farther announced that Dr Graham had been lately enabled to determine, with the assistance of Dr Brown, certain points which he had left undecided in his paper of the previous session, on the botanical source of true Ceylon gamboge. It now appears, that the specimen from which Murray of Göttingen established his *Stalagmitis gambogioides*, and which is still preserved in the Banksian Herbarium, is in reality a patched one, consisting, probably, of the *Xanthochymus ovalifolius* and of the true plant. Dr Graham has therefore felt no hesitation in attaching to Mrs Colonel Walker's specimens a new generic name, derived from the dehiscence of the anthers, namely, *Hebradendron*. He has retained the old specific name *Gambogioides;* and he has been enabled to add to the new genus a second species, *H. ellipticum*, found by Dr Wallich in Sylhet, and supposed by that botanist to be a *Garcinia*.

3. Farther account of indications of Changes in the relative Levels of the Sea and Land. By James Smith, Esq. of Jordanhill.

The new localities in which the author has found alluvial deposits containing marine remains, occur on both sides of the river Clyde, in Loch Ryan, in the island of Skye, and on the east and west coast of Ireland. Near Glasgow, and in the county of Limerick, sea-shells were found about 80 feet above the level of high water. In the vicinity of Dublin the marine deposit was upwards of 200 feet above the sea. Mr Smith considers that indications of this change of level will be found on every part of the coasts of the British islands. The deposit belongs to the newer pliocene of Lyell. The shells, of which about seventy different species have been collected, agree in general with those now existing in the British seas. There are, however, some of them which appear to have become extinct, or at least are not known upon our coasts.

Monday, 19*th December* 1836.

Dr HOPE, Vice-President, in the Chair.

The following Donations were presented :

History of the Extinct Volcanoes of the Basin of Neuweid, on the Lower Rhine. By Samuel Hibbert, M.D., F.R.S.E.—*By the Author*.

Proceedings of the Berwickshire Naturalists' Club, No. 4.—*By the Club*.

Description Sommaire des Phare et Fanaux allumés sur les Côtes de France, au 1er Sept. 1836.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences de France (2d Semestre 1836), Nos. 17, 18, 19, 20, 21, 22, 23, 24. *By the Academy*.

Flora Batava, No. 108.—*By the King of Holland*.

The following Communications were read :—

1. Observations on Terrestrial Magnetism made in different parts of Europe, especially with reference to the influence of Height. By Professor Forbes.

These observations have reference chiefly to the intensity of the earth's magnetism, and were made for the most part with Hansteen's apparatus, in the possession of the society.

The *first* section of the paper refers to the method of making the observations, which is nearly that of Professor Hansteen.

The *second* refers to the corrections applied. These are—1. for the rate of the chronometer; 2. for reduction of the vibrations of the intensity needles to infinitely small arcs; 3. for the effect of temperature in diminishing the magnetism of the needles, which was determined for each by direct experiment; 4. for changes in the earth's magnetism; 5. for progressive changes in the needle's magnetism, which were considerable for one of the Hansteen needles, but for the other very small.

The *third* section contains tabular views of the results obtained from different series of observations, but particularly from one series made in the central chain of Alps in 1832, and another in the Pyrenees in 1835. The horizontal intensities at several detached points, as Edinburgh, Brussels, and Paris, were also ascertained; that at Edinburgh is expressed by .840, Paris being 1.000.

In the *fourth* section, the results are grouped and analyzed, the Alpine series being first taken, and the relations of the intensities determined with respect to latitude, longitude, and height. The same was done for the Pyrenean observations; the results being not merely graphically deduced, but actually calculated from as many equations of condition as there were stations, by the method of least squares. The following numbers were obtained :—

	Alps.		Pyrenees.
	By Needle No. 1.	By "Flat" Needle.	Both Needles.
Variation of intensity for 1′ of latitude, N increasing, .	—.000364	—.000505	—.000210
Variation of intensity for 1′ of longitude, E increasing,	+.000055	+.000106	—.000100
Variation of intensity for 100 of height, . . .	—.000033	—.000027	—.000053

Of these results, those obtained in the Alps, and by needle No. 1, are the most trust-worthy. From the variation due to latitude and longitude, the direction of the isodynamic lines is easily found. In the Alps, they form an angle of about 78° with the meridian, to the E. of north, nearly coinciding with the geological axis of that part of the chain. The results in the Pyrenees are of a more doubtful character, the observations having been made over a very small area of country, and exhibiting some anomalies. They would appear to indicate a direction from N. of W. to S. of E., which coincides with the mineralogical axis, and does not agree with Hansteen's map.

With regard to the effect of height, the author first considers the evidence already brought to bear on the subject, which he considers as almost quite inconclusive, from the imperfect nature of the data, and the limited extent of the induction. The result at which he has arrived as the most probable, from the combination of all his experiments, is a diminution of $\frac{1}{1000}$th part of the intensity for 3000 feet of ascent; a quantity so small, that it can only be expected to be discovered by combining a great many observations. The sum of the heights of the stations to which he has carried the Hansteen apparatus, amounts to above 160,000 feet, or 30 vertical miles.

In the *fifth* and last section of his paper, the author quotes his observations on magnetic dip, which he has determined (with a small instrument) at a considerable number of points; and by combining the results in the same manner as before, he has endeavoured to approximate to the position of the lines of equal dip in the Alps.

2. Notice respecting a New Reflecting Microscope. By Mr Guthrie. Communicated by Professor Forbes.

Mr Guthrie modifies Amici's microscope, by removing altogether the plane speculum, and placing the object to be viewed in the axis of the tube. This arrangement is to the microscope what Sir W. Herschel's is to the reflecting telescope. In order that the object may be properly illuminated, the part of the tube next the mirror is wholly removed, and three pillars substituted for it, to one of which the stage for the object is attached, and regulated by an adjusting screw.

Some observations were made by Dr Martin Barry on Unity of Organization in the Animal Kingdom.

Monday, 2d January 1837.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following Donations were presented:

The American Almanac and Repository of Useful Knowledge for the year 1837.—*By the American Philosophical Society.*

The Nervous System of the Human Body; as explained in a series of papers read before the Royal Society of London. By Sir Carles Bell, K.G.H., F.R.SS.L. & E.—*By the Author.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie door J. Van der Hoeven, M.D., en W. H. De Vriese, M.D. Vol. iii. Part 1.—*By the Editors.*

The article Mammalia, or a Treatise on Quadrupeds, (from the Encyclopædia Britannica). By James Wilson, Esq. F.R.S.E. —*By the Author.*

Report by a Committee of the Royal Society regarding the New Dioptric Light of the Isle of May.—*By Professor Forbes.*

The following gentleman was duly elected an Ordinary Fellow:

John Archibald Campbell, Esq.

The following communications were read:

1. On Tea Oil. By Robert D. Thomson, M.D. Communicated by Dr Christison.

A species of fixed oil, familiarly used in China for the same economical purposes for which olive oil is employed in Europe, has been ascertained by recent travellers in China to be produced in all probability by the tea-plant, or another species of the same natural family. The author assigns reasons for believing that it either is, or may be, obtained from the seeds of various species of the two genera *Thea* and *Camellia*. It has been hitherto almost unknown in Europe. It is when fresh quite free of smell, of a pale yellow tint, without any sediment when long kept. It resists a cold of 40° F., but at 39° becomes like an emulsion. Its density is 927. It is insoluble in alcohol, sparingly soluble in ether. It burns with a remarkably clear white flame. It consists of 75 parts of elaine, and 25 of stearine; whence the author infers its elementary composition to be, oxygen 9.853, carbon 78.619, hydrogen 11.527. He is inclined to think that this oil might prove an important article of commerce in the East, because in its properties it is superior

Fig I

Trigla lucerna.

Fig 2

Monochirus minutus

Parnell delt & sculp

to cocoa-nut oil, and the various other oils prevalently used for burning, or as oleaginous condiments, in Asiatic countries.

2. Observations on a New Species of British Gurnard, and on a Species of Sole new to Science. By Richard Parnell, M.D. Communicated by Mr Stark.

The author obtained, in the early part of last September, at Brixham, in Devonshire, seven specimens of a species of Gurnard, which has been known for thirty years past to the fishermen there under the name of Finned Captains. This he ascertained to be the *Trigla lucerna* of Brunner. The species is known as an inhabitant of the Mediterranean, where it was first noticed by Rondeletius, but mistaken by him for the *T. cuculus* of Linnæus. Since then, Brunner noticed it at Marseilles, Risso at Nice, Leach at Malta, and Cuvier at Naples; but it had not been previously observed by any naturalist on the British coasts. The largest specimen obtained by the author is 10½ inches long. The back is light red, the pectoral fins dark blue, the sides marked by a silvery band from the gill-cover to the tail; the lateral line smooth, and formed by numerous semicircular plates, beautifully radiated at their free margin; the scales thin, large, and entire; the second ray of the first dorsal fin very long, so as to reach, when folded down, beyond the sixth ray of the second dorsal fin. (See Plate.)

From the same source, the author obtained at the same time a small species of sole, which he believes to be entirely new to naturalists, and which he proposes to designate *Monochirus minutus*. It is five inches long, shaped like a sole, but narrower towards the tail. The back is reddish-brown; the pectoral fin on the eye-side is tipped with black, but the opposite one is white and rudimentary. The dorsal fin commences over the upper lip, and extends down the back to the caudal rays; and every sixth or seventh ray of the dorsal and anal fins is black. The number of fin rays is 73 dorsal, 54 anal, 4 ventral, 4 pectoral, and 14 caudal. The scales are small, with from 12 to 15 denticles at their free margin.—The *Monochirus lingula*, or red-backed sole, is the only species with which this fish might be apt to be confounded. But they differ in the red-backed sole presenting a distinct interval between the dorsal and caudal fins, a white fringing of the tail, and upon the anal and dorsal fins six or seven blackish spots, that extend beyond the base of the rays towards the body of the fish. This little sole is not unfrequently taken in the trawl-nets by the fishermen of Brixham, but on account of their diminutive size they are seldom brought on shore.

Specimens of the subjects of this paper were exhibited by the author, and may be seen in the Society's museum. (See Plate.)

3. On Aplanatic Telescopes, a posthumous paper by the late Archibald Blair, Esq. Communicated by Professor Forbes.

In this paper a new fluid composition is proposed for correcting chromatic aberration, free from the corrosive properties of those used by the author's father Dr Blair, the inventor of the fluid object-glass. The composition proposed is :—

Saturated solution muriate of lime, . .	40 parts
.... nitrate of lime, . .	20 ...
Strongest acetic acid, ...	2 ...

The secondary spectrum formed by the nitrate, combined with crown-glass, is similar to that when flint and crown glass are combined. The combination of crown-glass with the muriate is the opposite. Hence, by properly combining these, Mr Blair states that the secondary spectrum may be wholly destroyed.

Monday, 16th January 1837.

Sir THOMAS M. BRISBANE, President, in the Chair.

The following gentlemen were duly elected Ordinary Fellows of the Society :

1. John S. Russell, Esq., Lecturer on Natural Philosophy.
2. Charles Maclaren, Esq.
3. Archibald Smith, Esq., Fellow of Trinity College, Cambridge.

The following Donations were presented :

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences de France, (2d Semestre 1836), Nos. 25, 26.—*By the Academy.*

On the Unity of Structure in the Animal Kingdom. By Martin Barry, M.D., F.R.S.E.—*By the Author.*

Transactions of the Institution of Civil Engineers. Vol. i.—*By the Institution.*

Nouveaux Mémoires de la Société Impériale des Naturalistes de Moscow. Tome iv.

Bulletin de la Société Impériale des Naturalistes des Moscow. Tome ix.

By the Imperial Society.

Safety Apparatus for Steam Boilers. By A. D. Bache, Professor of Natural Philosophy and Chemistry, University of Pennsylvania.

Historical Notes. By A. D. Bache, Esq. &c.

Experimental Illustrations of the Radiating and Absorbing Powers of Surfaces for Heat, &c. By A. D. Bache, Esq.

Experiments on the alleged Influence of Colour on Radiation. By A. D. Bache, Esq.

Replies to a Circular in relation to the occurrence of an unusual Meteoric Display on the 13th November 1834, addressed by the Secretary of War to the Military Posts of the United States. By A. D. Bache, Esq.

Notes and Diagrams illustrative of the New Brunswick Tornado. By A. D. Bache, Esq.

On the Magnetic Dip at various places in the United States. By A. D. Bache, Esq.

On the relative Horizontal Intensities of Terrestrial Magnetism at several places in the United States. By A. D. Bache, Esq.

By the Author.

Report on the Geological Survey of the State of New Jersey. By Henry D. Rogers, Professor of Geology and Mineralogy, &c. —*By the Author.*

Report of the Managers of the Franklin Institute of the State of Pennsylvania, for the promotion of Mechanic Arts in relation to Weights and Measures.

Report of the Committee of the Franklin Institute of Pennsylvania, on the Explosion of Steam-Boilers.

General Report on the Explosion of Steam-Boilers, by a Committee of the Franklin Institute of Pennsylvania.

By the Franklin Institution.

Report of the Geological Reconnaisance of the State of Virginia, made under the appointment of the Board of Public Works. By William B. Rogers, Professor of Natural Philosophy.—*By the Author.*

The following Communications were read:

1. On the Condition of the Earth, as it is first described in the Mosaic Account of the Creation. By Mungo Ponton, Esq.

In this paper, the author confined his attention principally to those words of the original, which, in the received translation, are rendered " without form and void." He considered that, in a philological point of view, the most correct translation is " vastness and emptiness," or, in the adjective form, " immeasurable and imponderable."

The bearing of the most recent philosophical discoveries, and of the opinions of natural philosophers and geologists, upon the interpretation of this passage, formed the next subject of inquiry. It was stated that there are three prevailing opinions in regard to the Mosaic account of creation, arising out of three different views with respect to the period when those strata were formed which contain organic remains. One opinion is, that these strata were formed at a period altogether antecedent to the events described in the second and succeeding verses of Genesis. A second opinion is, that the strata were formed during the very epoch embraced in the Mosaic narrative; and a third, that they were formed subsequent to that epoch. In both of the latter views, the description of the state of the earth is considered as applicable to its original condition when first created. The author seems to lean to the second opinion, and infers that the primitive condition of the earth was probably gaseous.

2. On the Result of Experiments on the Weight, Height, and Strength, of above 800 individuals. By Professor Forbes.

These experiments were made upon students in the University of Edinburgh, chiefly between the ages of 14 and 25, and were intended to illustrate the general inquiry as to the law of physical development with age, but more particularly to afford data for instituting comparisons between different nations. For this purpose, throughout these experiments, natives of Scotland, England, and Ireland, were distinguished; and though the numbers belonging to the two latter countries were comparatively small, still the general coincidence of results, as to the three elements of weight, height, and strength, gives some confidence even in that part of the inquiry.

The weights were expressed in pounds including clothes; the heights in inches, including shoes; the strength was determined in pounds by Regnier's dynamometer.

All these data for different ages were expressed by projection upon ruled paper, and interpolating curves used to deduce the mean results, which were then tabulated. A comparison was instituted with M. Quetelet's conclusions, from experiments on a similar class of individuals in Belgium. The following deductions were made:

1. That, in respect of weight, height, and strength, there is a general coincidence in the form of the curves with those of M. Quetelet.

2. In Britain, the progress towards maturity seems greater in the earlier years (14 to 17) than in Belgium, and slower afterwards. This seems more strongly indicated in the English than in the Scotch curves.

3. The superior physical development of natives of this country above the Belgians is very marked. In strength it is greatest ($\frac{1}{5}$th of the whole); in height least.

4. So far as the English and Irish curves can be considered as correct, they indicate that the English are the least developed of the natives of Britain at a given age, the Irish most, the Scotch retaining an intermediate place.

5. The maximum height is barely attained at the age of 25.

6. All the developments increase during the period of observation (14 to 26 years of age), and all increase *more* slowly as age increases. Hence the curves are all convex upwards, (the abscissæ or ages being projected horizontally).

3. Description of a Single Achromatic Eye-Glass. By Edward Sang, Esq.

The author observes that, "in combining the surfaces of an achromatic eye-piece, a very limited question is resolved. The condition is, that pencils of light falling upon the first surface in directions parallel [approximately] to the axis of the instrument, emerge from the last surface in such a way, that the different rays into which each is decomposed may be parallel among themselves. On account of this restriction, achromatism can be obtained by the use of only one medium, and it is unnecessary to combine substances acting differently on the light of various colours."

The author then proceeds to show that, since the only required conditions are that two refractions shall take place of a certain amount and at certain distances, these conditions may be fulfilled by two refracting *surfaces*, or by a single lens of a certain thickness.

The author computes the relations of the radii of curvature of such a lens, and the interval between its surfaces, so as to fulfil—1. the condition of achromatism; and, 2. that of the whole light entering the object-glass being received also by the eye. This second condition determines the radii in the ratio of the line of incidence to the line of refraction. The correction for sphericity cannot be also included on this construction.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1837. No. 1[illegible]. //

Monday, 6th February 1837.

Sir THOMAS M. BRISBANE, Bart., President, in the Chair.

The following Donations were presented:

Bulletin de la Société Géologique de France. Tome vii. Feuilles 17–19.—*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences de France, (1er Semestre 1837). Nos. 1, 2, 3, 4.—*By the Academy.*

The American Journal of Science and Arts. Conducted by Benjamin Silliman, M.D., LL.D. Vol. xxxi. No. 1. for October 1836.—*By the Editor.*

Carte de la Côte Septentrionale d'Afrique entre Alger et les Iles Zafarines.

Plan de la Baie de Coquimbo—Plan de la rade d'Iquique.

Carte des Côtes de France, partie comprise entre le cap Fréhel et Caucale.

Carte des Côtes de France, (anse de Vauville, cap de la Hague), &c.

Carte des Côtes de France, (partie comprise le fort de Querqueville et le fort La Hague).

Carte des Côtes de France, (partie comprise entre la pointe de Barfleur et Grandchamp), &c.

Plan de Barfleur et de ses environs.

Plan de la rade de la Hongue.

Plan particulier de Mouillage d'Alger.

Par le Ministre de la Marine.

The following Communications were read :

1. On the Action of Disintegrated Surfaces of Crystals upon Light. By Sir D. Brewster.

In this paper the author commences with a summary of the present state of knowledge as to the internal constitution of crystalline bodies ; and he then proceeds to describe the optical figures produced by the disintegrated surfaces of minerals and artificial minerals, according as the disintegration is effected—1. By the action of solvents while the crystal is forming, or remains in the bowels of the earth ; 2. By the action of solvents on the surface of perfect crystals ; and 3. By mechanical abrasion. The crystals of the first denomination he has examined are Brazil topaz, white fluor-spar, hornblende, axinite, boracite, oxidulated iron, dodecahedral garnet, diamond, and amethyst. The perfect crystals which he found best fitted for presenting the phenomena he describes are alum, fluor-spar, and calcareous spar. The facts related in this paper consist of a description of a great variety of optical appearances, of which it is impossible to give an abstract.

2. Observations on the Pulsation of the Heart and Arteries. By Dr Knox.

The author here first describes briefly what has been done by previous physiologists towards determining the differences produced on the pulse by varieties in posture, by digestion, by age, by stature, by the period of the day, and by muscular motion. He then proceeds to relate the particulars of many new observations he has himself made upon these and other points connected with the circumstances which influence the rate of the heart's contractions. The general results are, that in his opinion the pulse is more frequent in the morning than at any other period of the day, abstracting the effect of stimuli ; that the heart is more excitable at the same period ; that the pulse is depressed by cold ; that it is excited by muscular exertion, and more in the weak than in the strong, and also more by exercise carried to fatigue than by moderate exercise ; that it is most frequent in the young, and least frequent in the old ; and that great varieties are produced by differences in posture, those positions of the body occasioning the greatest excitement which require most muscular effort for their maintenance.

Monday, 20th February 1837.

Dr ABERCROMBY, V. P., in the Chair.

The following gentlemen were elected Ordinary Fellows:

1. Richard Parnell, M. D.
2. Peter D. Handyside, M. D., Lecturer on Anatomy.

The following donations were presented:

Asiatic Researches; or Transactions of the Society instituted in Bengal for inquiring into the History, the Antiquities, the Arts and Sciences, and Literature of Asia. Vol. xx. Part 1.—*By the Society.*

The Journal of the Asiatic Society of Bengal for June and July 1836.—*By the Society.*

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Tome vii. Partie 2.—*By the Society.*

Recherches sur la Cause de l'Electricité Voltaique. Par M. le Professeur Auguste De la Rive.—*By the Author.*

Report on the New Standard Scale of the Royal Astronomical Society. By Francis Baily, Esq. F.R.S. &c.—*By the Author.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences de France, (1er Semestre 1837). Nos. 5. and 6.—*By the Academy.*

Brief Outlines illustrative of the Alterations in the House of Commons, in reference to the Acoustic and Ventilating Arrangements. By D. B. Reid, M.D., F.R.S.E.—*By the Author.*

The following communications were read:

I. On an Expression for the effort required to Ascend Planes of Different Inclinations. By Professor Forbes.

The author states that, whilst it has been pretty generally agreed by authors on animal mechanics that the measure of muscular effort is generally expressed by the weight multiplied by the *vertical* height through which it is raised, it is clear that this cannot be universally true, since, in the particular case of horizontal motion, no vertical height can be obtained; and, when the ascent is vertical, it is very unlikely that the same advantage of ascent should be obtained as at lower angles.

The author proposes, by a formula, to represent the length of path described by an average muscular effort at a given angular ascent in a given time, and which, multiplied by the sine of that angle, will give the vertical height gained.

Direct experiments are quoted, to shew the uniformity of vertical ascent within the usual limits, viz. between 12° and 25°. From the known results of tread-mill experiments, it is supposed that the diminution of effective action at a vertical ascent is not very considerable, but may yet amount to about 1100 feet per hour; whilst about 20°, the effective action, will be nearly 1500 feet per hour. The horizontal action is estimated at about four miles per hour. The following formula sufficiently represents extensive experiments at various angles of ascent, h = height ascended in English feet in an hour, at an angle α :—

$$h = \left\{ \frac{1900}{\sin. (\alpha + 5^\circ)} - 800 \sin. \alpha \right\} \sin. \alpha.$$

2. Observations on some New Species of British Fishes. By Dr Parnell.

The author stated that a species of sturgeon, for which he has proposed the name of *Acipenser latirostris*, as characteristic of the species, is occasionally met with in the Frith of Forth, in the Solway Frith and in the Tay. It is called by the fishermen the Broad-nosed Sturgeon, to distinguish it from the Acipenser sturio, or sharp-nosed species. The length, in general, seven feet; weight, about eight stone. The colour of the head, back, and sides, is of an olive-grey; the belly dirty white. The body is armed with five rows of osseous shields, extending from the head to the tail. The first row runs down the central ridge of the back. The two next rows arise one on each side of the former, and immediately on the lower margin of the pectorals the other two rows commence. The dorsal shields are but very slightly carinated, the fifth being the highest in the series.

The nose is broad and depressed, the point of which is larger than the diameter of the mouth. On the under surface of the snout are four cirri, situated much nearer the tip of the snout than to the upper lip. The central plates on the summit of the head are beautifully radiated, and of a fibrous appearance. The whole skin is rough, with a number of small angular osseous plates intermixed with very minute spicula. The position of the pectoral fins is the same as in other sturgeons.

This fish differs from the Acipenser sturio, the only other British species of sturgeon, in having the extremity of the snout much broader than the diameter of the mouth,—the keel of the dorsal plates but slightly elevated,—and the cirri situated much nearer to the tip of the nose than to the upper lip. For a representation of the head see the accompanying Plate. No. I.

Gobius unipunctatus. (Parnell.)

This species of Goby is common on the coast of Devon, rare in the Solway Frith, and occasionally met with in the Frith of Forth. It grows to three inches and a half in length. The back is of a reddish-brown crossed with a few short dark lines; the belly, ventral and anal fins, are of a pure white. The first dorsal fin is composed of six rays, the second of eleven rays, the last rays being shorter than the first. The tail is even at the end. Between the fifth and sixth ray of the first dorsal fin is a large dark spot which is always constant; from which circumstance the author has proposed the name of *unipunctatus.* This fish perhaps is nearer allied to the *Gobius minutus* than to any other; but the dark spot on the first dorsal, and the tail being even at the end, will readily distinguish it.

Gobius albus. (Parnell.)

This fish, in the month of June, is common in the Solway Frith, and is evidently the fry of a large species. Its length is about two inches. The body nearly transparent; the head large; the gape wide; the teeth small and sharp, placed in one row in each jaw. The numbers of the fin rays are—first dorsal 5; second dorsal 13; ventral 13; anal 13; caudal 12. The terminating rays of the second dorsal and anal fins are the longest. The presence of only five rays in the first dorsal fin is sufficient to distinguish this fish from every other of the same genus.

The accompanying plate No. I. represents the two new species together with the other species of Gobius previously distinguished.

Dr Parnell at the same time exhibited several specimens of fishes hitherto unnoticed on the coast of Scotland.

Trigla Blochii (*Yarrell.*) Specific character.—A black spot on the first dorsal fin; the dorsal ridge and lateral line strongly serrated. Frequent. July.

Trigla Hirundo (*Yarr.*) Sp. ch.—Lateral line smooth, pectoral fins large, of a deep blue colour. Rare.

Cottus Bubalis (*Yarr.*) Sp. ch.—Preoperculum with four spines; lateral line rough. Common. July.

Gasterosteus trachurus (*Yarr.*) Sp. ch.—Lateral plates extending the whole length of the body. Frequent. July.

Gasterosteus semiarmatus (*Yarr.*) Sp. ch.—Lateral plates extending as far as the vent. Frequent. August.

Mugil chelo (*Yarr.*) Sp. ch.—Upper lip thick and fleshy. Common. July

Pagellus centrodontus (*Yarr.*) Sp. ch.—Eyes large; a black spot at the origin of the lateral line. Rare. (See Plate II.)

Pagellus erythrinus (*Cuvier.*) Sp. ch.—Eyes rather small; lateral line and base of the pectorals without a spot. Rare. (See Plate II.)

Crenilabrus tinca (*Yarr.*) Sp. ch.—Caudal extremity of the body, plain. Frequent. June.

Crenilabrus Cornubicus (*Yarr.*) Sp. ch.—A black spot under the caudal extremity of the lateral line. Frequent. July.

Leuciscus dobula (*Yarr.*) Sp. ch.—Dorsal fin nine rays; lateral line fifty scales; middle ray of the tail more than half as long as the longest ray in the same fin; dorsal and anal fins even at the end. Common in the river Annan, Dumfries-shire.

Alosa finta (*Yarr.*) Sp. ch.—Teeth in both jaws; a row of spots along each side of the body. Frequent. July.

Alosa vulgaris (*Yarr.*) Sp. ch.—Jaws without teeth; sides without spots. Rare.

Pleuronectes hirtus (*Yarr.*) Sp. ch.—Under surface smooth; first dorsal ray not longer than the second. Rare.

Raia chagrinea (*Montagu.*) Sp. ch.—Tail with two rows of curved spines; back rough. Rare.

Raia radiata (*Yarr.*) Sp. ch.—Tail with three rows of spines; the spines forming the lateral rows three times as small and four times as numerous as those of the middle row. Frequent, April.

Ammocætes branchialis (*Yarr.*) Sp. ch.—Mouth without teeth. Rare. Frith of Forth above Stirling.

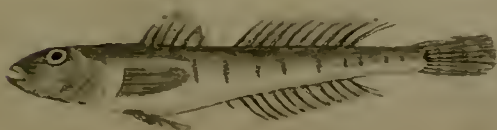
3. Dr Macdonald gave an account of a proposed improved system of chemical nomenclature.

Acipenser latirostris
Broad-nosed Sturgeon

Gobius niger Yarrell
Black Goby

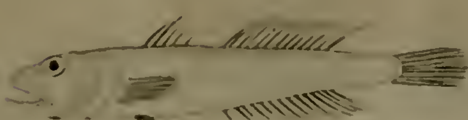
Gobius minutus Yarrell
Freckled Goby

Gobius unipunctatus
One-spotted Goby



Gobius gracilis Jan 526
Slender Goby

Gobius bipunctatus
Two-spotted Goby



Gobius albus
White Goby

Trigla Hirundo (*Yarr.*)
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Cottus Bubalis (*Yarr.*)
lateral line rough.
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Plate II.)
Crenilabrus tinca (*Yarr.*)
plain. Frequent.
Crenilabrus Cornubicus (
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Leuciscus dobula (*Yarr.*)
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Alosa finta (*Yarr.*) Sp.
along each side of th
Alosa vulgaris (*Yarr.*)
out spots. Rare.
Pleuronectes hirtus (*Yarr*
dorsal ray not longer
Raia chagrinea (*Montagu*
spines; back rough.
Raia radiata (*Yarr.*) Sp
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April.
Ammocætes branchialis (
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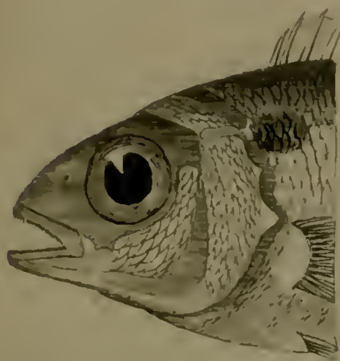
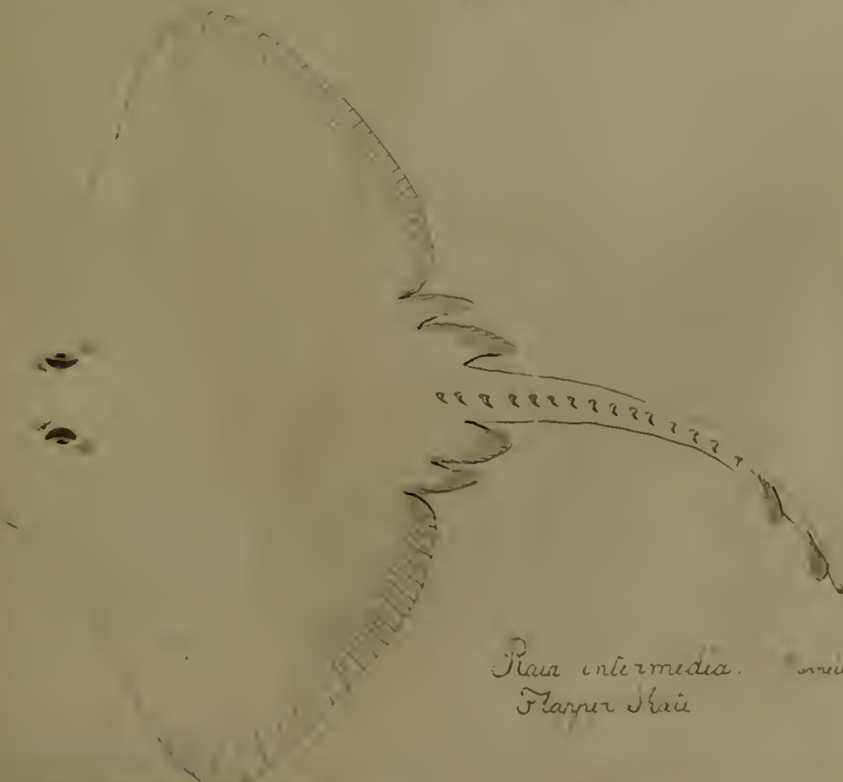
 Proceedings of the Royal Soc. Edin^r

Pagellus [illegible]. [illegible] 19
Axillary Bream.



Pagellus centrodontus. Yarrell v.i.p 107.
Sea Bream.

Pagellus erythrinus. Cuv. & Val. t vi. p 170.
Spanish Bream.



Raia intermedia. [illegible]
Flapper Skate

Monday, 6th March 1837.

Sir THOMAS M. BRISBANE, Bart., President, in the Chair.

The following Donations were presented :

The Journal of the Asiatic Society of Bengal for August 1836.—*By the Society.*

Transactions of the Zoological Society of London.—Vol. ii. Part 1. *By the Society.*

Statuti dell' Accademia di Palermo.—*By the Academy.*

De Redigendis ad unicam seriem comparabilem Meteorologicis ubique factis observationibus conventio proposita, et Tabulæ supputatæ, ab equite Nicolao Cacciatore, Regii Observatorii Panormitani Directore.

Considerations regarding the Edinburgh, Leith, and Newhaven Railway. By Patrick Neill, LL. D., F. R. S. E.—*By the Author.*

Specimen of a Treatise on the Differential Calculus or Fluxions; founded on an original principle derived from the Ancient Geometry. By the Rev. John Forbes, Minister of St Paul's, Glasgow.—*By the Author.*

The Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. No. 36, March 1837.—*By the Society.*

Transactions of the Society instituted at London for the Encouragement of Arts, Manufactures, and Commerce. Vol. li. Part 1. —*By the Society.*

Two Essays on the Geography of Ancient Asia; intended partly to illustrate the Campaigns of Alexander, and the Anabasis of Xenophon. By the Rev. John Williams, Vicar of Lampeter, and Rector of the Edinburgh Academy.—*By the Author.*

The following communications were read :—

1. On the power of the Periosteum to form new bone. By Professor Syme.

The object of the author in this paper is to state certain observations and experiments by which he considers it to be clearly established, that the periosteal membrane, covering the bones, has the power of secreting osseous substance and of forming new bony matter.

Duhamel, founding on a false analogy, which he supposed to exist between the periosteum and the bone on the one hand, and the bark and wood of trees on the other, was the first to lay down distinctly the theory that bony matter is formed by the investing membrane of the bones. The experiments and observations of *Haller* and others on the progress of ossification in young animals were believed, however, to militate against this idea, and tended rather to establish the doctrine, that new bony matter is formed by the pre-existing or old bone. Between these two theories, the opinions of physiologists and surgeons are still pretty equally divided.

The author was lately induced to suspect, from the circumstances of a case of necrosis, that the theory of Duhamel is the true one. In a case of inflammation of the tibia consequent on an injury and terminating in death, of nearly the whole of that bone, amputation became necessary at the close of five weeks after the accident. On examining the amputated limb, the periosteum of the tibia was found chequered with patches of osseous substance adhering to its inner surface, and covered with a delicate membrane. This observation led him to subject the question to the test of experiment, which he conceives he has accomplished in the following manner. An incision was made in the fore leg of a dog, and a portion of the radius, about two inches long, was removed along with its investing membrane. In the other fore leg the same operation was performed, with the exception that the periosteum was carefully dissected from the portion of bone which it was intended to remove, and two inches of bone were cut out, its membrane being thus left entire. In six weeks the animal was killed ; when it was found that a large vacuity was left in the radius, where the membrane was removed as well as the portion of bone ; while in the other, where the membrane had been left, the gap was entirely filled up by firm osseous texture, and at this part of the radius the bone was even thicker than elsewhere. The experiment was several times repeated with the same result. In another dog the periosteum of the radius was carefully dissected off as before, but without either disturbing the position of the membrane or removing the subjacent portion of bone ; and a thin metallic plate was passed around the bone between it and the detached periosteum. In six week the animal was killed and the limb examined. The inner surface of the membrane presented an extensive deposition of osseous matter between it and the metallic plate; while between the plate and the bone there was merely a membranous formation without any new bony substance whatever.

2. On one Troja. By the Venerable Archdeacon Williams.

The introduction only of this communication was read. The abstract will be given after the paper is concluded.

Monday, 20th March 1837.

Sir THOMAS M. BRISBANE, Bart., President, in the Chair.

The following Donations were presented:

Mémoire sur l'Instruction secondaire dans le Royaume de Prusse. Par M. V. Cousin, Directeur de l'Ecole Normale.—*By the Author.*

The Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 2 (November 1834).

Transactions of the Royal Asiatic Society of Great Britain and Ireland. Vol. ii. Part 1.—*By the Society.*

Transactions of the Horticultural Society of London (second series). Vol. i. and Vol. ii. Parts 1, 2.—*By the Society.*

Table des Positions Géographiques des Principaux Lieux du Globe. Par M. Daussy.

Sur l'Influence de la Pression Atmosphérique sur le Niveau moyen de la Mer. Par M. Daussy.—*By the Author.*

Novorum Actorum Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum Voluminis Septimi Decimi Supplementum. —*By the Academy.*

Transactions of the Institute of British Architects of London, Session 1835–36. Vol. i. Part 1.—*By the Institute.*

The Anatomy, Particular and Surgical, of the Human Body, illustrated by a series of Engravings. By A. Fyfe, F. R. C. S. E. Corrected and arranged, and with an Explanatory Letter-Press, by P. D. Handyside, M. D., &c. Part 1.—*By Dr Handyside.*

An Elementary Introduction to Mineralogy; comprising a Notice of the Characters and Elements of Minerals. By William

Phillips, F. L. S., M. G. S. L. and C. Considerably augmented by Robert Allan, F. R. S. E., M. G. S. L., &c.—*By Robert Allan, Esq.*

The following communication was read :

On the Action of Voltaic Electricity on Pyroxylic Spirit, and on Solutions in Water, Alcohol, and Ether. By Arthur Connell, Esq.

The author has found a perfect resemblance to exist between the appearances presented by pyroxylic spirit (Bihydrate of Methyline of Dumas and Peligot) under voltaic agency, and those which he had previously observed in regard to alcohol ; a coincidence which was to be expected, from the interesting analogy existing between these two liquids in other respects.

The pyroxylic spirit, after three distillations from quicklime, had a specific gravity of 801 at 62° F., and boiled in contact with mercury at 140° F., under a pressure of 29.5 inches. The leading facts observed were the following :—

Minute quantities of acid, alkaline, and saline bodies, when dissolved with rectified pyroxylic spirit, favoured the voltaic action, by increasing the conducting power of the liquid. When it held in solution $\frac{1}{350}$ of pure potash, and was submitted to the agency of thirty-six pairs of four-inch plates in a tube with parallel platinum foil poles, hydrogen was given off from the negative pole, while no gas proceeded from the positive pole. A ten thousandth part of potash had a marked effect in promoting this action.

When the pure spirit was submitted in a similar tube to the agency of seventy-two pairs of four-inch plates, hydrogen was in like manner evolved, although in smaller quantity.

When the same electric current was passed through the spirit and through water, each holding dissolved $\frac{1}{500}$ part of potash, the quantity of hydrogen evolved from both negative poles was the same.

Besides the evolution of elastic fluid, there were found in the liquid acted on small quantities of such substances as often result from the oxidation of analogous liquids, such as resinous matter ; and, where the quantity of dissolved potash was considerable, a speedy precipitation of carbonate of potash ensued, the liquid at the same time acquiring a red colour from the formation of resinous matter.

In the whole circumstances it was concluded, as had been done in regard to alcohol, that water, entering as such into the constitution of pyroxylic spirit, is resolved under voltaic agency into its elements, its hydrogen being evolved at the negative pole, and its oxygen employed in giving rise to the secondary effects of oxidation.

As pyroxylic ether (hydrate of methyline of D. and P.) bears the gaseous form, no galvanic experiments were attempted with it; but, as the author had formerly observed no evidence of the presence of water in sulphuric ether under electric agency, he is disposed to adopt the analogous view as in regard to alcohol, and to consider pyroxylic spirit as a hydrate of pyroxylic ether, which latter substance, like sulphuric ether, he regards not as an oxide, but simply as a ternary combination of its constituents.

The results formerly stated to the Society in proof of the secondary origin of chlorine or iodine, when aqueous solutions of the corresponding hydracids and haloid salts are submitted to voltaic agency, have been confirmed with stronger voltaic powers, the only difference being, that the chlorine or iodine, and also the corresponding hydracid, from the secondary decomposition of which, by nascent oxygen, the chlorine or iodine proceeds, are sooner carried over from the negatively electrified solution into the positively electrified water, than when smaller powers are employed. The decomposition of binoxide of iodine in an aqueous solution of starch, has also been ascertained, by analogous methods, to be a secondary action.

The appearances presented during the electric decomposition of alcoholic solutions of acids, alkalies, and salts, have been found to be very analogous to those observed in the corresponding aqueous solutions, the principal difference being, that the oxygen of the decomposed water of the alcohol rarely appears at the positive pole, for reasons formerly explained. An ordinary oxyacid salt dissolved in alcohol is slowly resolved, under voltaic action, into its constituent acid and base, with evolution of hydrogen at the negative pole; and, where the base is not of difficult reduction, a portion of it is reduced by the hydrogen. By experiments conducted on principles exactly analogous to those with aqueous solutions, it was found that the appearance of iodine at the positive pole, in an alcoholic solution of iodide of potassium, is a secondary effect due to nascent oxygen.

By instituting a comparison between the electric action on alcoholic and on aqueous solutions of chlorides and iodides, under circumstances in which no secondary actions could take place at the poles, the appearances led to the conclusion, that these salts are not dissolved as such in water, but as muriates and hydriodates. The solution was placed in a tube connected by means of asbestus with two other tubes containing distilled water, the positive pole being introduced into one of the tubes containing water, and the negative into the other. When an alcoholic solution of a chloride or iodide was in the outer tube, no acid was observed to be produced in the alcoholic solution, but only at the point of contact between the solution and the water. On the other hand, when an aqueous solution was employed, a plentiful production of the corresponding hydracid was observed in that solution on its positive side. These appearances are exactly those which ought to be observed, if we suppose chlorides and iodides to be dissolved as such in absolute alcohol, and as muriates and hydriodates in water. In none of these cases was chlorine or iodine produced, except at the positive pole in the positive water, by a secondary action on the corresponding hydracid.

When etherial solutions of various substances, such as potash, chromic acid, and metallic chlorides, are submitted to galvanic action, there is no symptom of decomposition either of the solvent or of the dissolved body. Thus no exception has yet been met with to the general conclusion, "That when solutions of binary combinations of elementary bodies in water, alcohol, or ether, are submitted to voltaic agency, the dissolved substance is not decomposed, but only the solvent, if itself an electrolyte." A few cases, however, comprehended within the law still remain to be experimentally investigated.

Sir Charles Bell gave a Verbal Notice regarding the importance of the Circulation in the Medulla Oblongata, and the office of the Vertebral Artery.

Monday, 3d April 1837.

The Right Honourable LORD GREENOCK, Vice-President in the Chair.

The following Donations were presented :

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences (1837, 1er Semestre), Nos. 7, 8, 9, 10, 11.—*By the Academy.*

Annalen der Physik und Chemie. Herausgegeben zu Berlin, von J. C. Poggendorff. 1836. Nos. 10, 11, 12.—*By the Editor.*

On the Arenarius of Archimedes. By S. P. Rigaud, M. A., Savilian Professor of Astronomy.—*By the Author.*

A Catalogue of the Collection of British Quadrupeds in the Museum of the Cambridge Philosophical Society.

Transactions of the Cambridge Philosophical Society. Vol. vi. Part 1.—*By the Society.*

Supplement to the Account of the Rev. John Flamsteed, the first Astronomer-Royal. By Francis Baily, Esq. F.R.S., &c.—*By the Author.*

On the Theory of the Moon, and on the Perturbations of the Planets. By J. W. Lubbock, Esq., F. R. R. A. and L. S. S.—*By the Author.*

Report of the Fifth Meeting of the British Association for the Advancement of Science, held at Dublin in 1835.—*By the British Association.*

Discussion of the Magnetical Observations made by Captain Back, R. N., during his late Arctic Expedition. By S. Hunter Christie, Esq., M. A., F. R. S., &c.—*By the Author.*

List of the Fellows of the Royal Society (1836).

Addresses delivered at the Anniversary Meetings of the Royal Society on Saturday, November 30. 1833, and on Wednesday, November 30. 1836, by His Royal Highness, the Duke of Sussex, K. G., &c. &c. &c., the President.

Proceedings of the Royal Society. Nos. 19 to 27.

Philosophical Transactions of the Royal Society of London for the year 1836. Part 2.—*By the Society.*

Astronomical Observations made at the Royal Observatory at Greenwich, 1834, Parts 4 and 5, and 1835, Parts 1, 2, 3, 4, 5, under the direction of John Pond, Esq., Astronomer-Royal.—*By the Royal Society.*

The following communications were read—

1. Geological Observations on Binny-Crag in West-Lothian, by Charles Maclaren, Esq.

Binny Crag in West Lothian is of compact greenstone, about half a mile in length, and from twenty to one hundred and forty feet in breadth. It extends south and north, and has a small ravine on its west side, above which the highest part of the crag rises about two hundred feet. Three phenomena connected with this crag are worthy of observation. 1. *It has the character of a trap vein which has ruptured the strata in a fluid state.* The dip of the sedimentary rocks on its west side is to west-south-west, on the east side to the east, and in both cases at a pretty high angle. We have here, therefore, evidence of the strata having been ruptured, and a fissure formed ; and we have the trap, the rupturing agent, placed on the fissure, and occupying the anticlinal line, or axis of the upheaving movement. According to the received hypothesis respecting the origin of trap, we might expect this appearance to be common, and yet it is rather rare. It forms the exception, while it ought apparently to be the rule. 2. *The trap has mingled with the shale, and affected its structure in a very remarkable manner.* It has enveloped portions of the shale within its mass, and penetrated laterally among the beds to the extent of one hundred feet or more on the east side. On the south flank of the highest part of the crag we have a section exhibiting the relations of the two rocks. The trap has the form of an arch, of perhaps twenty feet radius, with a long straight tabular mass about three feet farther to the east. A mass of shale lies under the arch exhibiting a laminar structure ; in the portions contiguous to the trap, its substance is hardened, and the planes of the laminæ, instead of being straight and parallel, are arranged concentrically with the curved surface of the trap which covers them. Portions of shale also lie under and above the thin tabular projecting mass of trap, and these likewise conform themselves to its surface. The inference is, that, independently of the original slaty form of the shale, a secondary laminar structure was induced upon it, by the heat of the fused trap being propagated through it progressively and unequally, each portion as it was dried and hardened, separating from that beyond it. 3. *The crag exhibits a striking example of the effects of denudation.* The north end of the ridge, which is low, and on a level with the surface of the land westward, has merely had its covering of shale stripped off, and exhibits a few trifling indentations ; but the south end, which rises in bold relief above the adjacent land, has been cut into seven distinct hillocks, separated by transverse ravines, which are steep in the sides, and from ten to sixty feet in depth. The appearance of these ravines shews, that they must have been cut by powerful currents flowing from the west.

2. Notice of Experimental Researches into the Laws of certain Hydrodynamical Phenomena that have not hitherto been reduced into Conformity with known Laws. By John Scott Russell, Esq. Lecturer on Natural Philosophy.

This Paper contained the results of researches in hydrodynamics extending over a period of two years, and which the author is continuing to prosecute under the auspices of the British Association in conjunction with Mr Robison, the Secretary of this Society. The present paper contained the development of two new laws in hydrodynamics, which appeared of sufficient importance to form a paper by themselves.

These two laws are,

1. The Law of Emergence—as an Element of Resistance.
2. The Law of the Wave—as an Element of Resistance.

The state of our knowledge in hydrodynamics is well known to be very imperfect in comparison with the other departments of Natural Philosophy. Mr Challis, in his Report to the British Association on the present state of hydrodynamics, remarks, that his review may serve to shew that this department of science is in an extremely imperfect state, and that possibly it may on that account be the more likely to receive improvement; and he adds, that a singular fact relating to the resistance of bodies, partly immersed in water, has been observed, viz. that a boat drawn on a canal with a velocity of more than four or five miles an hour rises perceptibly out of the water, making the resistance less than if no such effect took place; and he further observes, that though theory never predicted any thing of that kind, it may probably soon be able to account for it on known mechanical principles. Professor Whewell makes the same avowal, and the Institute of France have made it the subject of their prize for three years without having obtained a solution of the difficulties with which this part of Natural Philosophy is beset.

There is one law well established by the labours of Newton, Bernoulli, Euler, D'Alembert, and their followers, that the resistance of a fluid to a body moving in it is proportioned to the square of the velocity.

This law holds in a great variety of instances, for vessels or objects wholly immersed in the fluid.

The law of the square of the velocity does not hold except in a few instances, and in peculiar circumstances, as regards resistance of fluids to the motion of floating bodies. If the water be not very deep, and if the velocity be more than three or four miles an hour, the deviation will become exceedingly striking. The following are causes of the deviation :

I. An EMERGENCE of the floating body from the fluid takes place at all velocities. This emergence is produced by the velocity of the body. When at rest the body, in virtue of the force of gravitation, displaces a portion of fluid equal to its own weight; but if it be moved it will require to displace a greater and greater portion of fluid in a given time. Now the force of gravity acting downwards on the body is constant force, and the force with which the fluid must be displaced is an increasing one; by comparing these two quantities together the following result is obtained—

$$R = s\,v^2 \left\{1 - \frac{v}{2g}\right\}\frac{\varrho}{2\,g}$$

Where R is the resistance, s the transverse section of statical displacement, v the velocity of the body, g the measure of gravity, and ϱ the density of the fluid, and by differentiating we find R a maximum, when $r = \frac{4\,g}{3}$ and the immersion $= 0$ when $v = 2\,g$.

II. The WAVE of the fluid interferes with the resistance. Those portions of a fluid which are thrown aside by the prow of a vessel form Waves. These waves are propagated in the direction of the motion of the vessel.

The wave of a fluid moves with a velocity which is nearly uniform.

The velocity of the wave is dependent solely upon the depth of the fluid, reckoning from the summit of the wave. It is quite independent of the width of the channel. It is quite independent of the velocity of the vessel which creates the waves. The velocity of the wave is equal to that which would be acquired by a body falling freely by gravity through a space equal to half the depth of the fluid.

The resistance of a fluid at a given velocity is intimately connected with the velocity of the wave in the fluid.

When the velocity of the floating body is less than that of the wave, the effect of the wave is to increase the resistance of the fluid.

When the velocity of the floating body is greater than that of the wave, the effect of the wave is to diminish the resistance of the fluid.

The manner in which the wave increases the resistance opposed to a fluid, is by increasing the immersion of the anterior part of the solid, by raising the front and leaving the stern depressed in the hollow behind the wave, so that the transverse section of resistance has an increment of area in the ratio of the rise of the elevation.

The manner in which the wave diminishes the resistance at velocities not less than that of the wave, is by falling behind the stern, so as to raise a portion of the vessel equal to itself above the mean level of the fluid, thus diminishing the anterior section presented to the vessel.

At all velocities greater than that of the wave, the displaced fluid falls behind the prow, and forms a compound wave, on the ridge of which the vessel is carried along with diminished anterior immersion.

These doctrines receive illustration from the navigation of shallow rivers and canals, and are applicable to the improvement of inland transport by water.

Monday, 17*th April* 1837.

Sir HENRY JARDINE in the Chair.

The following Donations were presented :

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences (1837, 1er Semestre), Nos. 12 and 13.—*By the Academy.*

Bulletin de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Années 1832, 1834, 1835, Nos. 4, 5, 6, 7 ; and 1836, Nos. 8 and 12.

Essai Historique sur la Vie et la Doctrine d'Ammonius-Saccas, chef d'une des plus célèbres Ecoles Philosophiques de l'Alexandrie Par L. J. Dehaut.

Mémoire sur les Propriétés et l'Analyse de la Phloridzine. Par. L. de Koninck.

Annuaire de l'Observatoire de Bruxelles pour l'an 1837, par le Directeur A. Quetelet.

Annuaire de l'Académie Royale des Sciences et Belles Lettres de Bruxelles.—*By the Royal Academy.*

Sur la Latitude de l'Observatoire de Bruxelles. Par A. Quetelet, Directeur de cet Etablissement, &c.—*By the Author.*

Bulletin de la Société de Géographique (Deuxieme Serie), Tome vi. *By the Society.*

Astronomische Nachrichten. Nos. 312–322.—*By Professor Schumacher.*

Ueber die Kessels'schen Chronometer von Hansen.—*By the Author.*

Astronomische Beobachtungen auf der Königlichen Universitäts Sternwarte in Konigsberg. Von F. W. Bessel.—*By the Author.*

Arsberättelser om Vetenskapernas Framsteg, af gifne af Kongl. Vetenskaps-Academiens Embetsmän, d' 31 Mars 1835.

Kongl. Vetenskaps-Academiens Handlingar, för är 1835.—*By the Academy.*

Account of some Experiments made in different parts of Europe on Terrestrial Magnetic Intensity. By James D. Forbes, Esq., F. R. SS. L. and E., &c.—*By the Author.*

A large collection of Preserved Fishes was also presented by Dr Parnell. The following is a list of what have been presented by the same gentleman on this and on some prior occasions :

Perca fluviatilis, *Yarrel.*
Labrax lupus, *Yarr.*
Trachinus draco, *Yarr.*
Trachinus vipera, *Yarr.*
5 Trigla cuculus, *Yarr.*
Trigla lucerna, *Cuvier.*
Trigla gurnardus, *Yarr.*
Cottus scorpius, *Yarr.*
Cottus bubalis, *Yarr.*
10 Gasterosteus leiurus, *Yarr.*
Gasterosteus spinachia, *Yarr.*
Pagellus acarne, *Cuvier.*
Pagellus centrodontus, *Yarr.*
Scomber scomber, *Yarr.*
15 Caranx trachurus, *Yarr.*
Cantharus griseus, *Yarr.*
Zeus faber, *Yarr.*
Mugil chelo, *Yarr.*
Atherina presbyter, *Yarr.*
20 Blennius gattorugine, *Yarr.*
Muranoides guttata, *Yarr.*
Anarrhichas lupus, *Yarr.*
Gobius niger, (in spt.) *Yarr.*
Gobius minutus, (in spt.) *Yarr.*
25 Gobius unipunctatus, (in spt.) *Parnell.*
Gobius bipunctatus, in spt.) *Yarr.*
Gobius gracilis, (in spt.) *Yarr.*
Gobius albus, (in spt.) *Parnell.*
Callionymus lyra, *Yarr.*
30 Callionymus dracunculus, *Yarr.*
Lophius piscatorius, *Yarr.*
Labrus maculatus, *Yarr.*
Crenilabrus tinca, *Yarr.*

Crenilabrus cornubicus, *Yarr.*
35 Leuciscus rutilus, *Yarr.*
Leuciscus dobula, *Yarr.*
Leuciscus phoxinus, *Yarr.*
Cobitis barbatula, *Yarr.*
Salmo salar, *Yarr.*
40 Salmo cæcifer, *Parnell.*
Osmerus eperlanus, *Yarr.*
Coregonus marænula, *Yarr.*
Alosa finta, *Yarr.*
Gadus morrhua, *Yarr.*
45 Gadus æglefinus, *Yarr.*
Merlangus vulgaris, *Yarr.*
Merlangus pollachius, *Yarr.*
Merlangus carbonarius, *Yarr.*
Merlucius vulgaris, *Yarr.*
50 Lota molva, *Yarr.*
Motella quinquecirrata, *Yarr.*
Motella glauca, (in spt.) *Yarr.*
Raniceps trifurcatus, *Parnell, Zool. Bot. Mag. Vol. I.*
Platessa limanda, *Yarr.*
55 Hippoglossus vulgaris, *Yarr.*
Rhombus maximus, *Yarr.*
Rhombus vulgaris, *Yarr.*
Rhombus hirtus, *Yarr.*
Rhombus megastoma, *Yarr.*
60 Rhombus arnoglossus, *Yarr.*
Solea pegusa, *Yarr.*
Monochirus lingula, *Yarr.*
Monochirus minutus, *Parnell.*
Cyclopterus lumpus, *Yarr.*
65 Echeneis ramosa, *Yarr.*
Anguilla acutirostris, *Yarr.*
Ammodytes tobianus, *Yarr.*
Ammodytes lancea, *Yarr.*
Syngnathus typhle, *Yarr.*
70 Scyllius canicula, *Yarr.*
Scyllium catulus, *Yarr.*
Mustelus lævis, *Yarr.*
Spinax acanthus, *Yarr.*
Squatina angelus, *Yarr.*
75 Raia batis, *Yarr.*
Raia intermedia, *Parnell.*
Raia clavata, *Yarr.*
Petromyzon marinus, *Yarr.*

The following communications were read :

1. On the Constitution of the Earth's Atmosphere in Remote Geological Epochs. By Professor Johnston, Durham.

This is the first paper of a promised series on the subject here announced. In the present paper the author endeavours to shew, that in remote epochs the atmosphere was more extensive and heavier than it is now, that it contained a greater absolute quantity of oxygen, and that this quantity has gradually diminished up to our own era, and is probably still undergoing a sensible diminution. His views are founded partly on speculative considerations, of which it is not possible to give a sufficiently circumstantial abridgment, and partly on the evidence of various operations going on at or near the surface of the earth, the tendency of which must, on the whole, apparently be to diminish the quantity and proportion of the oxygen in the atmosphere. In addition to the ordinary and well known causes of deterioration, the author points out a new source of diminution to which his attention has been lately drawn. From experiments made upon the aëriform fluid discharged from the earth during an inundation, and obviously expelled by the water penetrating to a considerable depth, and displacing the gases contained in the soil, he found that this gaseous matter consists of 2.5 per cent. carbonic acid, 12.764 oxygen, and 84.736 nitrogen. Taking this observation in conjunction with many others previously made on the composition of the gaseous discharges in volcanic districts, and the gaseous contents of mineral waters, he infers that a process of oxidation is constantly going on at various depths below the earth's surface, the oxygen for which is in all probability derived by absorption of the atmospheric gases at the surface.

2. An Account of a New Species of British Bream, and a Species of Skate new to Science; with a List of, and Observations on, the Fishes of the Frith of Forth and Neighbourhood. By Richard Parnell, M.D., F.R.S.E.

The author stated that, in July last, he obtained from the Frith of Forth a species of Bream, which he believes to be the *Pagellus acarne* of Cuvier. Length 13 inches; depth 4 inches; head one-third the length of the body not including the tail-fin. General form resembling that of the Sea Bream, but not so deep in proportion to its length. Scales large; 70 forming the lateral line, 6½ in an oblique row between it and the first ray of the dorsal-fin. Anterior-teeth small and numerous, disposed in many rows; outer row composed of 30 teeth, longer and more bent than those within; molars large, disposed in three rows in each jaw.

D 12–12, P 16, V 8, A 3–11, C. 20. Body pale silvery red. Dorsal and caudal fins rose-red; ventral and anal fins paler. Between the eyes reddish-brown; in front of the eyes and on the lower half of the preoperculum, metallic grey; on the upper part of the base of each pectoral fin, a deep violet-coloured spot, very conspicuous even in the dried state. (See Plate II.)

It differs from the *Sea Bream* in the eye being smaller, the molars much larger, and in having a dark spot at the base of the pectorals, which the *Sea Bream* never possesses.

It differs from the *Spanish Bream* in having the origin of the lateral straight, whereas in the *Spanish Bream* it is suddenly bent; in the eyes being larger; and in presenting the pectoral spot, which is never found in the other Bream.

The species of Skate, to which Dr Parnell has proposed the specific name of *intermedia*, is stated by him to be not uncommon in the Frith of Forth. Length 2 feet; body thin; snout sharp and prominent; tail rather short, with a row of spines placed on the mesial line only, not extending further up than to the base of the anal fins. Body perfectly smooth on both sides; eyes rather small, with a spine placed in front of each; teeth small, not so sharp as in the grey skate. Body above, dark olive-green; on the under-surface dark grey, with minute specks of a deeper colour. (See Plate II.)

It is distinguished from *R. batis* by the nose being longer; the first dorsal fin being more remote from the second, and the skin on the back being perfectly smooth, which in the *R. batis* is covered with small spicula and rough to the touch.

It is at once removed from the *R. Oxyrhynchus* of Montagu, by the under-surface of the body being of a dark grey-colour; which part in the *R. Oxyrhynchus* is perfectly white.

Dr Parnell mentioned the names of 123 species of fishes found in the Frith of Forth and neighbourhood, about 40 of which have been added by himself from personal observation. Three of these are new to Science and two new to Britain.

3. Notice on the Composition of the Right Prismatic Baryto Calcite, the Bicalcareo-carbonate of Baryta of Dr Thomson. By Professor Johnston, Durham.

This mineral, as described by the author about two years ago in the London and Edinburgh Philosophical Journal, presents a new and very interesting example of the principle known to crystallographers by the name of *dimorphism;* having the same chemical constitution as the well known Baryto Calcite of Brooke, but having a form belonging to an entirely different system of crystallization. In Dr Thomson's System of Mineralogy lately published, however, it is described as a mineral species before unknown, having a composition different from that of every known mineral, and is therefore distinguished by the name of the *Bicalcareo carbonate of Baryta.*

To test his former analysis, the author re-examined the mineral from the only two known localities: he analyzed also the Baryto Calcite of Brooke, and the results are embodied in the following Table:—

	Theory.	Fallafield near Hexham.	Bromley Hill, Alston.		Baryto-Calcite of Brooke.
			Johnston.	Thomson.	
Carbonic Acid..........	29.625	29.613	29.710		30.05
Carbonate of Baryta...	66.102	65.248+	62.156+		65.97
Carbonate of Lime....	33.898		30.29+		-
Carbonate of Strontia.		2.87—	6.641—		2.317
	100		98.997		

From these results the author concludes, that in describing the mineral, Dr Thomson must have been under some misapprehension in regard to its true composition, and consequently that the name he has imposed upon it must be laid aside.

4. An Explanation of the Aristotelian Expression Μετα τα Φυσικα, with some inferences from the Explanation. By the Venerable Archdeacon Williams.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1837–38. No. 12.

55th Session. First Ordinary Meeting.

Monday, 4th December 1837.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following Communications were read :—

1. On the Food of the Herring and Salmon. By John Stark, Esq.

The author of this paper, after some preliminary observations, arranged his remarks under the following heads :—1. On the food and sex of the Vendace of Lochmaben. 2. On the food of the Herring (*Clupea Harengus*, Lin.) And, 3, On the food of the Salmon (*Salmo salar*, Lin.)

1. As to the food of the Vendace (*Coregonus Lavaretus,* Fleming), he observed, that fishes in lakes, and feeding on animal food, must necessarily subsist on the small aquatic animals found in these lakes: That there is no reasonable analogy between the vendace and the herring, because they live in different mediums, the one in salt, the other in fresh water; and that their food cannot, therefore, be the same, none of the animals upon which fishes feed being common to both: That, besides, they are of different natural families: That writers on natural history state the animalcules which are found in the stomach of the vendace, and the other minute animals found

in lakes, to form the food of fresh-water fishes generally; and that Leeuwenhoeck had even figured the identical animal found in the stomach of the vendace in 1833 more than 130 years before, stating that it and the other minute animals in similar localities, formed the food of the larger fishes.

Regarding the sexes of the vendace, the author did not consider the necessity of a male parent required to be proved.

2. *Food of the Herring.*—The author stated, that the food of the herring was known and described from personal examination by Neucrantz, previous to the year 1654; by Leeuwenhoeck in 1696; by Fabricius in 1781; by Müller in 1785; by Bloch about the same period; by Lacepede and Latreille in 1798; by the Rev. Dr Scoresby in 1820; by Pennant and others; and, in fact, is mentioned by every writer who treats of the natural history of fishes: And that what has been stated by all authors on the subject of the herring's food, is corroborated by the examination of the stomach and intestinal canal of that fish, and by the specimens on the table of the Society.

3. *Food and Reproduction of the Salmon.*—The author stated on this head, what had been remarked by the most esteemed authors on natural history to form the food of the salmon; and exhibited preparations by Dr Parnell, confirming the statements of these writers. He next noticed the valuable evidence taken before a Committee of Parliament in 1824 and 1825, regarding the food and natural history of the salmon, which also corroborated the statements of systematic writers; and remarked, that when these fishes prey upon animals in roe, the ova often remain in the stomach and intestinal canal, when the other portions of the food are wholly digested. He next gave an abstract of the evidence before the Parliamentary Committee, as to the periods of the ascent of the salmon in the different rivers for the purpose of spawning, and the descent of the fry to the sea; and pointed out the experiments made on the development of the ova by Mr John Hogarth junior, as detailed in the appendix to the Report of the Committee,—and those made by Mr Schonberg, and recorded in Sir David Brewster's Journal of Science.

2. Dr Barry made some verbal remarks on the Physiology of the *Proteus Anguinus*.

The following Gentlemen were elected Fellows of the Society:

1. J. Stuart Menteath, Esq.
2. John Clark, M.D., K.H.

The following Donations were presented:

Bulletin de la Société Géologique de France. Tome vii. Feuilles 20–23; and Tome viii. Feuilles 1–20.—*Par la Société.*

Memoires de la Société Geologique de France. Tome ii. Parts 1, 2. —*Par la Société.*

Flora Batava, Nos. 80, 95, 96, 97, 98, 99, 109, and 111.—*By the King of Holland.*

On the Results of Experiments made on the Weight, Height, and Strength, of above 800 Individuals. By Professor Forbes.

On the Muscular Effort required to ascend Planes of different Inclinations. By Professor Forbes.

Note relative to the supposed Origin of the deficient Rays in the Solar Spectrum; being an account of an Experiment made at Edinburgh during the Annular Eclipse of 15th May 1836. By Professor Forbes.

On the Temperatures and Geological Relations of certain Hot Springs, particularly those of the Pyrenees; and on the Verification of Thermometers. By Professor Forbes.

By the Author.

Biographical Sketch of the late Edward Turner, M.D., Professor of Chemistry in University College, London. By Robert Christison, M.D., Professor of Materia Medica in the University of Edinburgh, &c.—*By the Author.*

The American Journal of Science and Arts. Conducted by Benjamin Silliman, M.D., LL.D. For October 1833, January 1835, and January and July 1837.—*By the Editor.*

The Journal of the Asiatic Society of Bengal for November and December 1836, January, February, April and May 1837.

First Part of the Nineteenth Volume of Asiatic Researches, or Transactions of the Society instituted in Bengal for inquiring into the History, the Antiquities, the Arts and Sciences, and Literature of Asia. *By the Society.*

The Anatomy, Particular and Surgical, of the Human Body, illustrated by a series of Engravings; by A. Fyfe, F.R.C.S.E. Corrected and arranged, and with explanatory letter-press, by P. D. Handyside, M.D., F.R.S.E. Part 2.—*By Dr Handyside.*

The Quarterly Journal of Agriculture; and the Prize-Essays and Transactions of the Highland and Agricultural Society of Scotland. Nos. xxxvii, xxxviii, and xxxix.—*By the Highland and Agricultural Society.*

Investigation of the Equation to Fresnel's Wave Surface. By Archibald Smith, Esq., Trinity College, Cambridge.—*By the Author.*

Account of the Andersonian Museum, Glasgow.—*By James Smith, Esq. of Jordanhill.*

Memoirs, chiefly Anatomical and Physiological. By Robert Knox, M.D., F.R.S.E.—*By the Author.*

Astronomische Nachrichten, Nos. 323 to 336.—*By Professor Schumacher.*

The Fourth Annual Report of the Royal Cornwall Polytechnic Society, 1836.—*By the Society.*

Nieuwe Verhandelingen der Eerste Klasse van het Koninklijk-Nederlandsche Instituut van Wetenschappen, Letterkunde en Schoone Kunsten, te Amsterdam. Tomes 1, 2, 3, 4, 5.—*By the Institute.*

Naturkuundige Verhandelingen van de Hollandsche Maatschappij der Wetenschappen te Haarlem. Deels 13 to 23.—*By the Dutch Society of Sciences at Haarlem.*

Histoire des Maladies observées à la Grande Armée Francaise, pendant les Campagnes de Russie en 1812, et d'Allemagne en 1813. Par le Chevalier J. R. L. De Kerckhove dit De Kirckhoff.—*By the Author.*

Transactions of the Philosophical and Literary Society of Leeds. Vol. i. Part 1.—*By the Society.*

Annalen der Physik und Chemie. Herausgegeben zu Berlin, von J. C. Poggendorff. 1836, Nos. 2, 7, 8, 9. 1837, Nos. 1, 2, 3, 4, 5.—*By the Editor.*

Natuur-en Scheikundig Archief, uitgegeven door G. J. Mulder en W. Wenckebach. 1836. Stuk 4.—*By the Editors.*

Tijdschrift voor Natuurlijke Gescheidenis en Physiologie. Uitgegeven door J. Van Der Hoeven, M.D., en W. H. De Vriese, M.D. Vol. iii. Part 3.—*By the Editors.*

Transactions of the American Philosophical Society held at Philadelphia for promoting Useful Knowledge. Vol. v., and vol. vi.

Part 1; and of the New Series, Vol. i. and Vol. iii. Parts 1 and 3.—*By the Society.*

Recueil de Voyages et de Memoires, publié par la Société de Geographie. Tome v.—*By the Society.*

Neue Wirbelthiere zu der Fauna von Abyssinien gehorig, entdeckt und beschrieben von Dr Eduard Rüppell. Lieferungs 7, 8, 9. —*By the Author.*

The Ancient Kalendars and Inventories of the Treasury of his Majesty's Exchequer, together with other documents illustrating the History of that Repository. Collected and edited by Sir Francis Palgrave, K.H. 3 vols.

Proceedings and Ordinances of the Privy Council of England. Edited by Sir Harris Nicolas. Vols. vi. and vii.

Excerpta è Rotulis Finium in Turri Londinensi asservatis, Henrico Tertio Rege. A. D. 1246-1272, curâ Caroli Robert. Vol. ii.

By the Commissioners on the Public Records.

Nova Acta Physico-Medica Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum. Vol. xvi., and vol. xvii. part 2.— *By the Academy.*

Uebersicht der Säugthiere, Vogel, Amphibien und Fische Schlesiens von Dr C. L. Gloger.

Das Abandern der Vogel durch Einfluss des Klima's von Dr C. L. Gloger. *By the Author.*

Disquisitionum de Avibus ab Aristotele commemoratis Specimen I. Scripsit C. L. Gloger.—*By the Author.*

Bulletin de la Société Imperiale des Naturalistes de Moscow. 1837. Nos. 1, 2, 3, 4.—*By the Society.*

Library Catalogue and Regulations of the Telford Premiums of the Institution of Civil Engineers.—*By the Institution.*

Charter and Bye-Laws of the Institute of British Architects of London.—*By the Institute.*

Transactions of the Statistical Society of London. Vol. i. part 1. —*By the Society.*

Notice of two Roman Inscriptions relative to the Conquest of Britain by the Emperor Claudius Cæsar. By John Hogg, Esq. A. M., Fellow of St Peter's College, Cambridge.—*By the Author.*

Etudes des Gites Houillers et Metallifères du Bocage Vendéen faite en 1834 et 1835. Par Henri Fournel, Ingenieur des Mines.

Atlas au Meme. *Par M. le Duc de Cazes.*

Memorias da Academia R. das Sciencias de Lisboa. Tomo xii. parta 1.—*By the Society.*

Elements of Chemistry, by the late Edward Turner, M. D. Sixth edition. Enlarged and revised by Professor Liebig and Wilton G. Turner. Part 1.—*By the Editors.*

The Madras Journal of Literature and Science for October 1836 and January 1837.—*By the Madras Literary Society.*

Observations upon a "Report by the Select Committee on Salmon Fisheries, Scotland: together with the Minutes of Evidence, Appendix and Index." 30th June 1836. By Robert Knox, F.R.S.E.—*By the Author.*

Proceedings of the Geological Society of London. Nos. 48, 49, 50, 51.—*By the Society.*

Stellarum Duplicium et Multiplicium Mensuræ Micrometricæ per magnum Fraunhoferi Tubum annis a 1824 ad 1837 in Specula Dorpatensi institutæ, adjecta est Synopsis observationum de Stellis compositis Dorpati annis 1814 ad 1824 per minora instrumenta perfectarum, Auctore F. G. W. Struve.—*By the Author.*

Mesures Micrometriques obtenues à l'Observatoire de Dorpat avec la Grande Lunette de Fraunhofer de 1824 à 1837. Par F. G. G. Struve.—*By the Author.*

Memoires de l'Academie Imperiale des Sciences de Saint Petersbourg. (Sciences Mathematiques, &c.) Tome i. livr. 4.

Do. do. (Sciences Naturelles.) Tome ii. livr. 3.

Do. do. (Sciences Politiques, &c.) Tome iii. livr. 6, and tome iv. livr. 2.

Recueil des Actes de la Seance publique de l'Académie Imperiale des Sciences de Saint Petersbourg, tenue le 30 Decembre 1836. *Par l'Academie Imperiale.*

Systematic Treatise on Zoology. By Professor Jarotski of Warsaw. 5 vols.—*By Prof. Johnston of Durham.*

Observations on the Influence of Climate on Health and Mortality. By Arthur Saunder Thomson, M. D.—*By the Author.*

Principal Documents relating to the Survey of the Coast of the United States; and the construction of uniform Standards of Weights and Measures for the Custom-Houses and States. By F. R. Hassler. 3 Parts.—*By the Author.*

Commentatio de Definienda Quantitate Vaporis Aquei in Atmosphæra vel Aëre quocunque. Auctore A. C. G. Suerman.

Dissertatio Physica Inauguralis de Calore Fluidorum Elasticorum specifico. Auctore A. C. G. Suerman.

Specimen Inaugurale de Fractionibus Continuis. Auctore P. O. C. Vorsselman De Heer.—*By Professor Moll.*

Memoirs on the Nervous System. By Marshall Hall, M. D., F. R. S. L. & E.—*By the Author.*

Recherches Experimentales sur les Propriétés et les Fonctions du Systeme Nerveux dans les Animaux Vertébrés. Par P. Flourens.

Experiences sur le Systeme Nerveux. Par P. Flourens.

Nouvelles Experiences sur le Systeme Nerveux. Par P. Flourens.

Eloge Historique de G. Cuvier. Par M. Flourens.

Eloge Historique de Jean Antoine Chaptal. Par M. Flourens.

Eloges Historiques de R. Louiche Desfontaines et de J. Jul. De Labillardiere. Par M. Flourens. *By the Author.*

Report of the Sixth Meeting of the British Association for the Advancement of Science, held at Bristol in August 1836.—*By the British Association.*

The American Almanac and Repository of Useful Knowledge for the Year 1838.—*By the American Phil. Society.*

Report by a Committee of the Society of Arts in Scotland, on the best Alphabet and Method of Printing for the use of the Blind, 1837.—*By the Society of Arts for Scotland.*

On the Elements of the Orbit of Halley's Comet at its appearance in the years 1835 and 1836. By Lieut. W. S. Stratford, R. N.—*By the Author.*

Taylor's Calendar of the Meetings of the Scientific Bodies of London for 1837–8.—*By Lieut. W. S. Stratford, R. N.*

Bulletin de la Societé d'Encouragement pour l'Industrie Nationale. Pour Oct., Nov., Dec. 1835, et Jan. au Decembre 1836.—*Par la Societé.*

A Dissertation on the Causes and Effects of Disease considered in reference to the Moral Constitution of Man. By Henry Clark Barlow, M. D.—*By the Author.*

Constitution and Regulations of the Glasgow and Clydesdale Statistical Society, instituted April 1836.—*By the Society.*

Maps of the Ordnance Survey of Great Britain, No. lix.—*By the Board of Ordnance.*

Monday, 18*th December*.

Dr HOPE, V. P. in the Chair.

The following Communications were read :

1. Remarks on the Ossiferous Caves of Cefn, in Denbighshire. By Professor Traill.

These caves, which were first described by the present Bishop of Norwich in 1832, and have since been more fully explored by Dr Cumming of Denbigh, were visited by the author in the autumn of 1837. The principal cave is a fissure in a grand mural escarpment of the mountain limestone of Wales, about two miles and a-half south-west of St Asaph, and occurs half-way down the precipice, which seems to be about 250 feet in height. It forms at that point the southern boundary of the limestone, which constitutes the basis of the Vale of Clwyd ; and is divided from the extensive greywacke slate formation of that county by the narrow picturesque Vale of Cyffredin, through which the river Elwy flows.

The hill of Cefn consists of parallel beds of limestone, which the extensive quarries on its southern flank shew to have a regular dip of about 8°. This cave was discovered in 1830 to contain earthy deposits exceedingly rich in bones of mammifera ; and, since that period, they have been much employed as a manure by Mr Lloyd, the proprietor. During the excavations for this purpose, many teeth and fragments of larger bones, so entire as to be readily recognised, have been obtained. An interesting collection of them is preserved at Cefn House, and some are in the hands of the author. Among the former, he noticed part of the humerus and a molar tooth of a rhinoceros, several teeth and bones of the hyæna, and beautiful teeth, and a considerable portion of the lower jaw, of a bear. Dr Traill has in his possession two phalanges and two teeth of a bear ; a phalanx of a large Felis, resembling the tiger ; parts of the tibia, and of the astragalus, and a phalanx of a large Bos ; portions of the metacarpus of an immense ruminant, apparently a deer ; besides a variety of fragments, not so easily ascertained on account of their mutilated state.

The materials, which filled up the fissure or principal cave almost to its roof, are regularly stratified. They formed together a mass of earthy matter twelve feet in thickness. The first or upper bed consists of layers of clay and very fine sand, two feet thick. The second bed is of plastic clay-marl, containing many small water-worn pebbles, chiefly of clay-slate, two feet thick. The third is a stratum so filled with broken and comminuted bones, as apparently to consist entirely of that material, two feet thick. It is in this bed that all the bones mentioned, except those of the bears, are found. Immediately below is the fourth bed, consisting of plastic marl-clay, with many water-worn pebbles of slate and compact felspar, with angular pieces of limestone; this is also two feet thick. The fifth bed consists of fine sand, which seldom contains any pebbles. It rests on the floor of the cavern, and has usually a depth of four feet. In one part of the cave, however, Dr Cumming detected below this bed a floor of hard stalagmite, about sixteen feet square; and on breaking it up, bones of bears were found mingled with sand and large water-worn pebbles of the rocks already mentioned.

One of the most interesting observations which occurred to the author during his investigation was, that the stratified earthy materials filling the cave were *not deposited horizontally, but had an evident dip*, which he remarked was in the same direction and apparent inclination as that of the limestone rock itself. The important inference he drew from this is, that the stratified materials were deposited in the cave before the limestone received its present position; and he conjectured, that the animals whose remains are here preserved may have existed even before the last great disturbances of our carboniferous system of rocks. Should similar phenomena be observed in other caves, it would perhaps carry back the existence of mammiferous animals to geological epochs more ancient than generally supposed; and account for the occurrence of diluvial materials in similar situations, without the startling supposition of extensive degradations of solid rocks, by causes apparently inadequate to produce them.

Another cave exists in the same neighbourhood, in which bones have also been found. It is near the village of Pont Newydd. In its bottom was found a collection of hyæna bones, in a mass of calc-sinter and gravel, four feet in thickness.

The author illustrated his paper by a view of the Cliffs of Cefn, and by a plan and sections of the principal cave.

2. Experiments on the Growth of the Fry of the Salmon, from the exclusion of the Ova to the age of seven months. By Mr John Shaw.

The author of this paper had formerly made experiments on the growth of the salmon fry, by procuring spawn from the river bed where it had been deposited by the salmon. Not considering the experiments, however, as entirely unobjectionable, he procured t fishes from the river Nith in the act of spawning; and having expressed the ova of the female in a convenient place, the milt of the male fish was made to impregnate them as nearly as possible in imitation of the natural process. The ova were then placed in ponds prepared for the purpose, and so arranged as to exclude all chances of error as to the species, or the nature of the progeny. The ponds were two in number;—one twenty-five by eighteen feet, —the other fifty by thirty feet, and two feet deep. The bottom was thickly imbedded with gravel, and a small stream of spring-water entered the ponds at the upper corner, and escaped by openings at the other end. Both apertures were covered with a wire grating. The ova in one experiment were deposited on the 20th of January 1837. On the 10th of March (fifty days after deposition), the embryo fish were visible. On the 27th of April (ninety-eight days after deposition), they were excluded from the egg. Specimens were exhibited at thirty days old, taken on 26th May, measuring nearly an inch in length, and the ovum still adherent. On the 27th June, at two months old, the fry measured an inch and a half in length; and on the 27th of October, at six months old, a specimen exhibited measured about four inches in length. The temperature of the pond and the air was noted at the periods of examination. Another experiment in a different pond afforded analogous results. Mr Shaw is of opinion, from what he has observed in these and former experiments, that the young salmon remains in its native stream for two years after being hatched; and that the parr, or what is termed the parr in his neighbourhood, is the young of the salmon.

The following Donations were presented:

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, (1837 2me Semestre), Nos. 20, 21, 22.—*By the Academy.*

Journal of the Asiatic Society of Bengal for March 1837.—*By the Society.*

Scientific Memoirs, selected from the Transactions of Foreign Academies of Science and Learned Societies, and from Foreign Journals. Edited by Richard Taylor, F. S. A. &c. vol. i. —*By the Editor.*

A Synopsis of Chronology from the era of Creation, according to the Septuagint, to the year 1837. By William Cuninghame, Esq.—*By the Author.*

Monday, 1st January 1838.

Dr ABERCROMBIE, V. P. in the Chair.

The following Communication was read:

On the Terrestrial Mechanism of the Tides. By John Scott Russell, Esq.

Under the title Terrestrial Mechanism of the Tides, the author of this paper means to include the consideration of those causes which regulate the propagation of the tides, so as to exclude entirely the examination of the mechanism by which they are primarily produced. The generation of the tidal elevation in the Pacific or Atlantic Ocean is a question entirely of celestial mechanics. But the tides, after having been generated by solar and lunar attraction in a manner that is found to be perfectly in accordance with the varying intensities of these forces, do not subside at the instant when these forces cease to act, but continue to exist during a long period of time, reaching our shores three days after their birth; and have obeyed, during this long interval, laws perfectly independent of the original influence by which they were produced, and presented phenomena in direct opposition to it. They have obeyed the laws of terrestrial hydrodynamics. The law of the propagation of the tidal wave through the ocean and around our shores, belongs therefore to terrestrial, not to celestial mechanics.

Although our knowledge of the celestial mechanism of the tides has recently attained a high degree of accuracy, our knowledge of the terrestrial mechanism has been hitherto almost entirely conjectural. In the former department, the system of Bernouilli, based on the discoveries of Sir Isaac Newton, presents us with a theory of the tides in close accordance with the phenomena. Laplace, in his elaborate discussion of the tides of Brest, executed by M. Bonnard, has verified this accordance to a high degree of precision ; and the recent researches on the tides, by Mr Lubbock and Mr Whewell, may be considered as having rendered the celestial mechanics of the tide as perfect as any other department of Astronomy, the errors of prediction being now reduced within the limits of the errors of observation ; so that Mr Lubbock has stated that he does not look forward to any material improvement in this department of our knowledge.

But our acquaintance with the terrestrial mechanism of the tides is in a very different condition. In reference to the phenomena of this department, Laplace has said, in the third chapter of the fourth book of the Mecanique Celeste, and he repeats the opinion in the first chapter of the thirteenth book, at a much later date, where he says : " Que les circonstances accessoires produisent des variétés considerables dans les hauteurs et dans les heures des marées des ports même très rapprochés ;" and then he adds, " Il est impossible de soumettre au calcul ces variétés, parceque les circonstances dont elles dependent, ne sont connues." Mr Lubbock, in like manner, speaking of the fluctuation of the establishment, says, " This perplexing fluctuation presents an insuperable obstacle to extreme accuracy in tide predictions, until it can be explained ; at present we are only left to conjecture respecting the cause." And Mr Whewell says, in 1837, " I cannot conclude this paper without again pointing out that a great number of curious facts in fluid motion are established in these Tide Researches, of which it may be hoped the theory of hydrodynamics will one day be able to render a reason."

In 1834, the author of this paper had determined the law of the interference of a certain species of wave in the resistance of fluids, and this species of wave appeared to present very striking analogies to the tide-wave. In 1835, Mr Whewell expressed his decided conviction of their similarity, and Mr Robison and Mr Russell were, in 1836, appointed a Committee of the British Association to investigate the subject. The Report of these observations was given to the British Association in 1837 ; but as the observations themselves are not necessarily connected with the particular conclusions which may be drawn from them, these conclusions, at which the author had arrived, were made the subject of a separate paper to this Society.

The paper embraced three subjects of examination.

I. *Regarding the true nature of the tide wave.*—By observations made on the tides of the rivers Dee (in Cheshire) and Clyde, it was ascertained that the tidal elevation is a large compound wave consisting of a series of elements, each of which is identical with the wave of the first order, or great primary wave of translation, of which the author had already determined the nature and the laws. The *velocity* of the tide-wave is that due to the depth of the centre of gravity of the transverse section of the channel below the surface. The tide wave is a wave of translation, but the velocity of translation of the particles is entirely different from the velocity of propagation of the wave, the former being variable, and the latter constant. When the velocity of propagation is greatest, the velocity of translation is often least. The translation takes place almost uniformly to the greatest depth hitherto observed.

II. *The application of our knowledge to the explanation of the ordinary and extraordinary observed phenomena of the tide.*—The identity of the tide-wave with the wave of translation affords an explanation of the following phenomena, which have hitherto been wholly unexplained or imperfectly understood. (1.) The dislocation of the tide by which the time of ebb is increased, and the time of flood diminished by propagation, after a considerable space. (2.) The difference between the height of tides in places which are adjacent, and have been expected to have nearly the same tides. (3.) The variation of the establishment from time to time, arising from changes in the dimensions and form of the bottom of the sea or channels of rivers. (4.) The cause of the breaking surge or tide-bar. (5.) The variation in the form of the curve of semi-menstrual inequality in the height and in the interval at different places, and the exaggeration of the other inequalities.

III. *The deduction of practical maxims for the improvement of tidal channels.*—The last part of the paper is directed to the determination of the principles by which tidal channels may be improved, so as to facilitate the ascent of the tide,—to increase its volume,—to diminish the duration of ebb, and increase that of flood-tide,—and to impede the action of the tide in moving sand, producing bars, and injuring the banks of tidal channels or rivers.

The following Gentleman was elected a Fellow of the Society:

William Nichol, Esq.

The following Donations were presented:

Annalen der Physik und Chemie—Herausgegeben zu Berlin von J. C. Poggendorff.—*By the Editor.*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences (1837, 2me Semestre). Nos. 23 and 24.—*By the Academy.*

Essays on Unexplained Phenomena. By Graham Hutchison.—*By the Author.*

Observations Météorologiques et Magnétiques faites dans l'étendue de l'Empire de Russie. Redigées et publiées par A. T. Kupffer. Tome 1, No. I.—*Par le Ministre des Finances de Russie.*

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1838. No. 13.

Monday, 15th January 1838.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following Donations were presented :—

Natuur-en Scheikundig Archief, uitgegeven door G. J. Mulder en W. Wenckebach. 1837. St. 1, 2.—*By the Editors.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Van der Hoeven, M.D., en W. H. De Vriese, M.D. Vol. iii. Part 4.—*By the Editors.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences (1837, 2me Semestre). Nos. 25, 26.—*By the Academy.*

Account of a Case of Hermaphrodism. By P. D. Handyside, M.D. —*By the Author.*

Account of a remarkable Case of Suicide, with Observations on the fatal issue of the rapid introduction of Air in large quantity into the Circulation during Surgical Operations. By P. D Handyside, M.D., F.R.S.E.—*By the Author.*

The following Communications were read :—

1. Notice regarding the Composition of Dr James's Fever Powder. By Dr Douglas Maclagan, F. R. C. S. E.

James's Powder is a patent nostrum, which has been in use for upwards of a century as a febrifuge. It was avowed by its inventor to contain antimony ; but, as its mode of preparation was kept secret, the exact state in which the antimony existed in the powder was not known. The composition of James's Powder was first examined by Dr George Pearson, who published his experiments in the eighty-first volume of the Philosophical Transactions. He believed it to consist of 43 per cent. of phosphate of lime, and 57 of peroxide of antimony. M. Chenevix, in the Phil. Trans. for 1801, gave an account of some experiments which he had made on James's Powder, by which he found it to contain only 44 per cent. of the oxide of antimony. Berzelius, in his *Lehrbuch*, gives an account of an examination which he had made of a specimen of the powder. He found that about two per cent. was soluble in water, and this he found to consist of antimonite of lime. The remainder he found to contain about two-thirds of the antimonious acid, which is identical with the oxide of Dr Pearson, and one-third of phosphate of lime. The London College of Physicians had, in accordance with the views of Dr Pearson, introduced into their Pharmacopœia an imitation of James's Powder, under the title of Pulvis Antimonialis, which is now adopted by the other British pharmacopœias. This is prepared by roasting together hartshorn shavings and black sulphuret of antimony, and the product is a mixture of antimonious acid and phosphate of lime, as was shewn by Mr Richard Phillips in a paper which he published in the twentieth volume of the Annals of Philosophy. Both these preparations are much employed by physicians, but their operation has been frequently found to be very uncertain, and by many they are regarded as quite inert. This latter opinion, which is not in accordance with general experience, seems to be supported by the above view of their composition, for the antimonious acid is insoluble, even in strong acids, and the phosphate of lime is well known to be positively inert. This, however, afforded no explanation of the fact, that these powders both occasionally produce very decided effects; and, in order to discover the reason of this uncertainty of action, the author was induced to make an examination of some specimens of James's Powder and Pulvis Antimonialis. By treating them with boiling water, it appeared that both these powders contained a proportion soluble in water, which consisted of antimonite of lime and a little soluble superphosphate. The residue was acted on by hot muriatic acid, and was found to contain antimonious acid and phosphate of lime in variable proportion. By the action of sulphuretted hydrogen on the muriatic solution, it was shewn that there was always present a small quantity of sesqui-oxide of antimony, which is an active substance. The phosphate of lime was the most constant of these ingredients, generally averaging from 50 to 54 per cent. The sesqui-oxide of antimony was the most variable of all, there being sometimes as much as nine per cent., but in general, not more than three or four. The same results were obtained from Pulvis Antimonialis, the proportion of sesqui-oxide being generally smaller than in true James's Powder. As it is well known that sesqui-oxide of antimony, at a red heat, is converted into antimonious acid, it seems difficult to account for its presence in these preparations, except on the supposition, that a portion of it is united with the phosphate of lime as a triple salt, and thus escapes the action of the fire. Several specimens were examined of James's Powder, prepared by Messrs Butler and by Messrs Newberry of London, both of whom profess to follow the original recipe of Dr James, and all shewed the same variability of constitution. The same was found in various samples of Pulvis Antimonialis obtained from different druggists in Edinburgh. From these experiments it appeared, that the uncertainty of the action of these powders was probably owing to the variable proportion of sesqui-oxide of antimony which they contained, and there seemed to be nothing in the composition of the true James's Powder to warrant the high price at which it is sold.

2. Observations on the *Cysticercus Cellulosæ* inhabiting the Human Muscles. By Dr Knox.

The author commenced his memoir by observing, that about two years ago, he read to the Society some observations respecting an entozoon, of a very singular nature, occurring amongst the human muscles, a species of minute, and indeed microscopic, vibrio. The merit of the discovery was due to Messrs Hilton and Paget of London. Dr Farre afterwards gave an account of its internal structure. Soon afterwards it was announced, that this peculiar entozoon had occurred in other dissecting rooms—in Bristol, for example, and in Dublin. It was added, that the occurrence was rather frequent, in Dublin particularly, and that its existence amongst the human muscles seemed traceable to previous debility and exhaustion of the person before death had occurred. The author of the present memoir is, however, of opinion, that neither of these points has been made out clearly.

The worm, the *Cysticercus Cellulosæ*, which forms the subject of the present memoir, is oftener met with than the preceding one:

still, in Scotland it is rare. It occurs rarely in Vienna, on the authority of Bremser; but Rudolphi says, that every session a few càses occur in the dissecting-rooms of Berlin. The points of its anatomy, to which the author chiefly directed his attention, was, 1*st*, The structure of the enclosing cyst or capsule, which he still maintains to be an essential part of the worm, although not mechanically connected with it; and offers it as his decided opinion, that neither in the cysticercus, nor in the vibrio, does the enveloping cyst seem to be formed out of the surrounding cellular tissue. 2*d*, The anatomy of the disk of hooks, whose sole use anatomists have hitherto supposed to be to enable the parasite to attach itself to the surrounding textures of the animal on which, and by which it lives:—to the so-assigned use he finds an insurmountable objection if it really be, as most imagine, that the cyst or capsule is closed on all sides; and he further has described certain rounded or oval bodies, resembling globules, situated near the base of each hook, which he conjectures may be young cysticerci, which view, should it prove ultimately correct, would shew that the disk of hooks is more particularly connected with the generative system than with the digestive organs.

3. Examination of certain Objections to the Theory of Isomorphism. By Henry Madden, Esq.

The object of this paper was the refutation of certain arguments brought forward against the doctrine of Isomorphism, more especially by those who allow the existence of an approach to, although they deny absolute identity of, form.

The author sets out by shewing, that most of the arguments are deduced from observations made on crystallized minerals; and he then proceeds to state the many important circumstances which tend to influence the form of these bodies, but which can be easily avoided in those salts which admit of being formed artificially; such are, the intense temperature to which they are subjected, the pressure of surrounding matter, the admixture of foreign bodies, &c. each and all of which he proves to exert a powerful influence over the forms of crystals. From these facts, he concludes that the law of Isomorphism cannot be considered as invalidated by any slight differences found to exist in minerals, unless it could be proved that the crystals in question were formed under precisely similar circumstances. The author next proceeds to give an account of the results of his own experiments (when competing for the Hope prize), in so far as they show what circumstances require particular attention, in comparing even artificial crystals. In this part he proves, that the sooner crystals are measured after their deposition the better; that the solutions should be placed under precisely similar circumstances; that even the position of the crystals in the vessel in which they are formed, and the length of time that they have remained in contact with the mother-liquid, are circumstances of great importance, since even the system of crystallization may be changed by the latter. The author concludes by the consideration of two objections, drawn from observations made on artificial salts. The first of these is the well-known objection by Dr Clark of Aberdeen. This he refutes on the ground that the case in question is not a strict case of isomorphism, as the term is employed by Mitscherlich; and he brings forward abundant proof in support of this fact. The last objection is that which refers to the isomorphism of potass and ammonia; here, however, he shews that the difficulty falls to the ground, if the new and evidently more correct notion regarding the constitution of ammoniacal salts be substituted for the older opinion.

Monday, 5th February.

Sir GEORGE MACKENZIE, Bart., in the Chair.

The following Donations were presented.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, (1837, 2^{me} Semestre), No. 26, et (1838, 1er Semestre), Nos. 1, 2.—*By the Academy.*

Bulletin de la Société de Géographie, 2^{me} Serie, Tome vii.—*By the Society.*

Bulletin de la Société Géologique de France. Tome viii. Feuilles 21-25.—*By the Society.*

Journal of the Asiatic Society of Bengal for June 1837.—*By the Society.*

The following Communications were read.

1. Observations on the Parr and Young of the Salmon. By Dr Parnell.

2. Notice of the remarkable Mathematical Properties of a certain Parallelogram. By John Scott Russell, M. A., F. R. S. E.

The parallelogram which formed the subject of this communication is the rectangle whose sides are to each other in the ratio of the diagonal of a square to its side,—a figure well known to architects, sculptors, and painters, from its beauty, and frequently adopted in the practical arts.

The author shewed that if the given rectangle be bisected by a line parallel to its shortest side, each segment will be a figure similar in all respects to the original rectangle; and if either of these halves be itself bisected in the same manner, their halves will be rectangles similar to the original rectangle; and so on *ad infinitum*. The sides of the primary figure and its halves are continual proportionals, represented by the series

$$b, \frac{1}{\sqrt{2}}b, \frac{1}{\sqrt{2^2}}b, \frac{1}{\sqrt{2^3}}b, \frac{1}{\sqrt{2^4}}b \ldots\ldots \frac{1}{\sqrt{2^{n+1}}}.b.$$

The author endeavours to trace an analogy between the properties of this parallelogram and the logarithmic spiral.

A class of figures may be obtained by trisection and by division into four, five, or any number of figures, all of them similar to the primary figure, and capable of division *ad infinitum* in the same manner.

Monday, 19*th February*.

Dr HOPE, V. P., in the Chair.

The following Donations were presented:

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, (1838, 1er Semestre), Nos. 3, 4, 5.—*By the Academy.*

Bulletin des Séances de l'Académie Royale de Bruxelles, (1837). Nos. 1, 2, 3, 4, 5, 6, 7, 8.

Nouveaux Mémoires de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome x.

Memoires Couronnés par l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xi.—*By the Academy.*

Annales de l'Observatoire de Bruxelles, publiés, aux frais de l'etat, par le Directeur A. Quetelet. Tome i. partie 2.—*By the Author.*

Mémoires sur Trois Intégrales Définies, par M. J. Plana, Directeur de l'Observatoire de Turin.—*By the Author.*

Transactions of the Cambridge Philosophical Society. Vol. 6, Part ii.—*By the Society.*

Bulletin de la Société de Géographie. 2^{me} Serie, Tome 8.—*By the Society.*

The following Communications were read:

1. On the Composition of a new Ink, which, by resisting chemical deletion, promises to diminish the chances of the successful falsification of bills, deeds, and other documents. By Professor Traill.

The author was led to the investigation of this subject by its connection with that branch of Medical Jurisprudence which treats of the prevention and detection of forgery.

It is well known that common writing-ink may be totally effaced from paper by certain chemical agents, and that several others so impair its colour, that the characters traced with it become illegible. To the first class of chemical agents belong chlorine, and substances containing it, as well as oxalic acid: to the second diluted solutions, or the vapours of the mineral acids, and of the caustic alkalis. These agents were applied to written specimens of a great number of different inks, and the degree of resistance to their effects was considered as the criterion of the durability of each.

These views engaged the author in an extensive series of experiments on coloured metallic preparations, suspended in different vehicles, the results of which were laid before the Society. In one series, the colouring matter was precipitated on paper previously imbued with various chemical substances, capable of effecting the decomposition of the solutions applied; but no advantage was derived from this method. No useful results were obtained from the use of any of the metallic sulphurets or iodides, either alone or mixed with common ink; nor from preparations of indigo or other vegetable colours. Among the metallic preparations which resisted chlorine was a fine blue substance obtained by precipitating chloride of antimony by ferro-cyanide of potassium: but it was immediately destroyed by ammonia. The rich yellow substance formed by adding nitrate of cobalt to ferro-cyanide of potassium resists alkalis well; but it is effaced by acids. An ink composed of both these last-mentioned metallic salts was effaced by immersion, first in chlorine, and then in an alkali.

These failures to produce a durable ink from metallic combinations induced the author to attempt the composition of a carbonaceous liquid which should possess the qualities of good writing-ink

The inks used by the ancients were carbonaceous, and have admirably resisted the effects of time; but the author found that the specimens of writing on the Herculaneum and Egyptian *papyri* were effaced by washing with water; and on forming inks after the descriptions of Vitruvius, Dioscorides, and Pliny, he found that they did not flow freely from the pen, and did not resist water,—qualities essential to a good writing-ink in modern practice.

The carbonaceous inks with resinous vehicles, rendered fluid by essential oils, though they resisted water and chemical agents, had the disadvantages of not flowing freely from the pen, and of spreading on the paper, so as to produce unseemly lines. Solutions of caoutchouc in coal-naphtha, and in a fragrant essential oil, lately imported from South America, under the name of *aceite de sassafras* (the natural produce of a supposed Laurus), were subject to the same objections.

The author tried various animal and vegetable fluids as vehicles of the carbon, without obtaining the desired result, until he found, in A SOLUTION OF THE GLUTEN OF WHEAT IN PYROLIGNEOUS ACID, a fluid capable of readily uniting with carbon into an ink, possessing the qualities of a good, durable, writing ink. To prepare this ink, he directs gluten of wheat to be separated from the starch as completely as possible, by the usual process, and when recent to be dissolved in pyroligneous acid with the aid of heat. This forms a saponaceous fluid, which is to be tempered with water until the acid has the usual strength of vinegar. He grinds each ounce of this fluid with from eight to ten grains of the best lamp-black, and one and a half grain of indigo. The following are the qualities of this ink.

1. It is formed of cheap materials.
2. It is easily made, the colouring matter readily incorporating with the vehicle.
3. Its colour is good.
4. It flows freely from the pen.
5. It dries quickly.
6. When dry it is not removable by friction.
7. It is not affected by soaking in water.
8. Slips of paper written on by this ink have remained immersed in solutions of the above-mentioned chemical agents, capable of immediately effacing or impairing common ink, for seventy-two hours, without change, unless the solutions be so concentrated as to injure the texture of the paper.

The author offers this composition as a writing-ink, to be used on paper, for the drawing out of bills, deeds, wills, or wherever it is important to prevent the alteration of sums or signatures, as well as for handing down to posterity public records, in a less perishable material than common ink. He concluded his paper by stating, that should it be found to present an obstacle to the commission of crime—should it, even in a single instance, prevent the perpetration of an offence so injurious to society as the falsification of a public or a private document, the author will rejoice in the publication of his discovery, and consider that his labour has not been in vain.

2. Abstract of first part of Memoir on the Mid-Lothian and East Lothian Coal Districts. By David Milne, Esq.

The author commenced his communication by stating, that he should divide his memoir into two parts, the first being devoted to a mere narrative of *facts*, the second to *explanations* of these facts.

In describing the geological features of the district, he noticed first the *stratified* or rudimentary rocks, and next the *unstratified* rocks.

The STRATIFIED consist of sandstone, shales, limestones, coal, and clays; which rocks seemed severally to abound or prevail, in the order now stated.

These stratified rocks overspread the district from Portobello to Gladsmuir, in an east and west direction; and from the Firth of Forth to the Lammermoor Hills, in a north and south direction. Within these limits there are two basins,—the basin of the Esks, and the basin of the Tyne; and which basins are divided by the ridge or high ground that runs from Prestonpans (on the shore of the Firth) by Tranent, Falside, Carberry, and the Roman Camp.

The Esk basin contains between sixty and seventy coal-seams, exceeding one foot in thickness. The Tyne basin contains not more than ten or twelve, being those which appertain to the lower part of the deposit. The vertical depth of the Esk basin in its trough,—or, in other words, the thickness of the deposits composing it, is between 1000 and 1050 fathoms; but this thickness diminishes rapidly to the south, arising chiefly from the coal-seams and sandstone strata thinning away in that direction; and which diminution is compensated in but a trifling degree, by the increased thickness of the limestone in the same direction.

The Tyne basin comprehends only the deposits lying below the Great Seam of coal, and the entire thickness of these, is greatly less than in the Esk basin, arising chiefly from the sandstones and coals thinning away towards the east.

The strata on the west side of the *Esk* basin, dip to the east and south-east at a very steep angle, and are in some places absolutely vertical. On the opposite or east side of the Esk basin, they slope to the west at an angle varying from 20° to 40°.

The strata on the west side of the *Tyne* basin dip to the east, at an angle varying from 15° to 20° ; and on the opposite or east side of the same basin, they dip to the west at an angle of only 5° or 6°.

In the intervening ridge which runs from Prestonpans to the Roman Camp, the strata mantle over from the one basin into the other, and are there occasionally broken so as to shew an anticlinal line.

The different kinds of coal were described ; and it was stated, that each kind was characterized by differences in the fissures or joints intersecting them.

The principal slips in the district were next pointed out ; and the author referred to a table he had constructed, shewing the direction of each, and the amount of dislocation produced on the intersected strata. Between eighty and ninety of these were also laid down on the map accompanying the memoir.

In describing the UNSTRATIFIED rocks of the district, the author mentioned, there were no hills or amorphous masses of trap within the proper limits of the Lothian coal-field ; and that the trap shewed itself only in dykes, which run in straight lines intersecting the strata. He pointed out three or four such dykes, varying from 60 to 120 feet in width,—all of which appeared gradually to thicken towards the west, and all of which run in nearly an east and west direction.

3. The following Memorandum was communicated by Professor Forbes.

" A series of delicate and tedious experiments on heat have conducted me to the following results, which will be fully discussed in a paper shortly to be laid before the Society.

" 1. An entire confirmation of my previous statement, that different kinds of heat are differently susceptible of polarization by transmission through a given bundle of mica plates ; heat from obscure sources being less polarizable than that from luminous sources. I considered my investigations incomplete until I had proved not only that my former experiments had led me to correct results, but also why the only other person who I believe has attempted to obtain them was led to the opposite conclusion, as stated by M. Melloni in the Annales de Chimie for May 1837, namely, that all kinds of heat are *equally* susceptible of polarization. I have at length discovered, in the description of M. Melloni's method, the cause of his failure to detect this fact.

" 2. I have ascertained the laws and measures of the depolarization of heat by the doubly refractive energy of mica plates, by three series of experiments with heat from different sources, each performed with mica of various thicknesses.

" 3. I have discovered a method of measuring the mean index of refraction of heat from different sources with very considerable numerical exactness, which it is believed is now done for the first time; and the results confirm the opinion already entertained, that dark heat is the least refrangible, whilst that portion of luminous heat which is transmitted by glass is the most refrangible. The principle of the method includes a complete analysis of the heterogeneous heat derived from any source into any number of portions, between assigned limits of refrangibility."

Monday, 5th March.

Sir T. M. BRISBANE, Bart. P. in the Chair.

The following Honorary Fellows were elected:

Prof. Tiedemann, Heidelberg.
Prof. Müller, Göttingen.

The following Donations were presented:

Elements of Chemistry, by the late Edward Turner, M. D., sixth edition, enlarged and revised by Professor Liebig and Wilton G. Turner. Part 11.—*By the Editors.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. No. 6, 1er Semestre 1838.—*By the Academy.*

Flora Batava. Nos. 112 and 113.—*By the King of Holland.*

On the Nature and Treatment of the Diseases of the Heart; with some views on the Physiology of the Circulation. By James Wardrop, M. D., Surgeon to his late Majesty Geo. IV., &c. &c. *By the Author.*

Notice sur les Marbres; par M. Theodore Virlet.—*By the Author.*

The Quarterly Journal of Agriculture, and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. No. 40, March 1838.—*By the Society.*

Bulletin de la Société Geologique de France. Tome ix. Feuilles 1–5.—*By the Society.*

Recherches Historiques de Statistiques sur la Population de Geneve. Par Edouard Mallet.—*By the Author.*

Researches into the Cause of Voltaic Electricity. By Mons. Auguste De la Rive.—*By the Author.*

De l'Influence qu'exerce la Chaleur sur la Facilité que le Courant Electrique possede a passer d'une liquide dans un Metal. Par M. la Professeur A. de la Rive.—*By the Author.*

Proceedings of the Royal Society. Nos. 28, 29, 30.

Address of his Royal Highness the Duke of Sussex, K. G., the President, read at the Anniversary Meeting of the Royal Society on November 30. 1837.

Address to her Majesty, referred to in the Address of his Royal Highness the President of the Royal Society.

Philosophical Transactions of the Royal Society of London, for the year 1837. Parts 1 and 2.

List of the Fellows of the Royal Society for the year 1837.

Astronomical Observations made at the Royal Observatory, Greenwich, in the year 1836, under the direction of George Biddell Airy, Esq. M. A. Astronomer-Royal.—*By the Royal Society.*

The Mathematical Journal of Cambridge. Nos. 1 and 2.—*By the Editor.*

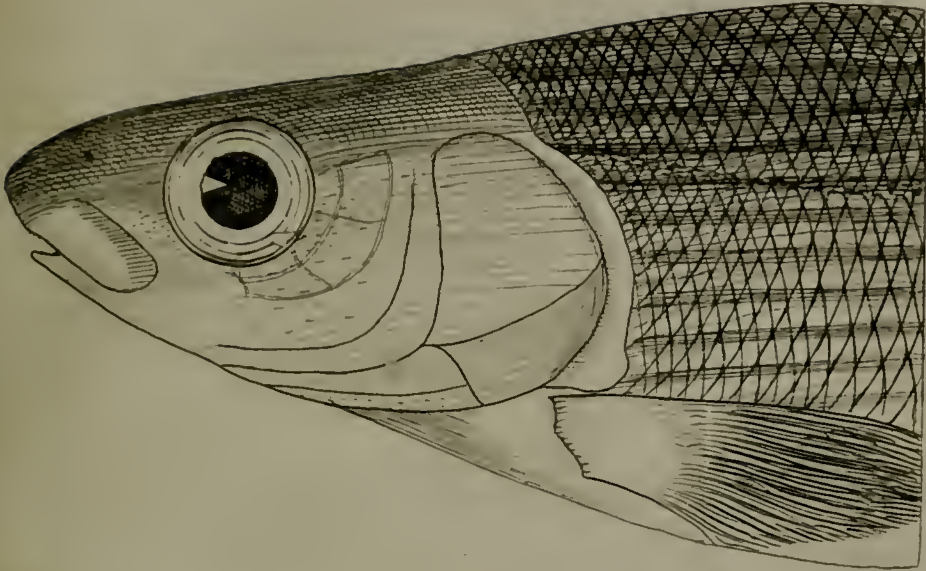
Malacologia Monensis. A Catalogue of the Mollusca inhabiting the Isle of Man and the neighbouring sea. By Edward Forbes, President of the Royal Physical Society of Edinburgh, &c. &c.—*By the Author.*

The following Communications were made:

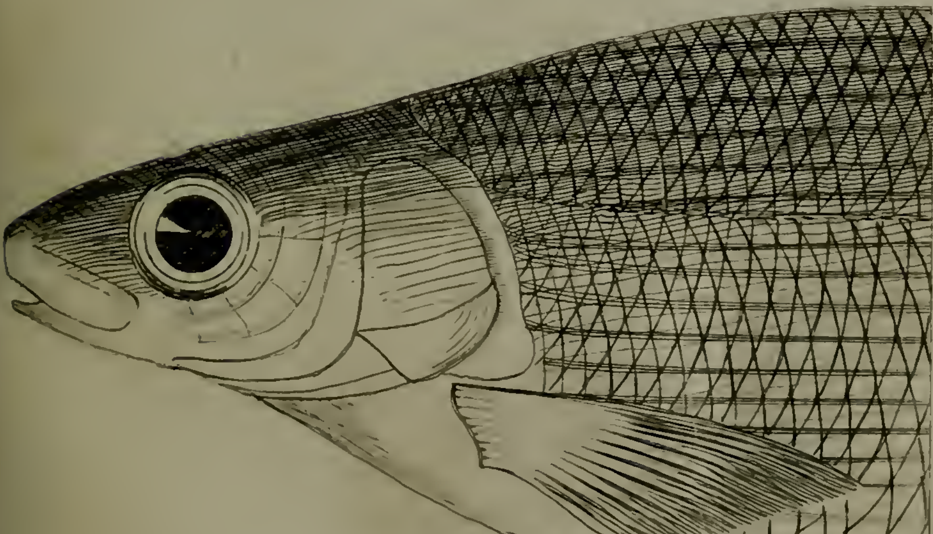
1. Notice regarding a New British Species of *Coregonus.* By Dr Parnell. (See Plate.)

It was stated by Dr Parnell, that in Lochlomond are found two species of Coregonus, one of which he believes to be an undescribed species, and the other, which was first noticed by Lacépède under the name of *Coregonus Clupeoide,* has been confounded by British naturalists with the *Coregonus Laveretus,* or Ulswater Gwyniard.

From Lacépède's short and imperfect description of the *Coregonus Clupeoide* of Lochlomond, and as two species are now found inhabiting the same locality, it is impossible to state with a certainty as to which of the species he alludes; therefore the name of



Coregonus Lacepedei Natural size.



Coregonus microcephalus natural size

Coregoni of Loch Lomond.

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Coregonus Lacepedei was proposed for the one species, and that of *Coregonus microcephalus* for the other, as illustrative of the species.

The *Coregonus Lacepedei* occasionally grows to the length of sixteen inches, and is distinguished by the great length of head compared with that of the body; the snout extending beyond the upper lip; the under jaw the shortest; the length of the pectorals and dorsal fin; the large scales, the number of rays in the anal fin; the peculiar shape of the caudal, and the position of the dorsal. It agrees in figure with *Salmo Wortmanii* of Bloch, but not in description.

The *Coregonus microcephalus* does not grow to the size of the last species, and differs from it in the head and pectorals being considerably shorter, and the snout not projecting ,beyond the upper lip. It is at once removed from the vendace and pollan in the under jaw being the shortest. On comparing it with the Gwyniard, it is a much deeper fish, the head and pectorals much shorter; the upper jaw furnished with distinct teeth: anal fin with fewer rays; besides it grows to a larger size than the Gwyniaad.

These fish are found in Lochlomond in great numbers, where they are named Powans or Freshwater Herrings, and are much prized in that neighbourhood as being wholesome, well-flavoured and delicate food, particularly during the autumn months. In the stomachs of those examined were found several species of entomostracious animals, larva of insects, a few coleoptera, and a number of small tough red worms. They shed their spawn in the months of October and November, after which they continue out of condition till March.

2. Abstract of Part II. of Memoir descriptive and explanatory of the Mid Lothian and East Lothian Coal-fields.

This part of the memoir was devoted exclusively to an attempt to *explain* or account for the facts described in the first part of the memoir.

The geological epoch when the strata composing the coal-measures of this district were deposited, was first noticed. It was stated that these coal-measures were deposited at a period immediately following the deposition of the old red sandstone formation; and that this older formation was to be seen both on the north and on the south sides of the Lammermuir Hills, dipping under the coal-measures, and resting on the upturned greywacke strata of these hills. The lowest member of the old red sandstone group is a coarse conglomerate, evidently formed by the denudation of these greywacke hills; and the uppermost members consist of soft argillaceous sandstone, of a deep red colour.

The coal-measures of this particular district extend also over the whole of East Lothian, though towards the north and north-east, they are much broken and shattered by eruptions of trap. Beyond the east and south-east crop of the Tyne Coal Basin, there are no members of the coal-measures proper, except those which occupy the lowest part of the series. The limestone known in the Esk and the Tyne Basins, as lying under the North Greens Coal, undulates along or near the surface, throughout all the country between Haddington and the sea, towards North Berwick, as well as Dunbar and Dunglass, except at those places now occupied by trap hills.

It appears that along the east margin of the Tyne Basin there is an anticlinal line, from which the limestone just spoken of dips gently to the east, so as to form in some measure a third basin, but one very flat and much broken.

The author proceeded next to speculate on the probable mode in which the strata of the coal-measures had been severally formed. It was inferred from various circumstances, that they must have been all deposited at the bottom of an aqueous medium, which in certain parts, or at certain periods, was calm and tranquil, and which, in other parts, or at other periods, was agitated by currents.

The *shales* and *clays*, it was said, might have been formed of sediment washed down from the Lammermuir Hills; but it was thought that the siliceous sediment necessary for the enormous deposits of *sandstone* must have come, not from the greywacke hills chiefly, but from primitive formations, and which were probably situated far off towards the west and north.

In regard to the origin of the *limestone* strata in the district, it was inferred, that they had been formed by a precipitate of carbonate of lime, held in solution by the aqueous medium which overspread the district. Water, it was said, would hold carbonate of lime in solution, if there was an excess of carbonic acid; and on the application of heat, a part of the carbonic acid gas would be liberated, and a precipitate occasioned. To account for the remarkable fact, that the limestone underlying the North Greens coal thickened as it approached the Lammermuir Hills, it was suggested that the water may have been warmer near them, not only from its being shallower there, and thus more capable of being acted on by solar and atmospheric influence,—but also from the subterranean heat being there more intensely felt or more frequently evolved. The same theory might account for the formation of limestone in the upper part of the basin, though in proportion to the distance between the subterranean heat and the water, the precipitates of lime would become less abundant and less frequent; a consideration which would explain why the five or six beds of limestone that occur in the district, are all situated in the lower half of the basin.

With regard to the origin of the *coal*-seams, it was observed, there could be no doubt of their having been formed from accumulations of vegetable matter, which, at different periods, had been drifted from a distance. The fact of these accumulations having taken place at the bottom of the same sea or aqueous medium in which the other strata of the basin were successively deposited, seemed to be placed beyond dispute, by the discovery in the substance of the coal itself, and about four inches below the top of a seam of coal,—of quantities of the teeth, bones, and scales of fish. These remains belong to the same species, the remains of which had been found in the shales of this coal-field by Lord Greenock, and in the Burdiehouse limestone by Dr Hibbert.

The vegetable matter which formed most, if not all, of the coal-seams of the district, appeared to have been drifted from the west or north-west, because in these directions the seams get gradually thicker.

As all the vegetables found in the coal-seams and adjacent shales are terrestrial, it seemed probable that they had been torn off or swept away from their native sites by periodical inundations:—that they had been carried out into a great lake or estuary, where, after floating about for a considerable time, they subsided in tranquil waters, but not before parting with the clay and other earthy matters attached to their roots, and not before the sediment carried off by the inundation, and mechanically suspended in the water, had time to subside. It was inferred from this circumstance, that beneath every seam of coal there ought to be a bed of fire-clay,—an inference which agrees with the fact.

After these vegetable accumulations had taken place, and probably after all the other strata of the basin were deposited, the entire series of rocks had evidently been operated on by some powerful agent, so as to give to each its peculiar crystalline structure, and many of the other known peculiarities in their constitution. That some such agent must have operated appears to be proved, (1.) By the formation of joints and fissures intersecting the strata; (2.) By the conformity of direction in these joints and fissures; (3.) By the internal movement of the particles or ingredients of the vegetable mass among each other, whereby different kinds of coal were formed in the same seam; and (4.) By the fissures and cavities in the coal being generally filled with *pearl-spar*, which could only be derived from an aqueous medium impregnating the vegetable mass, and holding carbonate of lime and magnesia in solution. It was inferred from these and other circumstances, that the agent which had operated on the strata after their deposition, was subterranean heat.

The rest of the paper was occupied with an explanation of the convulsions which had occurred after the deposition of these strata, and in consequence of which they had been thrown into the form and position now presented by them. It was mentioned that the very steep dip to the eastward, which the strata on the west side of the Esk basin presented, was occasioned by the eruption of Arthur Seat, Blackford Hills, and the other trap masses that occur along almost the whole extent of the west side of that basin.

It was next shewn, that before the enormous quantity of volcanic matter which burst forth emerged from beneath the strata of the district, these strata must have suffered dislocations or cracks, which would account for the slips and dykes that intersect the district. It was also shewn, how these slips and dykes behoved to run generally in a direction between N. and W., and cause the dislocated strata to sink down on the north side of them, rather than on their south sides. An explanation also was offered of the invariable rule which had been found to prevail in this district as in others, that if a slip haded or sloped from the vertical, the strata were always lowest on the upper side of the slip. A reason was also assigned for the fact, that in this district, the strata are not deranged (or in other words, "thrown down" on either one side or other) by *dykes*, but only by slips.

Monday, 19th March.

Dr HOPE, V. P. in the Chair.

The following donations were presented :—

Annals of Natural History, or Magazine of Zoology, Botany, and Geology. Conducted by Sir William Jardine, Bart.; P. J. Selby, Esq.; Sir W. J. Hooker; and Richard Taylor, Esq. (No. 1, new series).—*By the Editors.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. 1er Semestre 1838. Nos. 7, 8, 9.—*By the Academy.*

Proceedings of the Geological Society of London. Nos. 52, 53.

Transactions of the Geological Society of London. (Second Series.) Vol. 5, Part 1.—*By the Society.*

Theory of Heat. By Philip Kelland, M. A., Fellow and Tutor of Queen's College, Cambridge.—*By the Author.*

Hortus Mauritianus, ou Enumeration des Plantes Exotiques et Indigenes, qui croissent à l'Ile Maurice, disposées d'apres la Methode Naturelle. Par W. Bojer.—*By Lord Glenelg, H. M. Sec. of State for the Colonies.*

Journal of the Asiatic Society of Bengal, for June and August 1837.—*By the Society.*

The Keith Medal awarded by the Council to Mr John S. Russell for his Researches on Hydrodynamics, was presented by the Vice-President.

The following communications were read :—

1. Practical Researches on Respiration. By Dr D. B. Reid.

The object of the author was to lay before the Society the result of an investigation into the state of the air usually respired in public buildings in this country and on the continent, to shew that the amount of air usually allowed for respiration is far below what is necessary to sustain the system in a healthy tone, and to give an account of the various experiments and observations upon which this opinion was founded.

He entered also into an examination of the method that ought to be adopted in introducing and regulating the supply in different apartments. In pointing out some facts connected with the general history of respiration, he endeavoured to shew the powerful influence exerted by a full supply of light, and the important effect it has upon the general health ; and concluded by referring to the minute quantities in which he had found some gases to exert a very deleterious influence upon the animal economy, and a statement of the result of experiments made with absolute carbonic acid, and various mixtures of this gas with air.

2. Observations on the Fur Seal of Commerce. By Robert Hamilton, Esq.

The author states that the Fur Seal merits attention in a commercial as well as a scientific point of view. The South Sea Seal trade, though comparatively of recent origin, has been prosecuted to a much greater extent than the northern ; and especially in pursuit of two species of seals,—the *Proboscis* Seal, or Sea Elephant, for its oil, and the Fur Seal, for its skin.

After some preliminary remarks upon the nature of the coats or robes of seals, the author, in the absence of scientific information concerning the fur-seal, turns to the works of navigators and seal-hunters, and finds distinct allusion made to it in the writings of Cook, Clayton, and especially of Mr Weddell, who commanded several expeditions undertaken chiefly for its capture. This last-named gentleman, several years ago, presented two stuffed specimens of the animal to the Royal Museum of the Edinburgh University, and from these a detailed account is given of the external characters, and the measurements, together with a coloured drawing by Mr Stewart. The animal is an Otary ; the length of the largest males is little short of 7 feet, whilst that of the full-grown female is about 3½ feet. The habits of the animal, so far as known, are then supplied, together with an explanation of that singular peculiarity common to the whole group, whereby, with little or no use of their limbs, these amphibious quadrupeds can yet, on land, outstrip a man pursuing them at full speed.

The author then turns to the identification of this species, and endeavours to shew that it is not the *Ursine Seal*, or Sea-bear, as stated by some eminent French naturalists ; and, on the other hand, that the *Longicollis* and *Falklandica*, generally enumerated as belonging to different genera, and whose descriptions are universally regarded as too vague and obscure to be of any value, are yet one and the same species, and that identical with the Fur-seal. This animal is at the same time distinct from the Otary discovered in the Falkland islands by MM. Lesson and Garnet, and described as the *O. Molossina* in the "Zoologie de la Coquille."

In conclusion, the author maintains that there are probably other seals which would yield fur similar in quality to that which was long so much valued, and is now so greatly desiderated.

Monday, 2d April.

Dr HOPE, V. P., in the Chair.

The following donations were presented :—

The Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 8.—*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. 1838. 1er Semestre. No. 10.—*By the Academy.*

Madras Journal of Literature and Science. Published under the auspices of the Madras Literary Society, and Auxiliary Royal Asiatic Society. Nos. 15, 16, and 17.—*By the Society.*

The following communications were read :—

1. On the Wild Ox of Scotland. By Dr Knox.

In this memoir, the author endeavours to trace the antiquity of the white oxen of Cadzou and of Tankerville during the historic period of Britain, but thinks that materials are altogether wanting for such an inquiry. No records exist in proof of these cattle being aboriginal; or, if introduced into the island by any of the three great races of men found in it, it would be difficult to offer a conjecture by which race they were introduced. Had the cattle of Britain been generally white in Cæsar's time, it is probable that that great man would have noticed the fact. The author thinks it even probable that these white cattle may have been introduced by the Romans themselves, since they are not found in Ireland. Tacitus mentions that the German cattle were withont horns in his day. By " Germans," Tacitus here means the Saxon race; and yet the descendants of these Saxons in Holland had so completely lost all trace of the polled or hornless cattle of their ancestors, that they refused credit to Camper when he asserted to his countrymen that he had seen cattle without horns in Britain.

In the second part of the memoir the author examines the question, Whether the white cattle of Britain constitute a distinct species of the Bovine tribe, *i. e.* distinct from any known species or variety of the domestic ox? and he thinks that they do not; but, as the domestic ox of Britain, and of almost all countries, are now a mixed breed, derived from several species, he is at a loss, from want of materials, to shew to which of these species the white ox of Hamilton most approaches. They seem to him to bear the strongest resemblance to the Galloway breed. From not having been able to procure a cranium of the Tankerville white ox, he, of course, cannot say to what species it may belong.

The cranium of the wild ox of Hamilton differs very much from that of most domestic oxen, particularly in the breadth of the forehead, shortness of the nasal bones, and configuration of the interior of the nostrils. Many of the bulls have horns, whilst others are polled.

The author, with reference to the relation these oxen bear to fossil crania of the Bovine tribe, thinks that none of the fossil specimens which he has seen in museums, or which have been delineated in M. Cuvier's work, could have belonged to an animal similar to the existing species, and thinks that they may have differed even generically.

The author suggests, in conclusion, that the type of these cattle can never be satisfactorily made out, so long as their breeding is so much interfered with, by the destruction of all the calves which may differ in form or colour from the standard considered by the noble proprietors as essential to the purity of the breed.

2. On the Third Pair of Nerves. By Sir C. Bell.

This paper is the first of three communications, in which is shewn the distinctions in the regular series of nerves arising from the spinal marrow, and the ten nerves which arise directly from the brain.

The author remarks, that unless we comprehend the reason of the perfect symmetry of the spinal nerves, as contrasted with the irregularity of the encephalic nerves, we must confess ignorance of much of the structure of the animal frame.

After a general view of the nerves arising from the base of the brain, and assigning the reason of their apparent irregularity, he enters on the investigation of the third nerve. He shews that it arises from the distinct columns of which the *crus cerebri* is composed, by courses of parallel filaments; and that these afterwards compose a dense structure resembling ganglion. From the anatomical facts he deduces these conclusions:—That the third nerve being the motor of the eye, is unique in structure and function;

that it arises anterior to the *pons* or *nodus cerebri*, in order to be free of the intricate texture of nerves which have reference to the complex operations of the trunk and limbs; that the necessary combination of motion and sensation in the eye, uncontrolled by remote relations, and free of the combined operations of the frame, is the reason both of its peculiar origin and of the intimate combination of a sensitive and motor root.

3. Inquiry whether Sea Water has its Maximum Density at some degrees above its freezing point, after the manner of fresh water. By Dr Hope.

Dr Hope stated that it has been considered a matter of considerable importance in the reasonings of geologists and hydrographers respecting some oceanic phenomena, whether sea water obeys at all temperatures the general law of expansion by heat, and contraction by cold, or, after the manner of fresh water, observes the anomalous course of contracting by heat, and expanding by cold, during a short range of temperature near its congealing point.

In 1788, Sir Charles Blagden concluded, from a solitary experiment, that a solution of common salt, chloride of sodium, in water, began to expand, when cooled to abont 8° above its freezing point; and thence it has been inferred, that all solutions of salt will exhibit the same phenomenon; and the law has been laid down, that the combination of a salt with water has no other effect upon its quality of expanding by cold than to depress the point at which that quality begins to be sensible, just as much as it depresses the point of congelation, and that saline solutions begin to expand at $7\frac{1}{2}°$ above their point of congelation. Transferring these views to sea water, its maximum density was supposed to be about $36\frac{1}{2}°$. Various reasonings were founded upon that supposition.

Dr Hope then adverted to the discordant experiments of Dr Marcet in 1819, of M. Erman in 1828, and of M. Despretz in 1836 and 1837.

The object of Dr H.'s inquiries was to ascertain whether sea water and stronger solutions of common salt are subject to the common law, or the anomalous aqueous one. He carried on the investigation in two modes, 1st, By employing thermometric glasses, containing the saline fluid, and observing the descent of the fluid in tho stem during cooling to the point of congelation, and its subsequent ascent when again exposed to heat.

The result was, that the fluids descended in the tube from cold, and ascended from heat uninterruptedly, as mercury and alcohol do; and did not, like water, present any appearance of interruption in their course or retrocession.

2d, But as doubt must always hang over experiments conducted in this manner, in consequence of the interference of the changes in the capacity of the thermometric instruments, arising from the alterations of temperature, he resorted to the method described in his memoir read to this Society in 1804. This consists in discovering the effects of heat and cold on the density of fluids, by ascertaining by thermometers placed near the top and bottom of a column of the fluid, the direction of the currents induced in the fluids, fully assured, that the rarer will invariably ascend, and denser descend. Proceeding in this manner, Dr H. found that, when a frigorific mixture was applied to the middle of a column of sea water at the 40th degree, the cooled water immediately began to descend to the bottom, and continued to do so steadily, till the thermometer at the bottom indicated the congealing temperature of the fluid; and again, that when heat was thrown into the middle of a column of sea water cooled to its freezing point, the heated fluid immediately began to ascend, and continued to do so uniformly and uninterruptedly.

From this and the preceding series of experiments, Dr Hope considered himself warranted to conclude, that the strange anomaly which fresh water presents does not exist in sea water.—That at all temperatures above its point of congelation, it is expanded by heat and contracted by cold, and that its maximum of density does not occur at $7\frac{1}{2}°$ above its point of congelation, as is the case with pure water.

Dr Hope did not touch the very difficult and perhaps indeterminable question, viz. the temperature at which sea water and solutions of salt have their maximum of density; reserving that question, and the consideration of the effects of various substances soluble in water in rendering this fluid obedient to the general law of expansion by heat and contraction by cold, for another memoir.

Monday, 9th April.

Dr ABERCROMBIE, V. P. in the Chair.

The following donations were presented :—

Report on the Physical Condition of the Assam Tea Plant, with reference to Geological Structure, Soils, and Climate. By John M'Clelland, Esq., Assistant-Surgeon, Bengal Establishment.—*By the Author.*

Seventeenth Report of the Council of the Leeds Philosophical and Literary Society at the close of the Session 1836–7.—*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, 1838, 1er Semestre, Nos. 11, 12.—*By the Academy.*

Proceedings of the Geological Society of London, Nos. 54 and 55. —*By the Society.*

Nieuwe Verhandelingen der Eerste Klasse van het Konninklijk-Nederlandsche Instituut van Wetenschappen, Letterkunde en Schoone Kunsten te Amsterdam, Vol. 6.—*By the Institute.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. 1835.

Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königl. Preuss. Akademie der Wissenschaften zu Berlin vom Mai 1836 bis Juni 1837.—*By the Academy.*

Bestimmung der Länge des einfachen Secundenpendels fur Berlin von F. W. Bessel.—*By the Author.*

Astronomische Beobachtungen auf der Königlichen Universitäts—Sternwarte in Konigsberg von F. W. Bessel. 18th part.—*By the Author.*

The Glasgow Mortality Bill for the year ending 31st December 1837. By Henry Paul, Accountant.—*By the Author.*

Ordnance Survey of the County of Londonderry. Colonel Colby, R. E., F. R. S. L. & E. &c. Superintendent. Vol. 1.—*By the Lord Lieutenant of Ireland.*

Views of the Architecture of the Heavens, in a Series of Letters to a Lady. By J. P. Nichol, LL. D., F. R. S. E.—*By the Author.*

The following communications were read :—

1. On the Origin and Compound Functions of the Facial Nerve or Portio Dura of the Seventh Nerve. By Sir C. Bell.

In this paper the author treats of the *Facialis* nerve or portio dura of the seventh nerve.

He commences with a view of the Respiratory System of Nerves. Vindicating the term, he proceeds to shew that the *Facialis* belongs to this system, and that it possesses a double function and double origin. That this composite condition of the nerve is not, however, like the double nerves of the spine (which have a root for motion and a root for sensation), but that its origins shew it to be connected with the column of voluntary motion and of the column of respiration. He then enters on the illustration of the various influences exerted through the filaments of this small nerve on the face. Its double relation to the will and to the automatic action—the motions of the air-passages in unison with the other respiratory actions—the combination with the same in speech; and, finally, as they are the instruments of expression, of emotion or passion. Concluding with a comparison of the many functions of the nerve with its complex origins.

2. Description of the Hydrodynameter, a new instrument for shewing the rate of Sailing of Ships and Velocity of Currents, Rivers, Tides, &c. By Mr R. Adie, of Liverpool. Communicated by Dr Traill.

The author here first refers to the differential barometer of the late Dr Wollaston, from which he derives his new instrument. He then describes the instrument, which, in its simplest form, consists of a glass-tube bent into the form of the letter U inverted, the one end open in the line of the arms downwards, the other has its point turned up at right angles to this line. A divided scale is placed between the tubes, having its zero point as the centre. When the instrument is used, the upper curve and arms are to be filled with oil, or any other fluid lighter than water, as far as the zero on the scale; the remaining parts of the tubes are to be filled with water. If the instrument is in this state placed in any current, with the end of the tube which is bent at right angles turned towards the current, the oil will rise in the one arm and descend in the other, till the velocity of the current is counterbalanced by the length of the column of oil displaced, and this varying with the velocity, serves as its measure. The author then goes on to describe the form of instrument to be used for giving the rate of sailing of a ship, being a modification of the same instrument, to answer the situation and to correct for want of perpendicularity caused by the heeling of the vessel. The communication with the sea is made by tubes brought from the bottom at midships to the cabin, where the glass tubes and scale are placed; and the rate of sailing may at all times be known by observing the length of the column of oil displaced.

3. A verbal communication on the Osseous Structure of Fishes. By Dr Macdonald.

Monday 16th April.

Sir T. M. BRISBANE, Bart. President, in the Chair.

The following donations were presented :—

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences. 1838. 1er Semestre. No. 13.—*By the Academy.*

A Systematic and Stratigraphical Catalogue of the Fossil Fish in the Cabinets of Lord Cole and Sir Philip Grey Egerton. By Sir Philip Grey Egerton, Bart.—*By the Author.*

The following communications were read :—

1. Researches on Heat. Third Series. By Professor Forbes.

This paper is divided into three sections, each containing a distinct investigation.

The First Section is on the Variable Polarizability of different kinds of Heat. This fact, namely, that when polarization takes place by refraction through a bundle of parallel mica plates, some kinds of heat are less completely polarized than others at the same incidence, the author proposed to establish in the second series of his researches. His investigations, however, having been considered by some persons as open to objection, and directly contrary results having been obtained by M. Melloni in his repetition of these experiments, the author was induced to investigate the subject anew and with every precaution. He used rays of heat rendered parallel by a rock-salt lens, previous to falling on the mica plates, which were removed to a distance from the pile; but still the differences in the Parallel and Crossed positions of the mica bundles, when heat of various qualities was used, were as unequal as formerly; and having varied the experiment in different ways, the author concludes by adhering to his former conclusion, and gives the following table of the proportions of the heat penetrating the mica plates when parallel, which were stopped in their crossed position :—

Source of Heat.	Rays per cent. polarized.
Argand Lamp,	78
Locatelli Lamp,	75 to 77
Incandescent Platinum (usually),	74 to 76
Incandescent Platinum, with glass .06 inch thick interposed, 6 to 7 per cent. more, or	80 to 82
Alcohol flame,	78
Brass heated to about 700°,	66.6
Do. with a plate of Mica .016 inch thick interposed,	80
Mercury in a Crucible at 450°,	48
Boiling Water,	44

The apparently uniform polarizability of all kinds of heat, as observed by M. Melloni, the author shews must necessarily arise from the use of mica bundles, such as he used, consisting of a great number of distinct plates of mica superimposed. Such a thickness of mica modifies heat from dark sources in such a way as to give the portion which it transmits the same character as to polarizability as luminous heat. The plates used by the author, and split by the action of a hot fire, as explained in a former paper, contain so many surfaces within a very small thickness, that the polarized heat is comparatively unaltered in its character. The author shews that the piles used by him transmit heat from a lamp sifted by glass, and from brass at 700° in nearly equal proportions, whilst mica .016 inch thick transmits five times less of the latter than the former.

The Second Section relates to the Depolarization of Heat. Pursuing the methods given in the first series, the author ascertained the proportion of heat depolarized by five different thicknesses of mica. From the numerical results thus obtained, he deduces the value of the expression in Fresnel's formula of depolarization, for $\frac{\text{retardation}}{\text{length of wave}}$, either of which quantities being assumed, the other becomes known. If the numerator (the difference of paths described within the depolarizing mica plate by the ordinary and extraordinary ray) be assumed to be the same as in light, the length of a wave would come out 3 times as long as for red light, and $4\frac{1}{2}$ times as long as a violet wave. Since, however, this result seems not easily reconcilable with the slight difference of the mean refractive index for heat and light (which is afterwards obtained), the author rather inclines to the supposition, that the energy of double refraction is smaller for heat than for light, or that a greater thickness of the medium is required to produce a given retardation.

Almost exactly similar numerical results were obtained for heat from an argand lamp, from incandescent platinum, and from brass at 700°.

The Third and longest Section of the paper, relates to the Index of Refraction for Heat of different kinds compared to Light. The method of observation adopted by the author, resembles in principle Dr Wollaston's method of determining Indices of Refraction for Light by the Critical Angle of Total Reflection. (Phil. Trans. 1802.) The practical part consists in determining the critical angle of transition from partial to total reflection within a rock-salt prism, having two angles of 40° and one of 100°. The sentient surface of the thermal pile is so placed with regard to the prism, that it continually receives rays coming from the source of heat after undergoing two refractions and one reflection, whatever be the angle of incidence. This is accomplished by mounting the whole on a jointed rhomboidal frame, the surface at which total reflection takes place being maintained by a mechanical contrivance constantly perpendicular to the diagonal of the rhomboid, the incident and reflected rays being always parallel to its side, to which the source of heat and thermal pile are fixed. In this way (a number of precautions being taken, and modes of reduction adopted which cannot here be explained) the following indices of refraction were approximately determined, for the *mean* quality of the heat most abundantly contained in the rays obtained from various sources :—

Heat from	Index of Refraction from Rock-Salt.
Locatelli Lamp,	1.571
Ditto, transmitted by Alum,	1.598
.... Glass,	1.587
.... Opaque Glass,	1.593
.... Opaque Mica,	1.583
Incandescent Platinum,	1.572
Ditto, transmitted by Glass,	1.588
.... Opaque Mica,	1.584
Brass about 700°,	1.568
Ditto, transmitted by Clear Mica,	1.577
Mercury at 450°,	1.572
Mean Luminous Rays,	1.902

The following general conclusions were deduced from the experiments of this section. (1.) That the *mean* quality, or that of the more abundant proportion of the heat from different sources, varies within narrow limits of refrangibility. (2.) That these limits are very narrow indeed where the *direct* heat of any source is employed.

(3.) That all interposed media (including those impermeable to light), so far as tried, *raise* the index of refraction. (4.) That all the refrangibilities are inferior to that of the mean luminous rays. (5.) That the limits of Dispersion are open to farther inquiry, but the dispersion in the case of the sources of low temperature appears to be smaller than in that from luminous sources.

2. Remarks on the Illustrations presented by the Surface of the Moon, respecting certain Geological Phenomena. In a Letter to Sir J. Robison, K. H, &c. from Professor Nichol, University of Glasgow.

Professor Nichol conceives that, as the upheaving cause is a general or cosmical phenomenon, no true or complete theory of it can be deduced from a review of its merely terrestrial actions; and in the notice read to the Society, he called the attention of geologists to a few general but important inferences, from the peculiar form of the elevations in the moon.

The author introduced his observations, by adverting to the following facts, as now ascertained and generally known concerning these elevations.

1. There are ranges of mountains in the moon, but they are comparatively few. Some of them, especially the Apennines, with their attached extensive highlands, bear a close resemblance to many terrestrial ranges.

2. The chief form of elevation is the *circular*. The moon's surface is absolutely studded with crater-forms,—objects recently examined with much care, and represented in an admirable map, by Beer and Mädler of Berlin. Their diameters vary from fifty or sixty miles to the *minimum visibile*, and they greatly increase in number as their magnitude diminishes. They are all marked by this singular feature—*their interior is deeper than the general lunar surface*, as if the elevation had been occasioned by a mass of the moon being blown out from a single point of disturbance. It is to be noticed, likewise, that the *external* effect of this disturbance in no case extends very far. In some instances the crater-ridge rises at once out of the flat body of the moon, without appearing to affect it almost at all; but even where this surface has been raised and disturbed, as in the case of the crater *Copernicus*, the sphere of the action seems exceedingly confined, when compared with the transverse extent through which a disturbance is felt on the earth. There is nothing on the earth to which these formations can be

likened, except "*craters of elevation.*" The Cantal and the Montagnes d'Oisans, however, appear to be the ruin or debris of very similar objects.

3. For the most part, the *disposition* of these craters is irregular and capricious; but, in a number of instances, sufficiently considerable to indicate the operation of *law,* we find rows of small craters, close to each other, arranged almost in a straight line. This arrangement is perhaps a clue to two phenomena. *First,* Were the craters a little closer, a longitudinal portion of the moon's surface would be blown out, and a *furrow* would result, exactly like those curious furrows or ditches, which have often puzzled moon-explorers. *Secondly,* Had the seat of the disturbance been somewhat deeper, or the disturbing force somewhat weaker, a mere rectilinear elevation would have ensued,—*a serrated chain of mountains.*

Generalizing on these phenomena, Professor Nichol suggests that the following conclusions may be safely hazarded.

I. The forms of the moon give decided countenance to the theory of elevation craters, developed by Von Buch and De Beaumont, as at least one *modus operandi* of the upheaving cause. It even appears to be the leading or fundamental one.

II. The doctrine of the central heat derives no support from these phenomena. The irregular distribution of the craters is not favourable to the idea of any central or general action; and the limited sphere of the disturbance connected with them, demonstrates that their source is superficial. They rather appear as the *clearing out* of local deflagrating forces, whose seat is between the two outermost shells of the moon's body.

III. The hypothesis of secular refrigeration is, according to the author, discredited by the survey of lunar phenomena. This hypothesis was formed upon the idea, that elevations are generally linear, and along great circles of the sphere; whereas in the moon, linear elevations are the *exception.*

IV. The moon enables us to eliminate a number of non-essential circumstances, from the ultimate problem of the upheaving cause. For instance, the theory lately promulged by Sir John Herschel relative to the dependence of convulsion and elevation upon abrasion and stratification, according to the author, will not stand good. Considering that the temperature of the earth increases with its depth, in so far as we have yet descended, it is undoubted that abrasion and stratification will cause changes of temperature among the inferior rocks, and therefore expansions, fractures, and extensive though slow movements; and to this extent the theory indicates a *vera causa*, the origin, probably, of certain changes upon the earth; but it is not the ultimate and complete theory of the elevating cause. *The moon contains no abrading or stratifying agents*, nor is it probable that any substance akin to water has yet been developed there.

Professor Nichol means to examine with great care, and sketch upon a large scale, some of the more characteristic individual formations in the moon, with a view to their geological relations. In so far as general selenography is concerned, the labours of Beer and Mädler leave nothing to be desired.

Monday, 7th May.

Dr HOPE, V. P. in the Chair.

The following was elected as an Ordinary Fellow:—

Thomas Mansfield, Esq.

The following Donations were presented.

A Catalogue of Circumpolar Stars, deduced from the Observations of Stephen Groombridge, Esq., F. R. S. Edited by George Biddell Airy, A. M., Astronomer-Royal.—*By the Lords Commissioners of the Admiralty.*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences 1838. 1er Semestre. Nos. 14, 15.—*By the Academy.*

Memorias da Academia R. das Sciencias de Lisboa. Vol. xi. pt. 2, and vol. xii. pt. 1.—*By the Academy.*

Proceedings of the Royal Irish Academy for the year 1836–37. Part 1.

Transactions of the Royal Irish Academy. Vol. xvii., parts 2 and 3.—*By the Academy.*

Journal of the Asiatic Society of Bengal for September and October 1837.—*By the Society.*

Inquisitionum in Officio Rotulorum Cancellariæ Hiberniæ Asservatarum, Repertorium. Vols. i. ii.

Rotulorum Patentium et Clausorum Cancellariæ Hiberniæ Calendarium. Vol. i. part 1. Hen. II.—Hen. VII.

Rotuli Chartarum in Turri Londinensi Asservati. Accurante Thoma Duffus Hardy, S. S. A. è Soc. Int. Templ. Lond. Vol. i. part 1. Ab anno MCXCIX. ad annum MCCXVI.

Registrum vulgariter nuncupatum, "The Record of Caernarvon;" è Codice m.s[to]. Harleiano 696 Descriptum.

General Report to the King in Council from the Honourable Board of Commissioners on the Public Records, appointed by His Majesty King William IV., by a Commission dated the 12th March in the first year of his reign; with an Appendix and Index.—*By the Commissioners on the Public Records of the Kingdom.*

The following communications were read:

1. On the Fourth and Sixth Nerves of the Brain, being the concluding paper *on the distinction observed in the Nerves of the Encephalon and Spinal Marrow.* By Sir C. Bell.

As no fewer than six of the nine nerves which arise from the brain are connected with the organ of vision, he finds it necessary to announce, not only the distinct sensibilities possessed by the organ of vision, but the motions to which it is subjected. Having shewn the connection of the voluntary motions of the eye-ball with the sensation on the retina, and the motions involuntary and for the protection of an organ so delicate and so exposed, he proceeds to shew the necessity of combinations among the muscles of the eye. As there are no direct communications between the muscles, necessarily united in action, he shews the necessity of distinct nerves, and also the necessity of their relations being established at their roots, and hence deduces the reason of the fourth and sixth nerves deviating from the others in their place and mode of origin.

The paper concludes with a recapitulation, accounting for the fact that no one nerve of the head is like another, and why they are all different from the spinal nerves.

First, As to the irregularity of the NERVES OF THE SENSES, they all tend inwards to that column which has received the nerves of sense, and must take a course round the column which extends from the spinal marrow to the brain, and which is given to the voluntary motions. Hence the form of the *tractus opticus*—the peculiar roots of the olfactory nerve, and course of the roots of the auditory nerve.

Second, The second, third, fourth, part of the fifth, the sixth, in addition to the nerves of the eyelids, crowding into the orbit; each for a particular purpose, or with distinct endowment, causes much of the apparent irregularity in the nerves of the base of the brain.

Third, The fifth nerve being like a spinal or double nerve, shooting up into the base of the brain, and in the centre of nerves of a peculiar function, gives additional intricacy.

Fourth, The Nerves of Respiration, standing distinct in origin and function from all the others, and yet necessarily bestowing influence on some of these, complete the apparent irregularity of the nerves of the base of the brain.

In short the double origin and double function of the nerves of the spine, is the reason of their uniformity and simplicity, as they are all alike. The nerves of the brain differ from each other, and from the nerves of the spine, inasmuch as each has its peculiar origin and distinct function; they, therefore, vary in course and distribution, and hence the apparent intricacy.

2. On the Superficial Deposits of Gravel, Clay, Sand, &c., which cover the Rock Formations of the Lothians, and south coast of Fife. By David Milne, Esq.

The author enumerated seven different deposits, overlying the rocks of the district, and subjacent to the existing soil which supports vegetation. These he described in the following order, beginning with the lowest.

(1.) *Sand and fine gravel,* which in some places form beds twelve feet thick.

(2.) *Boulder-clay*—being a stiff black or dark brown clay, characterised by enormous boulders imbedded in it, and which is occasionally forty feet thick.

(3.) *Gravel or stoney clay*—of a light brown colour, full of gravel and angular fragments of rock, not exceeding thirty feet in thickness.

(4.) *Beds of fine clay,* out of which the greater part of the bricks and tiles manufactured in the district are made. At Portobello this clay is 100 feet thick.

(5.) *Banks of sand*—pretty free from gravel, and containing occasionally fragments of shale and coal, sometimes thirty-five feet thick, and existing at a level 200 feet above the sea.

(6.) *Shelly and sandy deposit,* intervening between the shores of the Firth of Forth and an ancient sea-cliff that runs nearly parallel to the shore, but not rising higher than forty feet above high-water mark.

(7.) *Upper covering of gravel and boulders*—nowhere exceeding ten feet in thickness, and rising to a height of 900 feet above the sea.

(8.) *Existing soil.*

The particular characters of each of these deposits were fully described, and the organic remains found in each taken notice of; the places where they are visible were mentioned, as also the highest level above the sea where the author had observed them. These matters of mere fact occupied the first portion of the paper.

In the last part of the paper were stated the inferences of the author regarding the condition of things on the surface of the globe (in this particular district) when the several deposits above enumerated took place.

(1.) The beds of sand and fine gravel indicate the prevalence over the district of a deep sea, by the waters of which the shales and sandstones and limestones of the coal-measures had been worn down to a nearly uniform surface. Reference was made to a paper on the coal-field of the Lothians, read at a previous meeting, where it was stated, that the strata cut across by the Sheriff-hall slip had sunk down ninety fathoms on the north side, in consequence of which there had been a precipice of more than 500 feet on the south side, all which had been worn down and washed away. As the whole coal-field was riddled with similar slips, it was evident that abundance of materials would in this way be provided for the formation of banks of sand and gravel.

(2.) The next period was characterized by violent and extensive movement in the waters which covered the district. The boulder-clay had, with its imbedded boulders, been evidently brought from the west. These boulders were most numerous to the east of Arthur Seat, where they had been protected from the rush of waters. The ruts and scratches on the boulders, and in the subjacent rocks, were, both in Mid-Lothian and in Fife, about W. by S. in direction by compass ; and, moreover, many of the boulders imbedded in the clay belonged to rocks which do not occur nearer than Callendar. A deep excavation or scooping out in the rocks was noticed as occurring between Niddry and Stoneybank, which excavation is filled with large boulders. The waters which transported this enormous mass of debris must have been *at least* 600 feet above the level of the present sea.

(3.) The stoney or gravel-clay, lying immediately over the boulder-clay, indicated less violence and less extent of agitation and movement in the waters.

(4.) The deposits of clay prove that general tranquillity or calmness succeeded the above periods. From the discovery of terrestrial remains, both animal and vegetable, in this deposit, it is obvious that land had not been far distant; and, accordingly, the nature of the shells found in it, partakes somewhat of an estuary character.

(5.) The banks of sand which lie over the clay, shew that the supply of albuminous sediment which, during the former period, was poured into the ancient sea, at or near this district, had altogether ceased. The fact of these sand-banks running nearly east and west, in all parts of the district, coupled with the discovery in them of stones which must have come from the west, prove the general direction of the current to have been from the west. The sea at this period must have been still *at least* 300 feet above the present level of it.

(6.) The next epoch is characterized by a very remarkable change of the relative levels of sea and land. The old bank which runs nearly parallel with the shores of the Firth of Forth, has been formed sometimes out of the fine brick-clay, and sometimes out of the sand last described. The base of this bank on the east shore of Haddingtonshire is about thirty feet above high-water mark; whilst towards the west it gradually increases to forty feet, which is its height in Linlithgowshire. A bed of shells and sand generally intervenes between said old bank and the present shore.

(7.) The next period is characterized by a still more remarkable change in the relative levels of sea and land. The upper covering of gravel and boulders has been spread over and above all the deposits previously described, and it reaches even to the height of 900 feet above the sea. This would indicate a sinking of the land or elevation of the waters, to that extent, and a subsequent reversal of the operation, whereby at length the land again emerged from the waters, and attained the elevation which it now possesses. These boulders are not very much rounded in shape, and do not seem to have been transported from very distant parts. They are frequently angular in shape.

3. Investigation of a New Series for the Rectification of the Circle. By J. Thomson, LL.D. Glasgow.

4. On the Real Nature of Symbolical Algebra. By D. F. Gregory, B. A.

The object of this paper is to determine in what consists the difference between general Symbolical Algebra and the sciences subordinate to it, particularly Arithmetical Algebra. The view which the author takes is, that Symbolical Algebra takes cognizance only of the laws by which the symbols are combined, without considering the nature of the operations represented. The greater part of the paper is occupied in applying this definition, by shewing what are the laws to which are subject the various symbols of operations we are in the habit of using; and one or two examples are given of the advantages derivable from this way of considering the subject—particularly with respect to the connection between the arithmetical and geometrical meanings of + and —. The chief application of the theory may be said to be the elucidation of the causes of analogies between operations by no means similar in their nature.

2. On a New Method in the Conic Sections. By J. Scott Russell, Esq.

In this paper the author institutes an examination of the various methods of conceiving and constructing the conic sections, the different standards of comparison to which they have been referred, and the means by which their properties have been developed and expressed in the ancient and modern schools of mathematics. He finds that the constitution of the curves *in plano* by means of their remarkable properties, and the demonstration of their other properties from the constitution so obtained; have been noticed by Eutocius in the 6th century, and by him referred to Apollonius, although the formal adoption of the plane method is generally referred to a recent date.

The author agrees with modern writers in considering the plane method in the conic sections as more philosophical, as well as more useful, than the solid method; but he differs from them in the methods of constituting these curves, without reference to what he considers their proper origin and standards of reference. Apollonius employed the straight line and circle to constitute his cone; or, in other words, he derived the conic sections from the straight line and the circle, using the cone as the *mechanism of derivation*. Mr Russell has succeeded in deriving the conic sections from the straight line and circle directly, without the intervention of the cone. He thus removes the conic sections altogether from the geometry of solids into the geometry of planes, according to the modern method, without separating them from the family of the circle to which they properly belong.

The definition from which he sets out is this: If between a given circle and its tangent straight line there be traced a curve whose distance from the circle shall bear a constant proportion to its distance from the straight line, that curve is a conic section, and according as the given ratio is one of equality, deficiency, or excess, the cone becomes a parabola, ellipse, or hyperbola.

The author shews with how much facility the other properties of the curve follow from this constitution: he gives examples of some of these, shews a new and remarkable property of the tangents of the conic sections, and proves that they may be readily identified with the sections of the cone from the constructive property alone, without the intervention of any derived property.

[*The Meetings were adjourned till the first Monday in November.*]

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1838–9. No. 14.

Monday, 3d December 1838.

Lord GREENOCK in the Chair.

The following Donations were presented:

The Journal of the Royal Geographical Society of London. Vols. i. to vii., and Vol. viii. Part 1.—*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences 1838. 1er Semestre, Nos. 17 to 26. 2me Semestre, Nos. 1. to 20.—*By the Academy.*

Annalen der Physik und Chemie. Herausgegeben zu Berlin, von, J. C. Poggendorff. 1837, Nos. 10, 11, 12.—*By the Editor.*

Researches on Heat. 3d Series. By James D. Forbes, F.R.SS.L. & E.—*By the Author.*

Nova Acta Physico-Medica Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum. Vol. xviii. Part 1.—*By the Academy.*

Statistique de la Grande-Bretagne et de l'Ireland, par Alex. Moreau de Jonnés. 2 tomes.—*By the Author.*

The American Journal of Science and Arts. Conducted by Benjamin Silliman, M.D., LL.D. For January and April 1838. —*By the Editor.*

Bulletin de la Société Géologique de France. Tome ix. Feuilles 6–19.—*By the Society.*

Journal of the Statistical Society of London, for June, July, August, September, October, and November.—*By the Society.*

Mémoires de la Société de Physique et d'Histoire Naturelle de Geneve. Tome viii. Part 1.—*By the Society.*

The Fifth Report of the Royal Cornwall Polytechnic Society, 1837.—*By the Society.*

A Dissertation on the Nature and Character of the Chinese System of Writing, in a Letter to John Vaughan, Esq. By Peter S. Du Ponceau, LL.D., President of the American Philosophical Society, &c.—*By the American Philosophical Society.*

Journal of the Asiatic Society of Bengal for December 1837 and February 1838.—*By the Society.*

Proceedings of the Geological Society of London. No. 56.—*By the Society.*

Revue Zoologique par la Société Cuverienne, No. 1.—*By the Society.*

Astronomische Nachrichten, Nos. 337 to 348.—*By Professor Schumacher.*

Astronomical Observations made at the Royal Observatory, Edinburgh. By Thomas Henderson, F.R.S.E. and R.A.S., &c.—*By the Royal Soc. of London.*

Maps of the Ordnance Survey of Great Britain, Nos. 49, 50, 66, 67, and 68.—*By the Board of Ordnance.*

The Malacological and Conchological Magazine. Conducted by G. B. Sowerby, F. L. S., &c. &c. &c. Part 1.——*By the Editor.*

Nieuwe Verhandelingen der Eerste Klasse van het Konninklijk-Nederlandsche Instituut van Wetenschappen, Letterkunde en Schoone Kunsten te Amsterdam. Deel 7. Stucks 1, 2, 3.—*By the Institute.*

Elements of Chemistry, including the Applications of the Science to the Arts. By Thomas Graham, F. R. SS. L. & E., &c. Part 2.—*By the Author.*

Fifteenth Report of the Whitby Literary and Philosophical Society, presented at the Annual Meeting, October 31. 1837.—*By the Society.*

Statistical Report on the Sickness, Mortality, and Invaliding among the Troops in the West Indies. By Captain Alex. Tulloch and Henry Marshall, Esq.—*By the Authors.*

Description Nautique des Côtes de l'Algerie, par M. A. Berard, Capitaine de Corvette; suivies de Notes par M. de Tessau

Ingenieur-Hydrographe, 1837. 8vo, avec Carte.—*Par le Directeur General du Dépot des Cartes de la Marine.*

Bulletin de la Société de Géographie. Deuxieme serie. Tome ix. —*By the Society.*

Transactions of the Society for the Encouragement of Arts, &c. Vol. li. Part 2.—*By the Society.*

Mémoire sur la Chaleur Solaire, sur les pouvoirs rayonnants et absorbants de l'air Atmospherique, et sur la Temperature de l'espace. Par M. Pouillet.—*By the Author.*

Flora Batava, Nos. 114, and 115.—*By the King of Holland.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Van Der Hoeven, M.D., en W. H. De Vriese, M.D. Deel iv. Stucks 3, 4.—*By the Editors.*

Minutes of Proceedings of the Institution of Civil Engineers.—*By the Institution.*

An Experimental Essay on the Physiology of the Blood. By Charles Maitland, M.D.—*By the Author.*

Christiani Hugenii aliorumque seculi xvii. Virorum celebrium Exercitationes Mathematicæ et Philosophicæ ex Manuscriptis in Bibliotheca Academiæ Lugduno-Batavæ servatis. Edidit Petrus Joannes Uylenbroeck in eadem Academia Physices et Astronomiæ Prof. Extraord. Fascic. 1, 2.—*By the Academy.*

Transactions of the American Philosophical Society held at Philadelphia for promoting Useful Knowledge. New Series. Vol. vi. Part 1.—*By the Society.*

Transactions of the Royal Irish Academy. Vol. xviii. Part 1.—*By the Academy.*

Proceedings of the Royal Irish Academy for the Year 1837–38. Part 2.—*By the Academy.*

Second Report of the Commissioners appointed to consider and recommend a General System of Railways for Ireland, with Atlas, Plans, and Sections of the several lines.—*By the Irish Railway Commissioners.*

On the present state of our Knowledge in regard to Dimorphous Bodies. By J. F. W. Johnston, M. A.

The Economy of a Coal-Field. By J. F. W. Johnston, M. A.
By the Author.

Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Konigl. Preuss. Akademie der Wissenschaften zu Berlin vom Juli 1837 bis Juni 1838.

Abhandlungen der Koniglichen Akademie der Wissenschaften zu Berlin, 1836. *By the Academy.*

The Seventh Report of the British Association for the Advancement of Science, held at Liverpool in 1837.—*By the Association.*

Eloge Historique d'Antoine Laurent de Jussieu, par M. Flourens. —*By the Author.*

Catalogue of the Chinese Library of the Royal Asiatic Society.

Journal of the Royal Asiatic Society of Great Britain and Ireland. No. ix. for August 1838. *By the Society.*

Mémoires de la Société Geologique de France. Tome iii. Part 1.— *By the Society.*

Eighteenth Report of the Council of the Leeds Philosophical and Literary Society, at the close of the Session 1837–38.—*By the Society.*

The American Almanac and Repository of Useful Knowledge for the Year 1839.

Proceedings of the American Philosophical Society, January to August 1838. *By the Society.*

Recueil d'Observations Magnétiques faites à St Petersbourg et sur d'autres points de l'Empire de Russie. Par A. T. Kupffer.— *By the Author.*

Bulletin de la Société Impériale des Naturalistes de Moscow. 1837, Nos. 5, 6, 7, 8; and 1838, Nos. 1, 2, 3.—*By the Society.*

Recherches sur le Mouvement et l'Anatomie du Stylidium Graminifolium. Par Ch. Morren, Professeur de Botanique à l'Universitie de Liege.—*By the Author.*

Ten other Botanical Tracts.—*By the same Author.*

On a New Correction in the Construction of the Double Achromatic Object Glass. By Richard Potter, Esq.—*By the Author.*

Sketch of the Geology of Exeter and the Neighbourhood. By T. Shapter, M. D.—*By the Author.*

Documents and Records illustrating the History of Scotland, and the Transactions between the Crowns of Scotland and England, preserved in the Treasury of Her Majesty's Exchequer. Collected and Edited by Sir Francis Palgrave, K. H. Vol. i. —*By the Commissioners on the Public Records.*

Annalium Societatis Eruditæ Hungaricæ Volumen Tertium.—*By the Society.*

Memoirs of the Royal Academy of Stockholm for 1836.

Annual Reports on the Progress of the Sciences, presented to the Royal Academy of Stockholm in 1836.—*By the Academy.*

Maps of the Ordnance Survey of Ireland.—*By the Lord Lieutenant.*

The Quarterly Journal of Agriculture; and the Prize-Essays and Transactions of the Highland and Agricultural Society of Scotland. For June, September, and December 1838.—*By the Society.*

The following Communication was read:

Discussion of one Year's Observations of Thermometers sunk to different Depths in different localities in the neighbourhood of Edinburgh. By Professor Forbes.

These observations were made, at Professor Forbes's suggestion, at the expense of the British Association. They are still continued, and the present notice contains only a first approximation to the solution of the problems which they are intended to give.

The chief aim of the experiments is to ascertain the progress of Solar Heat in the Crust of the Globe, and has no *immediate* reference to the question of central heat; the depth to which the experiments extend being inadequate to afford decisive results on that head.

The experiments differ in their object from any hitherto made, from having an especial regard to the structure of the soil and the conducting power for heat of different geological formations. With this view three series of thermometers were constructed by Mr Adie, under Mr Forbes's directions, each nearly of the same length and range, and these were sunk in holes prepared for them to precisely similar depths, (1.) in the Trap Tufa of the Calton Hill, within the Observatory grounds; (2.) in the homogeneous bed of Sand at the Experimental Garden; and (3.) in the compact Coal Formation Sandstone of Craigleith Quarry, all in the immediate neighbourhood of Edinburgh, and within a radius of about a mile. With a view to render these observations more immediately comparable with those made at Paris and Brussels, the extreme depth was the same, or the lowest thermometer had its bulb at the distance of 24 French feet (= 25.6 English) below the surface, and the others were placed at each station at depths of 12, 6, and 3 French feet.*

* At the Observatory a thermo-electric pair of iron and copper wires

The tube which connected the bulb with the reading part above ground was made capillary, so as to contain as little liquid (alcohol) as possible. Notwithstanding, all the observations have been rigorously corrected for the inequality of temperature of their stems, and likewise for the expansion of the liquid above ground. The observations were commenced in February 1837, and have been made once every week since. After being corrected they were projected in the form of Curves: and the general consistency of these with one another, and the peculiarities proper to each station, are such as to give considerable confidence even in the first approximation, which extends from February 1837 to February 1838.

I. The general form of the curves at all the stations corresponding to different depths agre perfectly with what has hitherto been observed under similar circumstances. As we descend, the curve becomes more even, and flatter, the range rapidly diminishing, and the epochs of minimum, mean, and maximum temperature occur later.

II. The mean temperature of the soil appears to increase as we descend (this has been observed at Brussels and elsewhere). At the Experimental Garden the mean annual temperature is, at 3 feet (French), 45°.54 Fahr.; at 6 feet, 46°.70; at 12 feet, 46°.90; at 24 feet, 47°.28. The Craigleith observations are ambiguous in this respect.

III. The annual ranges at the three stations and at the different depths, are the following:

	3 Feet.			6 Feet.		
	Observatory.	Garden.	Craigleith.	Observatory.	Garden.	Craigleith.
Fahrenheit,	18°.95	19°.65	17°.25	11°.9	14°.95	13°.9
Centigrade,	10 .53	11 .23	9 .58	6 .61	8 .30	7 .72

	12 Feet.			24 Feet.		
	Observatory.	Garden.	Craigleith.	Observatory.	Garden.	Craigleith.
Fahrenheit,	5°.5	7°.55	9°.4	1°.45	2°.1	4°.1
Centigrade,	3 .05	4 .19	5 .22	0 .80	1 .16	2 .28

Now it is known by theory that the range ought to diminish in geometrical progression as the depths increase arithmetically; and accordingly these results may be very closely represented by logarithmic curves, having different Moduli at each station, depending

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was sunk along with the deepest thermometer, with a view to test the applicability of M. Peltier's apparatus to this object. Several observations closely agreeing with the thermometer have thus been made.

on the nature of the soil. If Δ_p denote the range in Centigrade degrees at a depth p, and A and B two constants, we have

$$\text{Log.}\ \Delta_p = A + Bp$$

And B depends upon $\sqrt{\frac{\text{specific heat}}{\text{conductivity}}}$ of the soil. Now this constant B is found to have the following negative values: *

Observatory — 0.0547; Garden — 0.0440; Craigleith — 0.0317.

Consequently the conducting power of the strata is in the order just written, the first being the lowest, the last the greatest (supposing the difference of specific heat immaterial). By extending the Logarithmic curve, the depth at which the range has any amount may be found.† Thus the range will be reduced to $\frac{1}{100}$ of a Centigrade degree, or may be reckoned insensible, at the following depths:—

Observatory, 58 feet; Experimental Garden, 72 feet; Craigleith, 97 feet.

Now it is remarkable that the above variations in the value of B exceed those contained in M. Quetelet's table, which includes all the observations made in different parts of Europe; shewing that the increase of the value of B with the Latitude, which was thought to have been observed (Quetelet, *Mémoire sur les Variations Diurne et Annuelle de la Temperature Terrestre*, p. 61), was quite accidental; and that the value of B must depend solely on the constitution of the soil in which the experiments are conducted.

IV. The epochs of the winter minimum of 1837 are ill determined for the upper thermometers, owing to the great irregularity of the winter curve, and also because the observations were commenced too late to obtain them correctly. The epochs of maximum temperature give, however, a complete confirmation of theory, and of the preceding deductions. We find that, with a single exception (the shortest thermometer at Craigleith), and that exception is doubtful, all the thermometers at Craigleith attained their maximum first, then those at the Experimental Garden, and lastly, at the Observatory, as the following table shews:—

* In order to render the results directly comparable with those in M. Quetelet's excellent paper in the Brussel's Transactions, the French foot and Centigrade degree are employed as unities.

† The values of A are 1.164, 1.176, 1.076 in the same order as before.

	Maximum at			
	3 Feet.	*6 Feet.*	*12 Feet.*	*24 Feet.*
Observatory,	August 6.	September 2.	October 17.	January 8.
Exper. Gar.	July 31.	August 24.	October 7.	December 30.
Craigleith,	August 5.	August 19.	September 11.	November 11.

We also find, as theory assigns, the retardation of the maximum increases arithmetically with the depth. So that, if we project these observations and cause an interpolating straight line to pass through the points for each station, we find that the progress of heat downwards is,

At the Observatory,	1 foot in 7.5 days.
.... Experimental Garden,	...... 7.1 ...
.... Craigleith Quarry,	...... 4.9 ...

giving the same order of conducting power as before.

The bearing of these experiments on geological theories, and especially on the movement of the Isothermal lines in the interior of the globe, is evident.

Monday, 17th December 1838.

Dr ABERCROMBIE in the Chair.

The following Donations were presented:

Mémoires Couronnés par l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tomes xii. and xiii.

Bulletin des Séances de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. 1837, Nos. 10, 11, 12. 1838, Nos. 1, 2, 3, 4, 5, 6, 7, 8.

Annuaire de l'Académie Royale des Sciences et Belles Lettres de Bruxelles pour l'an 1838. *By the Academy.*

Annuaire de l'Observatoire de Bruxelles pour l'an 1838, par le Directeur A. Quetelet.—*By the Author.*

De l'Influence des Saisons sur la Mortalité aux differens Ages dans la Belgique, par A. Quetelet.—*By the Author.*

Résumé des Observations Météorologiques faites en 1837 à l'Observatoire de Bruxelles, et communiquées par A. Quetelet.—*By the Author.*

Recherches sur les Propriétés des Courants Magnéto-Electriques, par M. le Prof. Aug. de la Rive.—*By the Author.*

Examen Critique d'un Mémoire de M. P. Leroux, intitulé du Bonheur, par L. A. Gruyer.—*By the Author.*

Discurso lido em 15 de Maio de 1838 na Sessas publica da Academia Real das Sciencias de Lisboa, par Joaquim José Da Costa de Macedo.—*By the Academy.*

Astronomische Nachrichten, Nos. 349 to 354.—*By Professor Schumacher.*

Mémoires de l'Académie Impériale des Sciences de St Petersbourg. (Sciences Mathématiques, &c.) Tome i. livrs. 5, 6; et tome ii. livrs. 1, 2.

Do. do. (Sciences Naturelles). Tome ii. livrs. 4, 5, 6.

Do. do. (Mémoires présentés par divers Savans). Tome iii. livrs. 3, 4, 5, 6; et tome iv. livrs. 1, 2.

Recueil des Actes de la Séance Publique de l'Académie Impériale des Sciences de St Petersbourg tenue le 29 Décembre 1837. —*By the Academy.*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, 1838. (2me Semestre). Nos. 21, 22.—*By the Academy.*

Natuur-en-Scheikundig Archief, uitgegeven door G. J. Mulder en W. Wenckebach. Jaargang 1837. 3d Stuk.—*By the Editors.*

The following Communications were read:

1. On the Law which connects the Elastic Force of Vapour with its Temperature. By John Scott Russell, Esq.

The object of the paper was to examine into the present state of our knowledge of this subject, for the purpose of ascertaining its defects, and indicating the manner in which they were to be remedied.

Although it appears to any one who examines only a single authority on the constitution of vapour, that its laws are sufficiently definite, yet on comparing together all the authorities we possess on this subject, or even the best of them, we find such discrepancies both in the general expressions of the law, and in the experiments themselves upon which they rest, as are highly discreditable to mechanical science, and far exceed the limits of error usually admitted in similar departments of experimental science. Between 32° and 212°, the difference between Dr Dalton's experiments and Dr Ure's amounts to more than three-tenths of an inch of mercury. Between the experiments of the Institute of France and of the Franklin Institute,—the latest and most extensive series of experiments,—there is a difference at the eleventh atmosphere of more than 6° in temperature, and about 20 inches of mercury in the pressure of the vapour.

The author entered into a comparison of the empirical formulæ which have been successively employed to express in mathematical terms the simultaneous progressions of temperature and elastic force. These are of two classes: the first comprehends the formulæ of Prony, Laplace, Biot, and Ivory, in which the elasticity is the sum of the terms of an infinite series, of which five terms at least now require to be taken; and it was shewn that, even with an operation so tedious and laborious, the results of calculation differ from those of experiment still more widely even than those from each other. The formulæ are as follows:—

(1.) $F_t = \mu \, \varrho^t + \mu_{,} \varrho^t_{,} + \mu_{,,} \varrho^t_{,,}$ &c. . . . . Prony.

(2.) $F_t = \text{Log}\ 760 + \alpha t + \beta t^2 + \gamma t^3 +$ &c. . . Laplace.

(3.) $F_t = 0^{?}.76 . 10^{\,A t + B t^2 + C t^3 + \&c.}$ . . Biot.

(4.) $F_{\frac{t}{30}} = 0.0087466\, t - 0.000015178\, t^2 + 00000002483\, t^3 +$ Ivory.

The other class of formulæ are those of Dr Young and his followers. He was the first to give a manageable expression of a simple form, in which the expression for the elastic force of the vapour is merely a multiple of the temperature, increased by a constant quantity, and placed under the index 7. This simpler expression, although absolutely empirical, having been selected by Dr Young, as he candidly avows, from above a dozen others, merely because it happened to approximate to the best experiments he at that time possessed, yet has been almost invariably followed ever since. But while the form of the expression has been preserved, it has been found necessary to alter the value of its terms at each step of experimental research, in such a manner that this branch of knowledge now appears to have become degraded to the very lowest degree of empiricism. Dr Young's expression having been found too high for the subsequent experiments of Southern, the index was reduced from 7. to 5.13. Dr Ure's experiments next made their appearance, and forthwith the index 7 being found too great, and 5.13 too small, the number 6. was adopted as best representing *them*. The subject being next examined by M. Coriolis, who, reviewing the works of all his predecessors, found none of them sufficiently consistent, he satisfied himself with taking an average of the whole, and obtaining as an index the mean number

5.355. But Mr Tredgold, arguing that a fractional number was not likely to represent a law of nature ! restored the index 6. His decision has been overturned by the Commission of the Academy of Sciences, who have adopted the number 6, as best representing their higher experiments; and last of all, this decision is reversed by the Committee of the Franklin Institute of Philadelphia, who alter other terms of the formula, but reinstate the index 6.

These formulæ are:—

(5.) $F_t = (0.0029\,t + 1)^7$ . . Dr Thomas Young.

(6.) $F_t = \dfrac{(t + 51.3)^{5.13}}{37344,000,000} + 0.1$. Mr Southern.

(7.) $F_t = \left(\dfrac{t}{168.57}\right)^6$ . . . Mr Crighton.

(8.) $F_t = \left(\dfrac{0.01878\,t + 1}{2.878}\right)^{5.355}$. Mr Coriolis.

(9.) $F_t = \left(\dfrac{t + 100}{177}\right)^6$ . . Mr Tredgold.

(10.) $F_t = (0.7153\,t + 1)^5$ . . French Academy.

(11.) $F_t = (0.00333\,t + 1)^6$ . . Franklin Institute.

The author next proceeded to examine the theoretical views of Dr Dalton. From long calculations, and laborious discussions of the experiments and formulæ, he has been led to the conclusion that, with certain modifications, these views represent the actual state of our knowledge of this subject better than any of these empirical formulæ. Dr Dalton finds, that, if the scale of temperature which he considers as the true scale be reckoned from a zero at 175° lower than the present scale of Fahrenheit, the progressions of the temperatures being as the square root of the expansions of the mercury, then the progression of the elasticities will be in geometrical ratio to those equal or true intervals of temperature. By modifying this hypothesis, so as to reduce it to the following, that the intervals of the common scale are in a geometrical ratio to the intervals of true temperature, reckoned from a point 175° below the present zero, Mr Russell finds that he obtains formulæ that perfectly represent the best series of experiments,—so closely indeed, that the greatest difference between theory and experiment does not exceed $\frac{8}{100}$ of an inch of mercury from 0° to 212°, and as far as 25 atmospheres does not average half a degree. He also adduces ground for supposing that the theory of temperature on which this rests is the only tenable one. The first equation is of this form:

$$\frac{t+i}{c} = r^{\frac{\text{Log. F}}{\text{Log. } m}}$$

whence the experiments of Dr Dalton are accurately represented by the expression

$$(12.) \quad \ldots\ldots\ldots\ldots\ldots \quad \frac{t+175}{387} = 1.1320^{\frac{\text{Log. F.}}{\text{Log. } 2.602}}$$

But it is remarkable that, if one series of experiments below 212° be taken, and any other above 212°, the expression which accurately represents the one will widely deviate from the other. So that, though a formula of the same nature represent the experiments of the French Academy and of the Franklin Institute very accurately, it requires different constats. If we average Dr Dalton's and Dr Ure's below 212°, and those of the Academy and Institute above that point, e find they coincide more nearly with the following formula than with each other:

$$\frac{t+121^\circ}{333^\circ} = 1.11401^{\frac{\text{Log. F}}{\text{Log. } 2}}$$

From the whole investigation, the author arrives at the following conclusions:—(1.) That the discrepancies between the most recent and extensive experiments we possess are so great, as to leave this branch of experimental science in a disgraceful state of uncertainty, and that it is desirable that those who are engaged in experiments on heat, would revise this useful and interesting branch of inquiry; and it is suggested that, for this purpose, *the same apparatus and methods* of experiment which are employed in the experiments *below* atmospheric pressure, should also be those which are employed at high temperatures *above* atmospheric pressure. (2.) That the most accurate experiments we are in possession of at pressures below 212° are Dr Dalton's recent ones, which accurately coincide with the hypothesis that the intervals of the common scale are to those of true temperature, in a geometrical register, reckoned from the zero point of the mercurial thermometer 175° below the zero of Fahrenheit, and of which the common ratio is 1.1320, the corresponding elastic forces forming the logarithmic progression to the true temperatures, whose index is 2.602. That the mean of the experiments of Dr Dalton, Dr Ure, the French Academy, and the Franklin Institute, give 1.11401 as the ratio of progression of the temperatures, 2. being the index of the progression of elastic force, and —121° the zero of same temperature. (3.) That Dr Dalton's theory of temperature does, with very slight modifications, represent accurately our knowledge of the law which connects the temperature with the elastic force of vapour. (4.) Expressions may be derived from this theory of the same form as the empirical formulæ at present in use; and these are :

For Dr Dalton's experiments below 212°, the temperature being reckoned from —175°, or $t =$ temp. F. + 175°.

(14.) .... $\text{Log } t = 0.12965 \log F + 2.587711$

(15.) .... $\text{Log } F_t = 7.71307 (\log t - 2.587711)$

For the mean of the experiments of the French Academy and the Franklin Institute above 212°, the temperature being reckoned from —121° or $t =$ temp. F. + 121°.

(16.) .... $\text{Log } t = 0.1557634 \log F + 2.5224442$

(17.) .... $\text{Log } F_t = 6.42 (\log t - 2.5224442)$

For the following substances, we obtain, by means of a single modulus or constant number, derived from Dr Dalton's experiments for each substance, which is substituted for 2.602, the modulus for vapour of water in equation (12). This modulus is 2.57 for acetic acid, 2.700 for alcohol, 1.978 for sulphuret of carbon, and 2.00 for ether; and the formulæ are as follows:—

Alcohol .... $\begin{cases} \text{Log } t = 0.12483 \log F + 2.5428254 \\ \text{Log } F_t = 8.01090 (\log t - 2.5428254) \end{cases}$

Ether .... $\begin{cases} \text{Log } t = 0.178873 \log F + 2.4345689 \\ \text{Log } F = 5.59063 (\log t - 2.4345689) \end{cases}$

Acetic Acid............ $\begin{cases} \text{Log } t = 0.13116 \log F + 2.5965971 \\ \text{Log } F = 7.52427 (\log t - 2.5965971) \end{cases}$

Sulphuret of Carbon $\begin{cases} \text{Log } t = 0.18277 \log F + 2.4548449 \\ \text{Log } F = 5.4714 (\log t - 2.4548449) \end{cases}$

2. Abstract of a Paper on Results of Observations made with Whewell's New Anemometer. By Mr John Ranken. Communicated by Professor Forbes.

In laying the results of these observations before the Society, it was thought necessary to make a few remarks in explanation of the manner in which they were made.

The instrument consists of a fixed japanned cylinder, on which the points of the compass are marked, and a moveable portion, which revolves freely round the cylinder as the wind changes; the circular disk of a fly kept opposite to the wind by a weathercock vane, is made to revolve with a velocity proportional to that of the wind. The motion thus produced is diminished by means of endless screws, working in a pair of toothed-wheels, and carried down to a pencil, which, in its descent, rubs on the surface of the cylinder, and traces a broad line, whose length is proportional to the velocity of the wind, and the time during which it blows from any one direction taken jointly. The compartment of the cylinder on which the marks are made indicates the direction of the wind.

It was stated that the indications of this anemometer differed from those of former ones, in so far as the *integral effect* of the wind for any length of time, or the sum of all the elements of the current, was recorded, and that the force of the wind was taken into account along with the direction; thus affording more satisfactory data for meteorological speculations. This instrument was erected on the roof of the University about the middle of November 1837, and the register, as kept from that time till the 1st of April 1838, was presented in a tabular form.

The method of reducing these results was then explained. Groups of neighbouring winds were taken, and all the intercardinal were reduced to the cardinal points, by using certain multipliers, found by considering each intermediate point as the hypothenuse of a right-angled triangle; the east were subtracted from the west winds, and the north from the south, and the two resulting effective winds compounded, gave the mean magnitude and direction for the whole time during which the observations were made. These results were given in Tables, and also in the graphical form.

The observations with similar instruments at other stations have not been published, and therefore no comparison of results could be entered into.

Monday, 7th January 1839.

Dr ABERCROMBIE in the Chair.

The following Donations were presented:

Eulogy on Nathaniel Bowdich, LL.D., President of the American Academy of Arts and Sciences. By John Pickering.

A Eulogy on the Life and Character of Nathaniel Bowdich, LL. D., F. R. S. By Daniel Appleton White.

A Discourse on the Life and Character of the Hon. Nathaniel Bowdich, LL. D., F. R. S. By Alexander Young.

By the American Academy.

Journal of the Statistical Society of London for December 1838.—*By the Society.*

Memoirs of the Wernerian Natural History Society for the Years 1831–37. Vol. vii.—*By the Society.*

The Journal of the Royal Geographical Society of London. Vol. viii. Parts 2, 3.—*By the Society.*

A Sketch of the Geology of Fife and the Lothians, including detailed Descriptions of Arthur's Seat and Pentland Hills. By Charles Maclaren, Esq., F. R. S. E.—*By the Author.*

The American Journal of Science and the Arts.

Conducted by Benjamin Silliman jun., A. B.—*By the Editor.*

Memorie della Reale Accademia della Scienze di Torino. Tome xl. —*By the Academy.*

Transactions of the Institution of Civil Engineers. Vol. ii.—*By the Institution.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences (1838, 2me Semestre). Nos. 23, 24, 25.—*By the Academy.*

Journal of the Asiatic Society of Bengal. April, May, June, 1838.—*By the Society.*

The following Communications were read:

1. Notice respecting an Intermitting Brine Spring discharging Carbonic Acid Gas, near Kissingen in Bavaria. By Professor Forbes.

The watering-place of Kissingen is situated in north latitude 49° 50′ east longitude, 9° 50′ from Greenwich, 60 English miles east of Frankfort. Long before it was frequented for medical purposes, its salt springs were turned to profitable account. Of these there are several, but the one recently enlarged by boring, known under the name of the *Runde Brunnen*, is much more remarkable than the others, on account of its Copiousness, its Temperature, its discharge of Carbonic Acid Gas in vast quantity, and its extraordinary phenomenon of Intermission.

The spring rises through the new red sandstone, of which the valleys in the neighbourhood of Kissingen are composed, on the left bank of the river Saal, whose course is marked for many miles by the occurrence of mineral springs, and by the discharge of carbonic acid gas. The author supposes its direction to be connected with a line of fissure, and the gas to have its origin in the neighbouring extinct volcanic focus of the Rhöngebirge.

The present spring was bored for in 1822, and the 4-inch shaft was carried to a depth of 323 Bavarian feet from the surface; but at the top it expands into a well eight feet in diameter. At a depth of 156 feet, the water ebbed for the first time, and it has done so since with more or less regularity; but what is particularly strange is, that this regularity appears to depend in a not very conceivable way upon the action of the pumps which are employed to raise the brine from the shaft for the purpose of evaporation. Whilst the pumping machinery works, the ebb and flow of the spring are very regular; when it stops, the regularity nearly ceases. When the spring is in full flow, its appearance is very striking. The great shaft of eight feet in diameter is filled with water, agitated in the most violent manner by the torrents of gas which it discharges. Whilst its turbulence is at a maximum, the gas abruptly ceases to flow, and in a few seconds the surface of the water in the shaft is perfectly tranquil. The water descends, and continues to do so, at first rapidly, then more slowly, until it has subsided nine or ten feet, which occurs in about fifteen minutes. This point has been but just reached, or for a very short time, when a sudden swelling up of the water first, and then of the gas, is observed in the bottom; the shaft fills very slowly,—the flow of water and of gas continue for a long time progressively to increase, not apparently attaining their maximum until the water is at its full height, which requires from thirty to forty minutes after the first return of the stream. It remains in a state of violent agitation for two hours, or somewhat more, when the preceding cycle of phenomena is repeated. This description applies to the ordinary state of the spring, when five or six pumps are in action; if these are fewer the periods are longer; if more, the reverse. This Mr Forbes clearly made out, from registers of observations frequently verified by himself. Of the natural state of the spring, when no pumps work, he had not the same means of satisfying himself. There can be no doubt, however, that, in that case, the periods are longer and more uncertain, those of flow amounting to three, four, or five hours, and of ebb to one, two, or three. Several of the neighbouring springs appear to partake of the intermittent character, especially as regards the carbonic acid gas which they discharge.

The temperature of the spring, many times observed during its various phases, was 65° Fahr. very nearly, and it seemed perfectly stationary. Now, it appears from direct observations, that the mean temperature of the air at Kissingen is about 51°, or 14° lower. The author made many observations upon the temperature of springs in the neighbourhood, both pure and mineral, which he finds to indicate a mean temperature rather lower than the above. Thus the great brine spring, in addition to its other remarkable characteristics, is distinctly *thermal*. Nor can this be ascribed to the depth of the bore through which it issues, for the spring which rose in the same spot before that bore was made had the same temperature half a century ago, and it did not increase during the operation of boring. A neighbouring spring, also intermittent and saline, called the Schönborn Quelle, rising through a bore 550 feet deep, has a temperature of only 52°.

Lastly, the author gives some account of the products of the spring. Thirty and a half cubic inches of almost pure carbonic acid gas are combined with one pound of water; but this gives no conception of the vast streams of that substance disengaged by the spring during its period of activity, and of which it is difficult to obtain the roughest measurement. It is collected and applied medicinally to different parts of the body, in baths suitably arranged. The water of the spring is discharged at the rate of from thirty-five to forty Bavarian cubic feet per minute during its full action. Its specific gravity is about 1.0157. The solid matter it contains amounts to 22.37 grains in 1000 of water, and consists, according to the analysis of Kastner, of 14 grains chloride of sodium, 3.2 muriate of magnesia, 0.5 muriate of lime, 3.3 sulphate of soda, 1.0 carbonates of magnesia and lime, together with several other substances in small quantity. It closely resembles the composition of sea-water. The brine is concentrated from 2½ to 17 per cent. by spontaneous evaporation in dropping through stacks of black thorn; and in this process at least 180 millions of pounds of water are annually carried off in the invisible form by the atmosphere. The quantity of pure salt obtained from this spring alone amounts to about 28,000 hundredweight (Bavarian Centner) yearly.

2. Notice on the Geology of Gottland, from the Observations of Mr Laing. By Dr Traill.

The fine Map of Sweden by Hissenger shews that the greatest part of that kingdom, to beyond the 61° N. Lat., may be characterized as a vast gneiss formation, skirted on the SW. and NE. by extensive detrital or alluvial formations.

The gneiss is interspersed with considerable tracts of granite, especially in the province of Ostergottland, and here and there exhibits small portions of hornblende-rock, porphyry, quartz-rock, mica-slate, and primary sandstone; but these rocks scarcely form any considerable tracts, and the scarcity of mica-slate is rather remarkable in a gneiss country.

The alluvial deposits consist of vast beds of clay, sand, and gravel, interspersed with greywacke-slate and transition limestone, with some mountain or encrinal limestone, lias beds, and oolite, and sparingly dotted with trap-rocks. The only considerable assemblages of these latter rocks are in two patches between the vast lakes the *Wenern* and the *Wettern*.

The constitution of the two most considerable Swedish islands, Oland and Gottland, are still more simple. They chiefly consist of encrinal limestone.

Gottland has a length of about seventy-six English miles, and its greatest breadth is thirty-four miles. Its general surface is flat, and in no point does it rise more than 200 feet above the sea. About one-tenth of its surface exhibits an oolitic limestone, bordered by a narrow stripe of sandstone on each side; which evidently belongs to the oolitic formation, from the nature of the organic remains found in them.

Petrifactions found in Gottland.

A. In the Mountain Limestone.

Crustacea
- Calymene, 4 species.
- Asaphus caudatus.
- Cytherina Balthica.

Cephalopoda
- Orthoceratites, 5 species.
- Ammonites Dalmanni.
- Nautilites complanatus.

Gasteropoda
- Turbinites, 2 or 3 species.
- Delphinula, 6 species.

Gasteropoda
- Euomphalus, 4 species.
- Turritella cingulata.

Acephala
- Modiola Gothlandica.
- Tellina Gothlandica.

Brachiopoda
- Septæna, 4 species.
- Orthis, 5 species.
- Eyrtia, 2 species.

Brachiopoda
Delthyris, 7 species.
Atrypa, 7 species.
Terebratula, 8 species.
Crinodea
Aprocrinites, 2 species.
Actiocrinites, 3 species.
Cyathocrinites, 3 species.
Other Encrinites, 5 or 6 species.
Sphæronites
S. Ornatus.
Corallina
Catenepora, 2 species.
Aulopora, 2 species.
Syringopora, 4 species.
Calomopora, 5 species.
Flustra lanceolata.

Corallina
Sarcinula organum.
Astrea, 3 species.
Meandrina.
Fungites patellaris.
Cyclolites numismalis.
Turbinolia, 4 species.
Cyathophyllum, 6 species.
Lithodendron oculinum.
Caryophylla, 2 species.
Milleflora solida.
Nulliflora.
Retepora Clathrata.
Alcyonia
Scyphia Empleura.
Siphonia præmorsa.
Phacites Gothlandicus.

B. In the Oolite and Sandstone.

Calymene Blumenbachi.
Cytherina.
Belemnites.
Turritellites.
Plagiostoma giganteum.
Avicula, 2 species.
Arca.
Pectunculus.
Lephæna Englypha.
Orthis, 2 species.
Delthyris sulcata.
Atrypa reticularis.
Terebratula plicatella.
Aulopora serpens.
Calamopora Gothlandica.
Flustra lanceolata.
Phacites Gothlandicus.

Specimens of *mountain-meal* was brought by Mr Laing from the parish of Degersfors, on the northern branch of the river Umea in Umea-Lapmark. It was discovered in July 1832 by a farmer in cutting down a tree. It forms a bed under moss, and has been used by the natives, mixed with rye-flour, to form bread, and boiled to make gruel. Government prohibited it on the idea of its being unwholesome.

Dr Traill found that it does not effervesce with acids; that it loses by calcination 24 per cent., and becomes more white after first blackening. The odour seems partly animal. The microscope shews it to consist chiefly of bodies that have the form of elongated and flattened elliptic bodies, probably the remains of infusoria. Dr Traill is analyzing it, and considers it, from his preliminary experiments, to consist chiefly of silica.

In the same district, in bad years, the farmers make a bread of half rye-flour and half bark. The inner bark of the pine is washed, dried, and pounded, for this purpose. Specimens of this bread were exhibited.

3. Notice regarding some points in Hydrodynamics that have been misunderstood. By Mr Scott Russell.

This notice is occasioned by a passage in the fifth volume of the Transactions of the British Association, page 251, in which Professor Challis claims for himself the merit of having been the first who deduced from mechanical principles the anomalous emergence of a floating body from a fluid at high velocities, and where he adduces Mr Russell's experiments in support of the method of reasoning he has there adopted. Previous to the publication of his paper, Mr Russell had given the theoretical explanation of the phenomenon, and had also adduced experiments in support of that explanation at the meeting of the British Association in Edinburgh. The object of this notice is not, however, to argue the claim to priority of discovery, which the author of this notice considers of little importance, provided the truths accordant with the phenomenon have been rightly determined; but his present aim is to remove certain misconceptions into which Professor Challis has fallen in regard to the nature of the phenomenon he has explained,—misconceptions of a grave nature, not merely as regards theory, but which are likely to produce a most injurious effect upon the practical application of these principles; for it appears that practical men have also been led astray by the authority of Professor Challis's name, and the imposing apparatus of calculus, which they were not able either to understand or expose: and, accordingly, we find the author of the last paper in the first volume of the Transactions of the Institute of Civil Engineers misled by Professor Challis, and a Mr Woolhouse, who has edited a second edition of Tredgold on the Steam-Engine, adopting similar views.

Now, as Professor Challis had adduced Mr Russell's researches in support of his views, he is thus brought in for a share of responsibility for the defect of those views, and has therefore felt it incumbent on him to place the question in its true light.

The following is the passage in Mr Challis's report:

" The circumstance of floating bodies rising vertically when drawn with considerable velocities along the surface of the water, having attracted attention a few years ago, induced me to try to explain the fact on mechanical principles; and, accordingly, in a paper published in the Cambridge Philosophical Transactions, I have entered on a mathematical investigation, which accounts for such a fact, and shews that, when the velocity of draught is uniform, the rise is proportional to the square of the velocity, in accordance with an experimental result obtained by Mr Russell. This inquiry is not pursued farther in that paper (though I believe it may be done according to the method here employed), the immediate object in view being to gain confidence for the particular process of reasoning adopted, by explaining to a considerable extent a fact which had not before been shewn to depend on received mechanical principles."

On examining Professor Challis's reasoning in the paper referred to, and divesting it of its technical form, it appears to be this;—that if you suppose the bow of a vessel to be of a spherical form, or what nautical men term " a spoon bow," and conceive it drawn through the water rapidly, the force of impact of the bow and the water may be resolved into two parts, one of which tends to throw the bow upwards, and being a given part of the whole resistance, tends to throw it up with a force proportional to the square of the velocity.

In other words, Mr Challis has expressed in mathematical terms what was at that time the prevalent and vulgar error on this subject. It was early supposed by those who witnessed the phenomena referred to, that the bow of the boat rose in the manner Professor Challis conceives, and, as the immediate inference from this, it was considered that the boat whose bow was most nearly of the spoon form would be that which, according to these views, would rise most and have least resistance; but, on the contrary, on building boats of this form which should have the greatest emergence and least resistance, according to the view adopted by Professor Challis, it turned out that they were the very opposite, and that, on altering them to the form of the most acute wedge in which, by Mr Challis's method, they could have no emergence, and no diminution of resistance, they became the very reverse of what had been supposed. Thus it occurred that a very simple experiment put them right, and overturned the views of Professor Challis.

The effect which Mr Challis conceives he has accounted for is one of a totally different nature, and indeed the opposite of what he has imagined. It is well known to every one at all acquainted with the motion of boats, or the theory of their construction, that a full or spherical bow is violently raised up when propelled at high velocities; but it happens unfortunately that the stern is violently depressed, while the resistance is greatly increased. Now Professor Challis's view would require the vessel to be wholly raised above the statical immersion, and the resistance diminished,—the reverse of the fact. It is further proved by experiment, that when the emergence which Professor Challis has examined takes place to the greatest extent, the resistance is at its maximum, whereas, according to him, it should be a minimum.

Whatever use, therefore, practical men may be induced to make of the reasoning of Mr Challis, it may be expected to lead them to results the reverse of what they intended.

The kind of emergence of a floating body from the surface of a fluid, which Professor Challis states that he was the first to explain on mechanical principles, is therefore of a different nature from that which he intended to explain, and is due only to the peculiarity of the form of the body. It is not the kind of emergence to which any of the phenomena he wished to explain are due.

The essential principle on which Mr Russell has explained the tendency to emergence of all bodies at high velocities, independent of their figure, is this: The gravity of a body is the cause and measure of its displacement. This gravitation, during a given interval of time, is a given constant quantity. The quantity of fluid displaced by a floating body in motion, in virtue of the gravitating force, is variable, increasing with the velocity. The gravitating force of the body during a second is a given quantity, acting downwards. The pressure of all the fluid displaced in a second is another force opposed to the former, and acting upwards on the bottom of the vessel. From these two forces an equation is formed, which gives the amount of emergence depending only on velocity, and an expression results, into which the former does not enter: this result was afterwards confirmed by experiment.

It is only necessary, in conclusion, to state, that these discussions have nothing to do with the phenomena of the wave, to which alone the chief anomalies of resistance are due.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1838–9. No. 15.

Monday, 21st January 1839.

Lord GREENOCK, V. P., in the Chair.

The following Donations were presented :—

The Natural History of the Fishes of the Firth of Forth and Tributaries. By Richard Parnell, M. D., F. R. S. E.—*By the Author.*

The Laws of Harmonious Colouring, adapted to Interior Decorations, Manufactures, and other useful purposes. By R. D. Hay, House Painter.—*By the Author.*

The Silurian System, founded on Geological Researches in the Counties of Salop, Hereford, Radnor, Montgomery, Caermarthen, Brecon, Pembroke, Monmouth, Gloucester, Worcester, and Stafford; with Descriptions of the Coal-Fields and Overlying Formations; with a large separate Map. By Frederick Impey Murchison, F. R. S., F. L. S.—*By the Author.*

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences (1838, 2nd Semestre). Nos. 26, 27.—*By the Academy.*

Flora Batava, No. 116.—*By the King of Holland.*

The following communications were read :—

1. On the Colour of Steam under certain circumstances. By Professor Forbes.

The author accidentally remarked, that the colour of the Sun seen through vapour issuing from the safety-valve of a locomotive engine is deep red, exactly similar to that which a column of smoke or a smoked glass gives to it.

He next noticed that this colorific character of steam extended but a short way beyond the orifice, and that it gradually became more opake, and perfectly white like noon-day clouds, both for transmitted and reflected light. At moderate thicknesses, in this state, its opacity is complete.

These observations were fully confirmed by direct experiments on high-pressure steam, made at Glasgow in December last. At the moment of issuing from the steam-cock, it is perfectly transparent and colourless; at some distance from the orifice it becomes transparent and orange-red; but, still farther off, it is white, and merely translucent. These properties were traced in steam from a pressure above that of the atmosphere of 55 lb., down to an excess of only three or four; and as in all cases the redness of the transmitted light was more or less distinctly seen, (and an excess of 10 or 15 lb. does as well as any higher pressure), it was concluded that the effect of partial condensation in producing the phenomenon, would be rendered visible in great thicknesses of vapour of the lowest tension.

The great analogy of the colour of steam to that which the clouds assume at sunset, or distant lights in certain conditions of the atmosphere, lead the author to suggest this singular property of condensing vapour as the probable cause of those phenomena, of which no satisfactory explanation could be given whilst this fact remained unknown. The prognostics of weather derived from the colours of the sky also receive elucidation from the fact.

Judging from the similarity of colour of steam and that of nitrous acid gas, and the remarkable power of absorbing certain definite rays of the spectrum discovered in that gas by Sir David Brewster, the author thought it probable that similar lines might be discovered in the spectrum formed by light transmitted through steam, and that these might be found to coincide with the *atmospheric lines* of the spectrum noticed by the same philosopher. The experiment was made with great care, but the expected result has not been hitherto obtained. The general action of steam on the spectrum is to absorb the violet, blue, and yellow rays, finally leaving only the red and orange, with an imperfect green.

Since a portion of watery vapour in a confined space, originally transparent and colourless, may become, by mere change of temperature, first deep orange-red and transparent, and finally white and semiopake, the author notices another analogy with the singular effect of temperature in deepening the colour of nitrous acid gas, and thinks that these facts may one day throw some farther light on the difficult subject of the mechanical constitution of vapours, and particularly of clouds.

2. On the meaning of the Homeric terms θεμισ, δικη, τιμη, ποινη, with their more important compounds and derivatives. By the Venerable Archdeacon Williams.

Monday, 4th February.

Dr ABERCROMBIE, V. P., in the Chair.

The following Donations were presented :—

Tijdschrift voor Natuurlijke Gescheidenis en Physiologie. Uitgegeven door J. Van Der Hoeven, M. D., en W. H. De Vriese, M. D.—*By the Editors.*

First and Second Annual Reports, Laws, and Transactions of the Royal Botanical Society of Edinburgh.—*By the Society.*

Address of His Royal Highness the Duke of Sussex, K. G., &c. &c. President of the Royal Society, read at the Anniversary Meeting on Friday the 30th November 1838.—*By the Society.*

Proceedings of the Geological Society of London, 1838. No. 59. —*By the Society.*

Journal of the Statistical Society of London for January 1839.— *By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, 1839. 1er Semestre. Nos. 1, 2.—*By the Academy.*

Natuur-en-Scheikundig Archief, uitgegeven door G. J. Mulder en W. Wenkebach. 1837. St. 4.—*By the Editors.*

The following communication was read :—

The Colours of the Atmosphere considered with reference to a paper " On the Colour of Steam under certain circumstances," read at the last meeting of the Royal Society. By Professor Forbes.

The object of this paper was to develope an application of the fact communicated by the author on the 21st January. It was then remarked, that the discovery that steam in a certain stage of condensation is deeply red-coloured for transmitted light, seemed to offer a probable solution of a difficulty which has never yet been fairly met, namely, the red colour of clouds at sunset, and the redness of light transmitted through certain kinds of fogs.

A pretty full history of theories proposed to account for the colours of the atmosphere was first given; it was obtained in almost every case from an examination of the original authorities. These theories were reduced under three general heads, exclusively of that of Göthe, and of most writers before Newton, that the blue colour of the sky results from a mixture of light and shade; and that of Muncke, that that colour is merely *subjective*, or arises from an ocular deception. The remaining theories are:

(1.) That the colour of the sky is that transmitted by pure air, and that all the tints it displays are modifications of the reflected and transmitted colours. This is more or less completely the opinion of Mariotte, Bouguer, Euler, Leslie, and Brandes.

(2.) That the colours of the sky are explicable by floating vapours acting as thin plates do, in reflecting and transmitting complementary colours. This is the theory of Newton and most of his immediate followers, and more lately of Nobili.

(3.) On the principle of opalescence and of specific absorption, depending on the nature and unknown constitution of floating particles. This head is intended to embrace the various opinions of Melvill, Delaval, Count Maistre, and Sir D. Brewster.

To the last named philosopher, however, the merit is due of having conspicuously turned attention to the important, complex, and hitherto unexplained phenomena of absorption, which he has proved to be totally inconsistent with Newton's theory of the colours of Nature, (considered as those of thin plates); and he has farther demonstrated the inapplicability of it in the case of the colours of the atmosphere, by shewing that their constitution is wholly distinct from that which any modification of Newton's theory would assign, by a series of experiments of which as yet the results only are announced.

Since, then, the constitution of the atmospheric colours analyzed by the prism resembles that produced by absorption, the question is, To what medium are we to refer that absorptive action? Evidently not to pure air, since a distant light is red in a fog, and in clear weather white, or nearly so. The author is disposed to attribute the effect to the presence of vapour in the very act of condensation. This intermediate or colorific stage occurs between the colourless and transparent form of steam wholly uncondensed, and that which may be termed the state of *proximate* condensation in which it is seen to issue from the spout of a tea-kettle, when it is likewise colourless, but semiopake. During the transition, it was shewn in the former paper that steam becomes intensely red, and remains transparent. The absorptive action resembles then, so far, that of the atmosphere observed under certain meteorological conditions; the dark lines and bands noticed by Sir David Brewster in the atmospheric spectra have not been discovered, and so far the analogy is as yet imperfect.*

In applying this theory to the colours of sunset in particular, the author quotes many acknowledged facts to prove that the redness of the sky is developed precisely in proportion to the probable existence of vapour in that critical stage of condensation which should render it colorific. And he applies the same reasoning to account for the prognostics of weather, drawn from the redness of the evening and morning sky.

Monday, 18th February.

Dr ABERCROMBIE, V. P., in the Chair.

The following Donations were presented :—

Journal of the Asiatic Society of Bengal, No. 49. for January 1836. —*By the Society.*

Researches in Embryology. First Series. By Martin Barry, M. D. F. R. S. E.—*By the Author.*

Elements of Chemistry. By the late Edward Turner, M. D. 6th edition. Revised by Justus Liebig, M. D., and W. G. Turner, Ph. D. Part 3.—*By the Editors.*

* Some plausible reasons are assigned why these bands should not have appeared in the experiment as it was made, when steam in every stage of condensation must necessarily have been present; nor does it seem easy to devise a form of experiment free from this objection. A very important observation would be to examine the spectrum produced by a distant artificial light seen through a red fog.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, 1839. 1er Semestre. Nos. 3, 4.—*By the Academy.*

The following communications were read:—

1. Notice of some observations made during the Storm of January 1839. By John Scott Russell, Esq.

The author stated, that the paper consisted principally of communications made by members of this society, which had been placed in his hands. Many points in the statistics of the storm had been noticed with great accuracy; and it is important, in the present promising condition of our knowledge of the statistics and philosophy of this branch of meteorology, that such communications should be arranged and preserved, for the purpose of furnishing materials for its improvement. The author went on to explain the views of the nature of storms which had been successively propounded by Franklin, Espy, Redfield, and Reid. He then read various communications of observations, from Sir John Robison, Professor Christison, Mr Nichol, Mr Stevenson, Professor Wallace, Mr Hunter of Thurston, Mr Scott, Sir David Brewster, Mr Russell, Mr Bald, and other gentlemen, who had, with himself, taken an interest in the subject. The paper concluded with deductions of a general nature from the facts observed.

2. On Fresnel's Law for the Intensity of Reflected and Refracted Light. By Professor Kelland.

The object of this memoir was to remove from the molecular theory, difficulties in which the recent investigations of Mr Green appear to involve it. The question at issue is the ratio of the densities of the ether within and without a refracting medium. The usual mechanical hypotheses would appear to lead to the conclusion that the former density is the greater; whilst from the molecular hypothesis the latter appears to be the truth.

In the memoir of Mr Green appears a very strong argument for the hypothesis as originally stated by M. Fresnel, together with a statement which adds force to the objection, otherwise strong, against the molecular theory, viz. that vibrations are not necessarily transversal. It will be found in this memoir, that all the conclusions, and all the statements, of Mr Green, excepting only those which translate into language his resulting equations, are perfectly compatible with the molecular hypothesis, and may be deduced from it as easily and with as little assumption as from the other. It is true the author has not endeavoured to give a closer approximation than that which M. Fresnel himself has exhibited to the vibrations which are polarized *in* the plane of incidence; but, as far as the approximation is carried, it gives precisely M. Fresnel's results. The want of experiments by which to test even the formulæ we do possess, is a sufficient reason for delaying farther investigations, which shall approach more nearly to the truth in all cases. In the mean time, it is of the utmost importance that M. Fresnel's empirical formula should be established, and his mechanical ones examined, by different processes.

Monday, 4th March.

Dr HOPE, V. P., in the Chair.

The following Donations were presented :—

Philosophical Transactions of the Royal Society of London for the year 1838. Part 1.

Proceedings of the Royal Society of London, 1837–38. Nos. 31, 32, 33, 34, and 35.

Astronomical Observations made at the Royal Observatory, Greenwich, in the year 1837, under the direction of George Biddell Airy, Esq. M. A., Astronomer-Royal.

By the Royal Society.

Transactions of the Cambridge Philosophical Society. Volume vi. Part 3.—*By the Society.*

Astronomische Nachrichten, Nos. 355 to 364.—*By Professor Schumacher.*

Annual Report of the Institution of Civil Engineers. Session 1839.—*By the Institution.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. 1839. 1er Semestre. Nos. 5, 6.—*By the Academy.*

Journal of the Statistical Society of London, No. 10, for February. —*By the Society.*

The Quarterly Journal of Agriculture; and the Prize-Essays and Transactions of the Highland and Agricultural Society of Scotland, No. 44, for March 1839.—*By the Society.*

A Geometrical Practical Treatise, named Pantometra, Longimetra, Planimetra, and Stereometra; by Thomas Digges, Esq. —*By P. D. Handyside, M. D.*

The following communications were read :—

1. On a new Galvanic Battery, and an improved Voltameter. By Martyn Roberts, Esq. Communicated by Sir John Robison.

Electrical observers have experienced three important defects in the common galvanic trough battery, as constructed by Cruickshanks, namely, that the zinc is deposited on the copper plates, that the zinc plates become gradually covered with a coating of oxide of zinc, and that the hydrogen formed by the decomposition of water adheres in globules to the surface of the copper; the result of all which circumstances is, that the galvanic action quickly decreases in force. These inconveniences have been in part removed in the battery of Professor Daniell, in which the zinc plates are covered by an animal membrane, and sulphate of copper is substituted for acids to form an exciting solution. By the former precaution, the deposition of zinc on the copper plates is prevented; and by the latter, hydrogen is no longer evolved so as to adhere to the copper plate. These contrivances, however, do not prevent the zinc plates from becoming gradually covered with oxide of zinc, as in the battery of Cruickshank; and, besides, the improvements made by Professor Daniell are attended with their own inconveniences in turn. Copper is gradually deposited on the zinc plates; the animal membrane obstructs in some measure the free transmission of the electric current, and it is also apt to putrefy in no long time; the cleaning of the plates is troublesome; and the expense of employing a battery of considerable size must also be taken into consideration.

The author proposes to obviate all the inconveniences hitherto noticed, by resuming the original construction of Cruickshanks, rendering the plates circular and moveable on a common axle, which is turned slowly by a handle at one end of the trough, and attaching a rubber of cloth along the margin of the trough, by which the plates are constantly kept clear equally of metal, oxide, and hydrogen gas. By this contrivance, the power of a battery may be maintained without diminution for any length of time which is desired. He has found that an equal quantity of water may be decomposed in one fourth part of the time by his method, compared with what is required when the plates are left at rest, so that the battery is converted into the battery of Cruickshanks. Among other causes which have appeared to him to contribute to the sustained action of his battery, he has remarked, that considerable advantage seems to arise from the occasional exposure of the plates to the air.

The voltameter of the author consists of a tube bent like the letter U, which at one end has a glass reservoir attached to it, of the same capacity with the tube, and at the other graduated end has a stopcock to allow the gas to escape upon occasion, which accumulates at that end from the platinum wires evolving the gases at the bottom.

2. Notice upon the Alcoholic Strength of Wines. By Dr Christison.

Various accounts have been given of the alcoholic strength of wines by Mr Brande, Julia-Fontenelle, and others. The author has been engaged for some time in experiments for determining the proportion of alcohol contained in various wines of commerce, and also the circumstances which occasion a variety in this respect. The present paper is an interim notice of the results.

The method of analysis consisted in the mode by distillation, which was applied with such contrivances for accuracy that nearly the whole spirit and water were distilled over without a trace of empyreuma, and without the loss of more than between 2 and 6 grains in 2000. From the quantity and density of the spirit, the *weight* of absolute alcohol of the density 793.9, as well as the *volume* of proof spirit of the density 920, was calculated from the tables of Richter founded on those of Gilpin.

The author has been led to the general conclusion that the alcoholic strength of many wines has been overrated by some experimentalists, and gives the following table as the result of the investigations he has hitherto conducted. The first column gives the per-centage of absolute alcohol by weight in the wine, the second the per-centage of proof spirit by volume.

	Alc. p. c. by weight.	P. Sp. p. c. by volume.
Port—Weakest,	14 97	30.56
Mean of 7 wines,	16.20	33.91
Strongest,	17.10	37.27
White Port,	14.97	31.31
Sherry—Weakest,	13.98	30.84
Mean of 13 wines, excluding those very long kept in cask,	15.37	33.59

	Alc. p. c. by weight.	P. Sp. p. c. by volume.
Sherry—Strongest,	16.17	35.12
Mean of 9 wines very long kept in cask in the East Indies,	14.72	32.30
Madre da Xeres,	16.90	37.06
Madeira, all long in cask in East Indies — Strongest	14.09	30.80
Madeira, all long in cask in East Indies — Weakest	16.90	36.81
Teneriffe, long in cask at Calcutta,	13.84	30.21
Cercial,	15.45	33.65
Dry Lisbon,	16.14	34.71
Shiraz,	12.95	28.30
Amontillado,	12.63	27.60
Claret, a first growth of 1811,	7.72	16.95
Chateau-Latour, first growth 1825,	7.78	17.06
Rosan, second growth 1825,	7.61	16.74
Ordinary Claret, a superior "vin ordinaire,"	8.99	18.96
Rives Altes,	9.31	22.35
Malmsey,	12.86	28.37
Rudesheimer, superior quality,	8.40	18.44
Rudesheimer, inferior quality,	6.90	15.19
Hambacher, superior quality,	7.35	16.15
Giles' Edinburgh Ale, before bottling,	5.70	12.60
The same Ale, two years in bottle,	6.06	13.40
Superior London Porter, four months bottled,	5.36	11.91

In addition to certain obvious general conclusions which may be drawn from this table, the author stated, as the result of his experiments, that the alcoholic strength of various samples of the same kind bears no relation whatever to their commercial value, and is often very different from what would be indicated by the taste even of an experienced wine-taster.

Some observations were next made on the effect produced on the alcoholic strength of wines by certain modes of keeping or ripening them, more especially by the method employed in the case of sherry, madeira, and such other wines, which consists of slow evaporation for a series of years through the cask, above all, in hot climates. The researches made by the author on this head are not yet complete ; but he is inclined to infer, from the experiments already made, that, for a moderate term of years, the proportion of alcohol increases in the wine, but afterwards, on the contrary, diminishes; and that the period when the wine begins to lose in alcoholic strength is probably that at which it ceases to improve in flavour. The increase which takes place at first in the alcohol of wine undergoing evaporation through the cask, appeared at first view parallel to the fact generally admitted on the authority of Söemering, that spirit becomes stronger when confined in bladder, or in a vessel covered with bladder, in consequence of the water passing out by elective exosmose.

The author, however, on repeating the experiments of Söemering, as related by various writers (for he could not obtain access to the original account of them), was unable, by any variation of the process he could devise, to obtain the results indicated by the German anatomist. Constantly the spirit, whatsoever its strength, whether proof spirit or rectified spirit, became weaker. It was observed at the same time, that, if the bladder containing spirit was enclosed in a confined space with quicklime, the spirit slowly became absolute alcohol of the density 796, in consequence of a permanent atmosphere of alcohol being speedily formed, while the watery atmosphere was absorbed by the quicklime as fast as it was produced. Subsequently it was proved that the bladder was not essential to the process : for an open cup of rectified spirit, inclosed in a confined space with quicklime, to absorb the water which arose from the spirit, became in two months absolute alcohol of the density 796. Professor Graham of London some time ago proved the analogous fact, that spirit might be thus rendered pure alcohol in the air-pump vacuum. A vacuum, however, is, upon principle, as well as in fact, not necessary for the process ; it merely accelerates it. The new method is obviously applicable on the great scale for obtaining absolute alcohol, wherever time may be allowed.

Monday, 18th March.

Dr ABERCROMBIE, V. P., in the Chair.

The following Donations were presented :—

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. Aus dem Jahre, 1833.—*By the Academy.*

Uber die Länderverwaltung unter dem Chalifate. Von Joseph von Hammer.—*By the Royal Academy at Berlin.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, 1839. 1er Semestre. Nos. 7, 8.—*By the Academy.*

The American Journal of Arts and Science. Conducted by Benjamin Silliman, M. D., LL.D. Vol. xxxv. No. 2, for January 1839.—*By the Editor.*

Journal of the Asiatic Society of Bengal for July 1838.—*By the Society.*

Natuur-en-Scheikundig Archief, uitgegeven door G. J. Mulder en W. Wenckebach. 1838. St. 1, 2.—*By the Editors.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Van Der Hoeven, M.D., en W. H. De Vriese, M.D. Deel v. St. 3.—*By the Editors.*

Recherches sur l'Histoire Naturelle et l'Anatomie des Limules. Par J. Van Der Hoeven.—*By the Author.*

Tables of Logarithms; published by Taylor and Walton, booksellers, London.—*By the Publishers.*

Journal of the Statistical Society of London for March 1839.—*By the Society.*

The following communications were read:—

1. Notice respecting the Drying-up of the Rivers Teviot, Clyde, and Nith, and their tributaries, on the 27th November 1838. By David Milne, Esq.

The phenomenon was in the first instance described, and certain views were afterwards offered explanatory of it.

It appears that, betwixt 10 P.M. on the 26th November, and 6 A.M. on the 27th November, the channels of the Teviot, Clyde, and Nith, became nearly dry for a great part of their course, so that scarcely any current flowed in them. All the mills on the Clyde, as far down as several miles below New Lanark, were stopped from want of water. The Nith was nearly dry as far down as Enterkinefoot; and the mills on it, and on its tributaries, were stopped. This was the case also on the Teviot. The phenomenon was most strikingly manifested in the higher parts of the rivers, near their sources. The small streams from which they derive their supplies, were in general completely dried up. The rivers, in the lower parts of their course, were not entirely deprived of their current; nor were the rivulets, which there supplied them, nearly so much affected as the rivulets in more elevated districts.

The desiccation continued all the morning, forenoon, and part of the afternoon of the 27th November. When the current was restored, it returned not with a sudden rush, but gradually; nor when the current was restored, did the waters rise much above their ordinary level.

With reference to the cause of the phenomenon, it was stated, that various explanations had been suggested. Some persons had attributed it to the *high wind* obstructing the flowing of the current; others, to the *frost* in forming barriers of ice on the caulds or dam-heads; others, again, had suggested that the phenomenon might be connected with an earthquake. In support of this last theory, it was mentioned, that Professor Phillips had, in a recent work on geology, attributed to this cause the drying-up of the English rivers Trent and Medway in the 12th century.

Mr Milne stated that he adopted none of these views, and that he thought the phenomenon might be accounted for by the united action of the frost and wind which prevailed during the night of the 26th November. After four o'clock that afternoon, the thermometer all over the south of Scotland sunk to 26°, at which point it remained for several hours. Accompanying this frost, there was a gale of wind from the east, which had the effect of very rapidly reducing the temperature of exposed and unsheltered spots. In this way, the small and shallow streams flowing in open drains and rivulets, or oozing through mosses and marshes in the hills, were soon frozen and arrested. But, on the other hand, larger bodies of water flowing rapidly in the main channels, at a lower level, and sheltered by high or wooded banks, could not in the same space of time lose enough of their temperature to be frozen. The waters thus ran off, without the usual renewal of supplies from the sources, so that the channel or bed of the river became speedily drained.

The reason of this phenomenon not happening more frequently appears to be, that there is very seldom a gale of wind in this country accompanied by a severe frost; and even on this occasion, the frost was not equally intense over the whole island. When a severe frost sets in, there is usually but little wind, so that the water in the *upper* parts of the river, is not liable to be cooled more rapidly than in the lower and more sheltered parts of its course. Though the sources will, in that case, to a certain degree, be frozen, and so, part of the usual supply cut off, the main body of the stream is frozen likewise, whereby the velocity of its current is diminished, by the obstruction of the ice at the bottom and at the surface of the current. So that if only half the usual supply is furnished to the river from its partially frozen sources, there will be no diminution in the quantity of water flowing in the main bed of the river, if it flows off with half its usual rapidity. This is the ordinary way in which frost acts on the rivers in this country. But when, as on the night of the 26th November, the frost is accompanied with a strong and keen wind, which lasts for only a few hours, it freezes the water in the small rivulets near the sources of the rivers in high and exposed situations, whilst it has not time to freeze even the surface of the deeper and more rapid currents flowing in the lower parts of the rivers.

The easterly gale which, by its low temperature, produced this phenomenon, continued to blow until about 7 or 8 A.M. on the morning of the 27th November. The temperature of the atmosphere then underwent a sudden change, as indicated both by the barometer and the thermometer. This change was brought about by the advent of two storms, which came from southern latitudes, and one or perhaps both of which had, on the morning of the 27th, begun to affect the upper regions of the atmosphere, and load them with warm vapour.

2. Memorandum on the Intensity of Reflected Light and Heat. By Professor Forbes.

"At the meeting of the Society on the 4th February, I remarked, on the occasion of Professor Kelland's paper on the Intensity of Reflected Light, that it was almost without a parallel in science, that a quantitative physical law like that of the intensity of the reflection of light at different angles, should have first been divined by the rare sagacity of Fresnel, and confirmed by the very different but elaborate mathematical investigations which Mr Green of Cambridge and Professor Kelland have applied to the subject, whilst scarcely any attempt has been made towards its verification by direct experiment.

"Some critical cases for polarized light were indeed assumed as the basis of the original formula; and M. Arago has confirmed it by one or two intermediate photometrical experiments: but the chief evidence for the truth of this remarkable law rests on the indirect observation of the change of the plane of polarization of an incident ray after reflection.

"It occurred to me, about the end of 1837, that the anomalies of photometrical observations being nearly as unsatisfactory as ever, some light might be thrown upon this important subject by ascertaining the law in the case of heat, the intensity of which we have no difficulty in measuring. And since the discovery in the case of heat, of refraction, single and double, of polarization, of total reflection, and the change it produces on polarized light, as well as the change of the plane of polarization by simple reflection, there seems the greatest reason to suppose that the laws of reflection for heat and light, if not identical for both, would be connected by some simple analogy.

"Accordingly, during the month of December 1837, I made some preliminary observations, which encouraged me to proceed. It appears to me, from those observations, that the quantity of heat reflected from different transparent bodies is independent, or nearly so, of the nature of the source of heat, and the diathermancy of the reflecting body, and that at 55° of incidence the intensity of reflected heat is nearly that which Fresnel's theory gives. The substances, however, were not all prepared so as wholly to exclude the action of second surfaces.

"I have this winter resumed the subject. I have had an apparatus constructed for securing sufficient accuracy in determining the angle of incidence, and I have used reflecting surfaces, both transparent and metallic; the former are wedges of plate-glass, by means of which reflection from the first surface only may be observed, and the latter are plane specula of steel and silver. The prosecution, however, of these apparently simple experiments has been attended with unforeseen difficulties; and although the relative proportions of heat at different angles of incidence are now pretty well determined for glass in several cases, I am not prepared to say whether the absolute amount is exactly the same as Fresnel's formula would give, assigning to heat its proper refractive index. It is satisfactory, however, to know, that the approximation to it is much greater than direct photometrical measures have yet given, with the single exception of two experiments of M. Arago already referred to; and that I have reason to believe that the experimental law which Mr Potter has given from direct observation in the case of light, represents my results much less accurately than the theory of Fresnel.

"With respect to reflection at the metals, I believe I may assert that I have verified the remark of Mr Potter, that metallic reflection is *less* intense at the higher angles of incidence. I have attempted to ascertain whether it reaches a minimum, and then increases up to 90° of incidence, as Mr Maccullagh supposes, but I have not obtained decisive results. The quantity of heat reflected by the metals is so much greater than Mr Potter's estimate for light, as to lead me to suspect that his photometric ratios are all too small, which would nearly account for their deviation from Fresnel's law.

"The most complete verification of Fresnel's law would be found in observations made on heat polarized in opposite planes. These I have attempted, and, so far as they go, they seem to confirm the analogies of heat and light. But the intensity is so much reduced in the process of polarizing, that I fear we must wait for yet more delicate instruments to measure it. In the mean time I may state the method which I propose to employ.

"When heat is polarized by transmission through inclined mica-plates, the polarization is *incomplete;* but if the plates be inclined at the polarizing angle, the transmitted heat is undoubtedly composed of a portion p polarized (in a plane which we will call $+$), and a portion $1-p$ unpolarized. This latter part philosophers are content to consider as compounded of a part $\frac{1-p}{2}$ polarized $+$, and an equal part polarized $-$. Now, let the intensity of reflected heat polarized in the plane of reflection (or $-$), and that perpendicular to it (or $+$), be represented by the following Table, which contains the quantities to be *found.*

TABLE I.

Incidence.	Reflected Rays Polarized.	
	$+$	$-$
0°	a_0	b_0
10	a_1	b_1
20	a_2	b_2
&c.	&c.	&c.

Also let the quantities of heat actually *observed* to be reflected after *incomplete* polarization by passing through a mica bundle, be the following:

TABLE II.

Incidence.	Polarizing Plane of Mica Bundle.	
	$+$	$-$
0°	A_0	B_0
10	A_1	B_1
20	A_2	B_2
&c.	&c.	&c.

Now, the quantities A and B will be thus composed: The quantity of heat transmitted by the mica bundle and incident on the reflecting surface contains, when the plane of polarization is perpendicular to the plane of reflection, a portion of heat $p + \frac{1-p}{2}$ polarized +, and a portion of heat $\frac{1-p}{2}$ polarized —; let these quantities be m and n; then $m + n = 1$. Now, let the plane of polarization be turned round 90°; then the part polarized in the plane of reflection will now be m, and that perpendicular n. So that the heat is first composed of a part m reflected according to the law of a in Table I., and a part n reflected according to the law of b; and then the converse; so that

$$A_q = m\,a_q + n\,b_q$$
$$B_q = n\,a_q + m\,b_q$$

Hence $A_q + B_q = a_q + b_q$, as it evidently ought, and

$$A_q - B_q = (m - n)\,(a_q - b_q)$$

Hence *the differences of the columns in Table II. are in a constant ratio to the differences of the columns in Table I.;* and as Table I. may be computed from Fresnel's formulæ

$$\frac{\tan^2(i-i')}{\tan^2(i+i')}, \quad \text{and} \quad \frac{\sin^2(i-i')}{\sin^2(i+i')},$$

the agreement or discrepancy will be apparent, and the coefficient $(m - n)$ will indicate the polarizing power of the plates. Also, since the sum of the numbers must be the same for both tables, a single comparison would suffice to determine the index of refraction, which must be assumed in computing the first table."

Monday, 1st April.

Dr HOPE, V. P., in the Chair.

The following Donations were presented:—

Memoirs of the Royal Astronomical Society. Vols. 9 and 10.—*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, 1839. 1er Semestre. No. 9.—*By the Academy.*

Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce. Vol. lii. Part 1.—*By the Society.*

Annuaire de l'Académie Royale des Sciences et Belles Lettres de Bruxelles, pour 1839.

Bulletin de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. 1838. Nos. 9, 10, 11, 12.

Nouveaux Mémoires de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xi.

Mémoires Couronnés par l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xiv. Premiere partie.

By the Academy.

Annuaire de l'Observatoire de Bruxelles pour l'an 1839, par le Directeur A. Quetelet.—*By the Author.*

Résumé des Observations Météorologiques faites en 1838 à l'Observatoire de Bruxelles, par A. Quetelet, Directeur de cet Etablissement.—*By the Author.*

Journal of the Asiatic Society of Bengal for August 1838.—*By the Society.*

Astronomical Observations made at the Royal Observatory, Edinburgh. By Thomas Henderson, F. R. S. E. and R. A. S. Vol. ii. for the year 1836.—*By the Royal Society of London.*

Journal of the Royal Geographical Society. Vol. ix. Part 1.—*By the Society.*

Geometrical Theorems and Analytical Formulæ, with their application to the Solution of certain Geodetical Problems. By William Wallace, LL.D., &c.—*By the Author.*

The following communications were read :—

1 On the Theory of the Motion of Waves. By Professor Kelland.

The author proposes, in a series of memoirs on this subject, to investigate the different problems of Hydrodynamics, in a manner which shall carry theory along with experiment. From the great attention that has been of late years bestowed on the question of the motion of the tide-wave, any mathematical investigation which does not assume some process of approximation, is extremely interesting. Whilst the more recondite problems of motion derived from impulses, &c. have been carefully examined by the greatest philosophers of the present day, the more simple and easy ones have been left almost untouched. This may be accounted for by the elegance of the process in the former case compared with that to be pursued in the latter; but still it is remarkable that the most useful speculations, in a theoretical point of view, should excite so little attention. The author proposes to supply the deficiency here felt, by examining in detail simple problems of wave motion, in every possible form of canal or channel, and intends to apply the results to the motion of the tide-wave, and similar problems. The results which he has already laid before the Society, are merely the introductory steps, comprising the discussion of the general form of uniform and perfect wave-motion, and an approximative solution of the problem of solitary translation. In other memoirs, he hopes to apply similar processes to incipient motion, retarded motion, and the combination of extraneous forces with internal cohesion.

2. On a New Method of shewing the Unequal Expansion of Crystals. By Professor Forbes.

This method is founded on the expedient devised by Mitscherlich, of obtaining two images of a minute distant object from a section of a hemitrope crystal of selenite, which is flat when cold, but is composed of two inclined surfaces when heated. By throwing the sun's image, reflected from such a surface, on a distant wall, the gradual formation of the double image during heating may be seen by any number of persons.

3. On the Diminution of Temperature with Height in the Atmosphere at different Seasons of the Year. By the same.

The results communicated to the Society were obtained from nearly five years of simultaneous observations, made twice a-day at Colinton and at the Bonally reservoir five miles south-west from Edinburgh. The height of the former station above the level of the sea is 364 feet, of the latter 1100 feet exactly; the difference 736 feet. The mean annual difference of temperature amounted to 3°.22, giving 229 feet of ascent for a diminution of temperature of 1° Fahr. The influence of the seasons is briefly shewn by the following numbers:

Months.	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov	Dec.
Mean Diff. of Temp.	2.10	2.31	3.61	4.60	4.69	3.79	3.22	3.74	3.12	3.13	1.90	2.49
Feet for 1°.	351	319	204	159	157	194	229	197	236	235	387	296

That the decrement of temperature is most rapid in summer, and least so in winter, has been long known. Its highest value appears to occur in April or May, and its lowest about November. These results are confirmed by the comparative observations made at Geneva and the Great St Bernard, where the difference of elevation is no less than 6800 feet. The reason of this the author conceives to be the following. When we compare the curves of annual temperature at the lower and higher stations, we find the following differences. (1.) The curve at the higher station is in every point *lower* than that at the other station. (2.) It is *flatter*; the annual range being less. This causes the difference of maxima to exceed the difference of minima. (3.) The curve at the higher station is *shifted*, so that its maximum and minimum occur later. This causes the difference between the two curves to attain a maximum during their rise, and a minimum during their decline, which corresponds to the fact, and is easily explained on known meteorological principles.

Monday, 15*th April*.

Lord GREENOCK in the Chair.

The following Donations were presented :—

Bulletin de la Société de Géographie. Deuxieme serie. Tome x. —*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, 1839. 1er Semestre. Nos. 10, 11, 12.—*By the Academy.*

Report on the Geology of Cornwall, Devon, and West Somerset. By Henry T. De La Beche, F. R. S., &c.—*Presented by the Lords of the Treasury.*

Flora Batava, No. 117—*By the King of Holland.*

Journal of the Statistical Society of London, No. 12, for April.—*By the Society.*

Herniarum Corporis Humani Tabulæ Anatomico-Pathologicæ ac Chirurgicæ quas edidere Professores Imperatoriæ Medico-Chirurgicæ Academiæ Petropolitanæ Christianus Salomon Petrus Savenko.

Eliæ Buialsky Tabulæ Anatomico-Chirurgicæ, Operationes Ligandarum Arteriarum Majorum exponentes.

By the Imperial Medico-Chirurgical Academy of St Petersburgh.

The following communications were read :—

1. Notice respecting the relative Voltaic agency of Circuits of Copper and Zinc, and Zinc and Iron. By Martyn Roberts, Esq. Communicated by the Secretary.

While conducting some galvanic experiments, the author accidentally used an iron-wire as a positive electrode, and was surprised to find it was not oxidated, but, on the contrary, retained its original brightness, and gave out oxygen-gas from water placed under its action, in the same quantity as a platinum electrode would have done in the same situation.

Struck by this fact, he followed it up by a course of experiments, and arrived at the conclusion that iron is in a singularly anomalous electric condition, being positive when compared with copper, and yet far more highly negative than copper when compared in their electric relation with zinc; and that although copper and iron form a galvanic combination in which the iron is positive to the copper, yet, when iron is associated with zinc as a galvanic pair, it produces a more powerful current of electricity than a galvanic pair of equal-size, consisting of copper and zinc.

A brief notice of illustrative experiments was given.

The first experiments were made on the 1st January of the present year. A galvanic pair, iron and zinc, immersed in dilute sulphuric acid, was connected with two cups of a differential galvanometer; another pair, copper and zinc, immersed in acid of the same strength as that in which the iron and zinc was plunged, was connected with the opposite cups of the galvanometer, both pairs being of precisely the same area. The power of the iron and zinc pair to deflect the needle of the galvanometer, exceeded that of the copper and zinc pair by 25°.

The author then constructed two small experimental batteries, each consisting of ten pairs, fitted upon Wollaston's plan, the zinc plates in both of which were $2\frac{1}{2}$ inches square. One of the batteries was a combination of iron and zinc, the other a combination of copper and zinc. With the battery of iron and zinc, a cubic inch of the mixed gases was decomposed in seven minutes, and with the copper and zinc battery the same quantity required thirty-three minutes for its formation. With the former, four cubic inches were produced in 104 minutes, when the action ceased from neutralization of the exciting acid; with the latter, one cubic inch and a half were formed in 125 minutes, and the acid liquor became neutral.

This singular result appears to the author likely to lead to some new law of electricity, and tends to overturn the present ideas of galvanic excitation. An investigation of the details is promised at some future period.

2. Investigation of analogous properties of Co-ordinates of Elliptic and Hyperbolic Sectors. By W. Wallace, LL.D., Emeritus Professor of Mathematics, University of Edinburgh.

The object of this paper is to investigate, for the ellipse and hyperbola, a series of propositions analogous to those which, in the circle, constitute the *calculus of sines.*

Any diameter of an ellipse, or a transverse diameter of a hyperbola, is expressed by a, its conjugate diameter by b, and the ratio of these diameters, viz. $\frac{a}{b}$, by c. The nature of the curves is expressed by this formula, $x^2 + cy^2 = a^2$. In the ellipse, c has the sign $+$, but in the hyperbola the sign $-$.

Any two sectors of the curves contained between any diameter of an ellipse, or a transverse diameter of a hyperbola, and any other diameter, are denoted by α and β, and sectors equal to their sum or difference by $\alpha + \beta$ and $\alpha - \beta$. The co-ordinates of the vertices of the diameters which bound a sector α, are denoted by $f(\alpha)$, and $\mathrm{F}(\alpha)$. These co-ordinates being considered as functions of the sectors, the letters f and F are used as characteristics of the functions; when applied to the circle, $f(\alpha)$ is the *cosine* of α, and $\mathrm{F}(\alpha)$ its *sine.* The expressions for $f(\alpha + \beta)$, $f(\alpha - \beta)$, $\mathrm{F}(\alpha + \beta)$, $\mathrm{F}(\alpha - \beta)$, the origin of the sectors being any diameter of the ellipse, are investigated, and the results tabulated.

Supposing the sectors to be contained between a, the transverse axis of an ellipse or hyperbola, and any oblique diameters, then putting e for the eccentricity of the curve, the formulæ found are these:

$$af(\alpha+\beta) = f(\alpha)f(\beta) - \frac{a^2}{a^2 - e^2}\,\mathrm{F}(\alpha)\,\mathrm{F}(\beta), \ldots\ldots\ldots\ldots(1)$$

$$a\,\mathrm{F}(\alpha+\beta) = \mathrm{F}(\alpha)f(\beta) + f(\alpha)\,\mathrm{F}(\beta), \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

$$af(\alpha-\beta) = f(\alpha)f\beta + \frac{a^2}{a^2 - e^2}\,\mathrm{F}(\alpha)\,\mathrm{F}(\beta), \ldots\ldots\ldots\ldots(3)$$

$$a\,\mathrm{F}(\alpha-\beta) = \mathrm{F}(\alpha)f(\beta) - f(\alpha)\,\mathrm{F}(\beta). \ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Proceeding from these formulæ, a theory of the functions $f(na)$, and $F(na)$, analogous to that of the functions cos (na), and sin (na), in the calculus of angles, is established entirely by the ordinary algebraic analysis.

3. On the Newer Tertiary or Pliocene Deposites of Scotland. By James Smith, Esq. of Jordanhill.

Mr Smith of Jordanhill stated the general results of his observations on the newest tertiary or pliocene deposites of Scotland. In every one of the maritime counties, elevated marine beds containing shells, of which about one-tenth are no longer to be found in the British seas, have been discovered. Some of the shells appear to have become altogether extinct, others occur in crag and Sicilian tertiary beds, and others in the Arctic seas,—indicating that the climate was probably colder at the period of their deposition.

The so-called submarine forests, and till or diluvium, lie under these deposites, and are therefore of still greater antiquity. Mammalian remains have been discovered in them, all of which appear to differ from recent species.

4. On certain circumstances affecting the Colour of Blood during Coagulation. By Dr P. K. Newbigging. Communicated by Professor Forbes.

The author described in this paper certain anomalous appearances presented by venous blood when left in contact with coloured porcelain. When blood drawn from a vein is either allowed to coagulate in a porcelain cup, or after coagulation is left in it for some hours, the dark purple tint characteristic of venous blood is found to be altered to the bright arterial hue, wherever it was in contact with any elevated device of the green colour, which is communicated by means of protoxide of chrome. In one instance the same effect was produced by a device of a crimson tint; but in more than sixty trials with this and every other variety of colour used in ornamenting porcelain, the author could observe no such effect as was invariably produced by patterns of a green tint. The effect was scarcely apparent, if the pattern was not somewhat elevated. Mere elevation of the porcelain, however, is not the cause of the change of colour. Adhesion of a little oxygen of the air to the surface of the pattern is not its cause; for no change is produced by the green devices of porcelain on a gelatinous mass of gelatin and protoxide of iron, which is quickly rendered brick-red wherever it is put in contact with oxygen. Neither is the change owing to any peculiar arrangement of the molecules of the blood, because it is produced equally on coagulated blood and upon that which is allowed to coagulate in the cup. The author is compelled, therefore, simply to record the fact, that objects on porcelain of a green colour produce their impression, and this with extreme accuracy, on venous blood left in contact with them, and that the change of colour which takes place seems identical with the florid hue occasioned by arterialization of the blood from ordinary causes.

5. On two Storms which passed over the British Islands in the end of November 1838. By David Milne, Esq. Advocate.

It was stated, that the first indication of the advent of these two storms to the British islands was given by the barometer. On the 25th and 26th November, the barometer in all parts of the United Kingdom began to sink; and it is important to observe, that, not only when this sinking began, but likewise for nearly two days after, the wind was blowing E. or NE., and was accompanied by a severe frost, circumstances which of themselves cause the mercurial column to rise.

The exact hours on the 25th and 26th November at which, in different places, the barometer began to sink were noticed, from which it appeared that the sinking took place in the south part of the United Kingdom about five or six A. M. on the 25th, and in the north of Scotland about two or three in the morning of the 26th.

I. Now, as the first storm did not reach England, or, in other words, that part of the surface of the globe, till about noon on the 26th, and the north part of Scotland till the night of the 27th or morning of the 28th, it is obvious that the upper regions of the atmosphere were, in the British islands, affected before the lower regions by a period of about thirty hours. It follows, that the *upper* part of the storm preceded the *lower* part, in its progress over the surface of the globe.

This first storm commenced at Cork on the 26th, at 11 A. M.; at Cornwall, about noon; at Dublin, about 3½ P. M.; at the Isle of Man, early in the morning of the 27th; at Lismore, on the night of the 27th; and Cape Wrath, not till the 28th November.

The wind at all these places, on the commencement of the storm, blew from SE. or SSE.; it afterwards veered to SW., and on the cessation of the storm it was blowing from NW. The veering to SW. took place in Cornwall during the *forenoon* of the 27th; it took place in Dublin in the *evening* of that day.

Heavy gusts came from a point due west, or rather to the north of west, shortly before the cessation of the storm. These were felt in Cornwall in the *afternoon* of the 27*th;* they did not commence at Pladda (off the coast of Ayrshire) till the *night* of the 28*th* November.

From these and other similar data, it was concluded, that the storm moved progressively in a N.NE. direction, at the rate of ten or eleven miles an hour.

The progress of this storm from southern latitudes was next described, by reference to various places both on sea and land, as far south as Gibraltar, at all of which it had been severely felt. On the 22d and 23d, a storm from the S. was experienced at the mouth of the Garonne. Off the NW. coast of Portugal, three vessels were dismasted by a hurricane on the 22d; at Gibraltar, there was a storm on the 21st November. It was most probably one and the same storm which passed over all these places, beginning at Gibraltar on the 21st, and reaching the British islands on the 26th November;—seeing it would arrive there at the very time that the first storm begun in England, and had the same direction and rate of movement.

Some circumstances were stated, shewing that this storm had probably a rotatory as well as a progressive motion. These were, (1.) the great velocity of the wind in the storm, compared with the actual motion of the storm; (2.) the veering of the wind in the storm from SE. to NW.; (3.) the greater violence of the gusts from S. and SW.,—the progressive and rotatory motions then coincided.

II. The second storm begun on the SW. coast of Ireland about 2 A. M. on the 28th; at Cork, about 3 or 4 A. M.; Cornwall, about 5 A. M.; Plymouth, about 9 A. M.; and Fairnborough (near Bagshot), about 10 A. M.

At all these places there was, during the previous night, a calm, or light airs from the westward.

This storm reached Dublin about 1 P. M. on the 28th; Glasgow, about 3 P. M.; and Kirkaldy, between 4 and 6 P. M. It travelled northward, therefore, at the rate of about twenty miles an hour.

This inference was corroborated by the periods at which, in different places, the wind in the storm veered from SE. to SW. This veering, which took place in Cornwall about *noon* on 28*th*, did not take place at Kirkaldy till the *afternoon* of the 29*th*.

A separate and still more striking confirmation is afforded by the period when the barometer reached its lowest point at different places. Its greatest depression in the Bristol Channel occurred at noon on the 28th; in Edinburgh and Glasgow, at 12 h. 16 m. on the 29th; in Kinfauns Castle (Perthshire), at 8½ P. M. on the 29th.

That this storm had, like the previous one, a progressive motion to N.NE., there can be no doubt; and from its moving in nearly the same track, but travelling with twice the rapidity, it overtook the first storm about the middle of Scotland; in consequence of which, the indications of two separate storms became indistinct in these northern parts.

There were many circumstances shewing that this second storm had a rotatory as well as a progressive motion, and that the centre of the stormy circle travelled along a path considerably to the west of the British islands. (1.) One of these was the greater magnitude of the angle made by the wind in veering, and the greater rapidity with which the veering was effected, in places situated to the west, than in places situated to the east. At Limerick, the wind veered 158° in 28½ hours; at Penzance, 112° in 24 hours; at Greenwich, 79° in 24 hours; at Kinfauns, 90° in 24 hours. (2.) When the storm ceased, the wind was blowing more from the north in places situated to the west. On the west coast of Ireland, it was blowing W. or W.NW.; in the south-west of Scotland, and at Holyhead, it was blowing W.SW. or SW. (3.) The barometer was lowest towards the west; and by classing together those places where the depression was the same, it appeared that these places lay in lines or zones running in a N.NE. direction, in each of which the barometer stood at a lower level in proportion as its situation was toward the west. In London and Greenwich, the barometer stood at its greatest depression at 28.70; at Limerick, it stood at its greatest depression at 27.49, both observations being reduced for height. (4.) It was found that a storm had traversed the eastern part of the Atlantic, moving in a N.NE. direction, having been felt at the Garonne on the 27th, 28th, and 29th; at Oporto, from the 24th to the 27th; at Lisbon, on the night of the 23d. It appeared that several vessels in the middle of the Atlantic had, on the 28th, been dismasted by a NW. gale, whilst the Great Western steamer, some degrees to the NW. of these ships, though on that day and the next she experienced no gale, encountered a heavy swell from the N.NE.

It appeared from these, and some other data which were detailed, that this storm moved N.NE. over the Atlantic, at the rate of about twenty miles an hour ; that it had also a rotatory motion, and that the centre of the circle passed very considerably to the west of the British islands, so that it was only a segment of the storm which swept over these islands.

It was mentioned that, before the most furious part of the gale reached England, and before the barometer reached its greatest depression, a storm-wave had entered the Irish and Bristol Channels, and caused, in most of the harbours there, on the night of the 28th November, an unusually high tide.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1839–40. No. 16.

Monday, 2d December 1839.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following Donations were presented :—

Outlines of Human Physiology. By William Pulteney Alison, M. D., F. R. S. E.—*By the Author.*

Two Essays. I. On the Nature of the Boetian Numerical Contractions. II. Notes on Early Calendars. By James Orchard Halliwell, Esq. of Jesus College, Cambridge.—*By the Author.*

Remarks on the Classification of the different branches of Human Knowledge. By J. W. Lubbock, Esq., F. R. S.—*By the Author.*

An Elementary Treatise on the Tides. By J. W. Lubbock, Esq., F. R. S.—*By the Author.*

Philosophical Transactions of the Royal Society of London for the year 1838. Part 2.—*By the Royal Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie Royale des Sciences, 1839. 1er Semestre. Nos. 13–25. 2d. Semestre. Nos. 1–19.—*By the Academy.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Van Der Hoeven, en W. H. De Vriese, M.D. Deel vi. St. 1, 2, 3.—*By the Editors.*

Proceedings of the Geological Society of London. Vol. iii. Nos. 60, 61, 62.—*By the Society.*

Transactions of the Institution of Civil Engineers. Vol. iii. Part 1.—*By the Institution.*

Proceedings of the American Philosophical Society. Nos. 5, 6, 7. —*By the Society.*

Bulletin de la Société de Géologique de France. Tome ix. Feuilles 28–32. Tome x. Feuilles 5–15.—*By the Society.*

Journal of the Asiatic Society of Bengal for September, October, November, December 1838.—*By the Society.*

The Quarterly Journal of Agriculture, and the Prize-Essays and Transactions of the Highland and Agricultural Society of Scotland, for June, September, and December 1839.—*By the Society.*

Nova Acta Physico-Medica Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum. Vol. xviii. Part 2.—*By the Academy.*

Eloge Historique d'Antoine-Laurent de Jussieu. Par M. Flourens. —*By the Author.*

Archives du Museum d'Histoire Naturelle, publiées par les Professeurs-Administrateurs de cet Etablissement. Tome 1. Liv^{n} 1.—*By the Editors.*

Recherches sur les Ossemens Fossiles de la Russie. Par G. Fischer de Waldheim.—*By the Author.*

Memoir of William Vaughan, Esq.—*By the Author.*

Transactions of the American Philosophical Society, held at Philadelphia, for promoting Useful Knowledge, Vol. vi. Part 2. (New series).—*By the Society.*

Memoires de la Société Géologique de France. Tome iii. Part 2. —*By the Society.*

Transactions of the Royal Society of Literature of the United Kingdom. Vol. i. Part 1. and Vol. iii. Parts 1, 2.—*By the Society.*

On the Enlisting, Discharging, and Pensioning of Soldiers, with the official documents on these branches of Military Duty. By Henry Marshall, F. R. S. E., Deputy-Inspector-General of Army Hospitals.—*By the Author.*

The Transactions of the Linnean Society of London. Vol. xvii. Part 2.—*By the Society.*

Proceedings of the Linnean Society of London. Nos. 1, 2—*By the Society.*

Quarterly Journal of the Statistical Society of London. July and Oct.—*By the Society.*

Memoires sur le Canada, depuis 1749 jusqu'a 1760.—*By the Lit. and Hist. Soc. of Quebec.*

An Essay on the State of Literature and Learning under the Anglo-Saxons. By Thomas Wright, Esq.—*By the Royal Society of Literature.*

Madras Journal of Literature and Science. 1838, April to December. 1839, Jan. to March.—*By the Madras Lit. Society.*

Transactions of the Royal Irish Academy. Vol. xviii. Part 2.—*By the Academy.*

Memoir of the late Honourable Nathaniel Bowditch, LL.D., of Boston. By N. J. Bowditch.—*By the Author.*

The Narrative of Capt. David Woodward and Four Seamen, who lost their ship while in a boat at sea, and surrendered themselves up to the Malays in the Island of Celebes.—*By Wm. Vaughan, Esq.*

Recueil de Voyages et de Mémoires, publié par la Société de Geographie. Tome iv.—*By the Society.*

Annuaire des Marées de Côtes de France pour l'an 1839. Par A. M. R. Chazallon.—*By the Author.*

Mémoire sur les divers moyens de se procurer une Base pour la mesure directe, par la vitesse du Son, par des Observations Astronomiques, &c. Par A. M. R. Chazallon.—*By the Author.*

Instructions pour Naviguer sur la Côte Orientale de Terre Neuve, depuis le Cap de Bonavista jusqu'au cap Normand. Par M. Ch. Lavand.—*By the Author.*

De l'Etablissement des Français dans la Régence d'Alger, et des Moyens d'en assurer la prospérité. Par M. P. Genty de Bussey. 2 tomes.—*By the Author.*

Rara Mathematica; or a Collection of Treatises on the Mathematics and subjects connected with them, from ancient unedited manuscripts. Edited by James Orchard Halliwell, Esq., F. R. S. *&c.*—*By the Editor.*

Mécanique Céleste. By the Marquis De La Place. Translated, with a Commentary, by Nathaniel Bowditch, LL. D., and with a Memoir of the Translator, by his Son. Vol. iv.—*By the Representatives of the Translator.*

Astronomische Nachrichten, Nos. 365 to 379.—*By Professor Schumacher.*

Astronomische Beobachtungen auf der Königlichen Universitats-Sternwarte in Konigsberg. Von F. W. Bessel. 9th Part.—*By the Author.*

Neue Wirbelthiere zu der Fauna von Abyssinien gehorig, entdecht und beschrieben von Dr Eduard Rüppell. Nos. 10, 11, 12 —*By the Author.*

Report upon the Military and Hydrographical Chart of the Extremity of Cape Cod, including the Townships of Province Town and Truro, with their Sea-coasts and Ship Harbour, projected from surveys executed under the direction of James D. Graham.—*By Professor A. D. Bache.*

Manuel Complet du Micrographie. Par Charles Chevalier.—*By the Author.*

The Journal of the Royal Geographical Society of London. Vol. ix. Part 2.—*By the Society.*

Address at the Anniversary Meeting of the Royal Geographical Society, 27th May 1839. By William R. Hamilton, Esq., F. R. S., President.—*By the Society.*

Narrative of the Discoveries of Sir Charles Bell in the Nervous System. By Alex. Shaw, assistant-surgeon to the Middlesex Hospital.—*By the Author.*

Report of the Eighth Meeting of the British Association for the advancement of Science, held at Newcastle in August 1838. Vol. vii.—*By the British Association.*

Memoir on the Mid-Lothian and East-Lothian Coal-Fields. By David Milne, Esq., F. R. S. E. and F. G. S.—*By the Author.*

Natuur-en Scheikundig Archief, uitgegeven door G. J. Mulder en W. Wenckebach. 1838. St. 3.—*By the Editors.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. Aus dem Jahre 1837.--*By the Academy.*

Bericht uber die zur Bekanntmachung geeigneten Verhandlungen der Konigl. Preuss. Akademie der Wissenschaften zu Berlin. Monats Juli 1838 bis Juni 1839.—*By the Academy.*

Remarkable case of Extrophy of the Urinary Bladder, with remarks. By P. D. Handyside, M. D.

History of the Sternoptixinæ, a family of the Osseous Fishes, and their anatomical peculiarities, with a description of the Sternoptix Celibes, a species not hitherto noticed. By P. D. Handyside, M. D.—*By the Author.*

Elements of Chemistry including the applications of the Science to the Arts. By Thomas Graham, F. R. S. L. and E. Part 1, 2, 3.—*By the Author.*

The Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 10.—*By the Society.*

Nineteenth Report of the Council of the Leeds Philosophical and Literary Society at the close of the Session 1838-39.—*By the Society.*

Annuaire Magnetique et Meteorologique du Corps des Ingenieurs des Mines de Russie. Par A. T. Kupfer.—*Par le Ministre des Finances.*

The American Almanac and Repository of Useful Knowledge for the year 1840.—*By the Amer. Phil. Society.*

Voyage dans la Russie Meridionale, sous la direction de M. A. Demidoff. Livraisons 1–23. Atlas au meme, folio.—*By Count Demidoff.*

Pilote Français Quatrieme partie comprenant les Côtes Septentrionales de France depuis l'Ile Brebat jusqu'a Barfleurs.—*Par la Ministre de la Marine.*

Maps of the Ordnance Survey of England and Wales. Nos. 71, and 74.—*By the Board of Ordnance.*

Maps of the Ordnance Survey of Ireland (County Kildare), 45 sheets.—*By the Board of Ordnance.*

The following communications were read:—

1. Solution of a Functional Equation, with its application to the Parallelogram of Forces and to Curves of Equilibration. By Dr Wallace, Emeritus Professor of Mathematics.

The functional equation to be resolved is this—

$$f(x_\circ)f(x_,)=c\{f(x_\circ+x_,)+f(x_\circ-x_,)\}$$

In this equation $x_\circ$ and $x_,$ denote any two values of the indefinite variable x, and c is a constant quantity. The object of inquiry is the *forms of the function.*

It is proved that there are two forms of the function, which alike satisfy the proposed equation: viz.

$$f(x)=a\cos\frac{x}{c} \quad . \; . \; . \; . \; . \; . \; . \; . \quad (1)$$

$$f(x)=\frac{a}{2}\left\{e^{\frac{x}{c}}+e^{-\frac{x}{c}}\right\} \quad . \; . \; . \; . \quad (2)$$

In the first of these functions x increases, while $f(x)$ decreases; and in the second, x and $f(x)$ increase together. The first of these functions is applied in the paper to the theorem of the *Parallelogram of Forces*, whilst the theory of *Curves of Equilibration* is deduced from the second function: these last, in their most general form, have two parameters. The curve of equilibration is formed by a perfectly flexible chain suspended in a vertical plane between two fixed points. Suppose the chain loaded with heavy rods of equal thickness, which hang vertically from it, indefinitely near to each other, at equal horizontal intervals, and with their lower ends in a horizontal straight line. It is shewn that the equation to the curve is derivable from the functional equation already mentioned, and that its solution in that case gives (putting y to denote the ordinates $f(x)$)

$$y = \frac{a}{2}\left\{e^{\frac{x}{c}} + e^{-\frac{x}{c}}\right\}.$$

Amongst other curious results, the author establishes a relation between the arcs of these curves similar to the properties of the sines and cosines of the circle. It also appears that curves of equilibration may be constructed from the catenary, just as the ellipse is formed from the circle. A series of Tables accompany the paper, intended to facilitate the calculations of engineers for suspension bridges or equilibrated arches.

2. On General Differentiation. Part I. By Professor Kelland.

" As early as the time of Leibnitz, it was suggested that a general form might be discovered for differential coefficients, somewhat in the same way as that which applies to expansions. Notwithstanding this suggestion, the difficulty of the subject appears to have deterred mathematicians from engaging in it, until a few years since M. Liouville published a series of memoirs, in which its principles are developed, and theorems deduced applicable to the solution of a variety of difficult and important problems. Amongst a mass of particular results, the generalization of each of which would probably give a distinct aspect to the science, M. Liouville appears to have selected that one which is the most readily applicable to practice, and which, at the same time, affords conclusions remarkably convincing of its completeness. As far, then, as relates to the foundation of the theory, nothing is wanting: when we examine the formulæ themselves, we find much room for improvement. In the first place, not only are there different formulæ for every combination of differentials of simple quantities, but even the very modes of demonstration made use of to produce them, vary widely from each other. Certain of the conclusions themselves also appear to be inaccurate. Added to this is the circumstance, that M. Liouville has not effected the exhibition of any formulæ analogous to the ordinary formulæ of the Differential Calculus, such as Taylor's Theorem.

" The objects of the present memoirs are, 1. The completion of the science as regards its elementary theorems, by the exhibition of one general form, and the deduction of all other forms from it: 2. The application of the general theorem to a variety of cases analogous to those dealt with in the common differential analysis: and, 3. The demonstration and application of theorems of expansion, not subject to failure for particular values of the variable. To complete the subject, a vast deal more is required; but the author hopes, by the present essay, and another which he intends shortly to present to the Society, that the study of this important calculus will be excited; and confidently anticipates the consequent improvement and extension of its processes."

Monday 16*th December* 1839.

Sir T. M. BRISBANE, Bart. President, in the Chair.

The following donations were presented:—

Journal of the Asiatic Society of Bengal, No. 85, for January 1839. —*By the Society*.

Transactions of the Meteorological Society, vol. i.—*By the Society*.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences (1839, 2nd Semestre). Nos. 20, 21, 22.—*By the Society*.

The following communications were read:—

1. Experiments on the Development and Growth of the Salmon, from the exclusion of the ovum to the age of two years. By Mr Shaw, Drumlanrig. Communicated by James Wilson, Esq.

The author, in this paper, gives an account of the continuance and confirmation of his experimental observations on the growth of salmon fry, as formerly communicated to the Society. He considers the objections made to his artificial ponds, in so far as they were supposed to afford an insufficient supply of food, to be without reasonable foundation, as these ponds actually abound with the ordinary insect food of fishes, and the young broods themselves correspond in every way to those of the same age in the natural streams and pools of the river. He had previously ascertained and stated, that young salmon remain in their native river for two years (under the names of parrs, pinks, fingerlings, &c.), and during that period, or till near its close, he applies to them the name of *parr*, as that by which they are usually designated in Scotland.

The hatching of the ova is regulated in a great measure by the temperature of the season. In severe winters, the principle of life is slowly developed. He found, by experiment, that spawn placed in a stream of spring water of the average temperature of 40°, exhibited the embryo fish (visible to the naked eye) by the end of the 60th day, and was hatched on the 108th day after impregnation Spawn deposited by the same parent on the same day *in the river* (the average temperature of which, for eight weeks, did not exceed 33°), did not exhibit visible young until the 90th day, and 131 days elapsed before their final hatching. Yet the departure of the more advanced fry *sea-wards* does not seem to depend on the variable time of hatching,—the first week of May, of the second ensuing season, being a very regular period for the main body, and on the occasion in question, large shoals of salmon fry were descending the river on the very day (10th May) on which the young of that year were only emerging from the ova. Yet the usual belief is, that they migrate in the course of the same spring in which they are hatched.

Mr Shaw's paper is accompanied by an extensive and varied collection of specimens, which exhibit the development of the fry from the period of hatching until the termination of the second year. A parr or young salmon twelve months old, measures about three and three-fourth inches in length, and exhibits what may be called the ordinary summer aspect. It corresponds in age and size with those which, in the natural bed of the river, are denominated "May parr," and it is these latter alone (with such as have been recently hatched) that are found in the river after the beginning of May, as about that period the two-year-olds all migrate to the sea. May parr are to be regarded as identical with the "Pinks of the river Hodder," alluded to by Mr Yarrell, but they are the produce of the preceding spring, instead of being, as usually supposed, only a few weeks old. They remain all summer, and throughout the ensuing winter, in the river, and, by an anomalous, or at least unusual, economy of nature, the males in the course of this early period become fit for generative purposes, and are seen to associate with the female adult salmon. A characteristic example of this stage was taken from the pond on the 14th November 1838, being then eighteen months old, and at that age all the males of the different broods exhibited a matured sexual character in relation to the *milt*, but none of the females of the same age shewed any signs of *roe*. Those in the bed of the river manifested the corresponding character of each sex,—that is, of maturity in the male, of immaturity in the female.

The great constitutional change which converts an old parr into a young salmon, usually takes place in the month of April of the second ensuing year. Specimens taken from the pond on the 5th of January 1839 measured six inches in length, and were twenty months old. They exhibited all the ordinary characters of the parr, commonly so called. But such as were allowed to survive till the 24th May, although they gained only half an inch in length, *cast off the livery of the parr*, and assumed that of the salmon,—this change consisting chiefly in the following particulars: the black opercular spots disappeared, the almost colourless pectoral fins became suffused with an inky hue at their extremities, the broad perpendicular bars or blotches on the sides were effaced, and the prevailing hues of dusky brown and yellowish-white were converted into deep bluish-black above, and into silvery white below. Various other specimens exhibited by Mr Shaw exemplify a similar change, and some of these distinctly shew, as it were, the intermediate or transitionary state between the parr and salmon. The whole, however, belonged to broods which, as formerly explained by the author, were the original produce of adult salmon.

The observations hitherto reported were made in confirmation and continuance of those formerly laid before the Society by the same author. But the circumstance of the male parrs in a state of sexual maturity being found to accompany the female adult salmon while she deposits her ova in the river, suggested the idea of the following singular and successful experiment. In the month of January 1837, Mr Shaw took a female salmon weighing 14 lb. from the natural spawning bed, from whence he also took a male parr weighing one ounce and a half. With the milt of the latter he impregnated the ova of the former, and placing the spawn in the stream of his pond he watched its development, as he had that of the salmon spawn fecundated in the ordinary way, and found the hatching and subsequent growth in all respects to correspond.

These experiments were repeated with the same results in the winter of 1838, and the parrs (taken from the river) which had been used as males, were kept alive till spring, when they assumed the migratory dress of young salmon. He also tried a corresponding experiment, by impregnating the ova of three adult female salmon taken from the river, with the milt of three parr bred in the confinement of the ponds, and the result was the same as to successful hatching and final growth,—this fact, moreover, shewing the constitutional strength of the pond-bred breed, and that they had not deteriorated or been altered in their natural character and attributes by confinement, as had been supposed. The specimens used in these experiments are exhibited to the Society, that all interested may satisfy themselves by ocular inspection.

One of these specimens is itself the produce of a male parr and female adult salmon; in other words, it is what naturalists (supposing the parr and salmon not to be identical) would call a hybrid or mule. Now, it is admitted by physiologists that the general rule in regard to these mixed productions, from kinds not specifically the same, is, that they do not breed; yet this male parr, originally produced from a parr and salmon, has itself become the parent of a numerous and healthy progeny of young salmon; and Mr Shaw attaches great importance to this fact, the experimental particulars of which are carefully detailed in his paper. It had, in truth, been objected to Mr Shaw's former experiments, that by a forced alliance between the parr and salmon, he had not proved their identity, but had merely succeeded in producing a *hybrid.* The brood, however, in no way differs from other young salmon in the parr stage, so far as external characters are concerned; and their procreative powers afford an additional confirmation of their being identical. Mr Shaw moreover observes, that, if the parr were a distinct species, the results of their attendance on the female salmon would produce universal confusion among the migratory inhabitants of rivers, "from the circumstance of the male parrs, in a breeding state, occupying in great numbers the very centre of the salmon spawning-bed; while the female salmon herself is, at the same instant, pouring thousands of her ova into the very spot where they are thus genially congregated."

Mr Shaw's experiments were conducted with great care; have been frequently verified by repetition; and have always been followed by the same results. He concludes his paper by stating, that so far as his own observations extend, the trough, or special spawning-bed, is excavated by the female alone, and by means of a peculiar action of the tail. The belief hitherto entertained has been, that she was greatly aided in this removal and replacing of the gravel by the snout and under jaw of the male. The process of laying usually occupies three or four days. He found in the course of his experiments, that the death of the female did not (at least within a short time) destroy the vitality of the spawn, or its receptive power of fecundation. He impregnated ova from the body of a fish which had been dead for nearly two hours, with the milt of a living parr, and vivification followed in the usual course.

2. On the use of the word "Temperature" in the Analytical Theory of Heat. By Professor Kelland.

" It appears to the author, that the only fact established by the experiments of MM. Dulong and Petit is the following :—That the scale of measurement by which we express our knowledge of the state of heat within a body, is not applicable to the expression of the flow of heat within or from the surface of the body. Proceeding upon this supposition, he deduces the thermometric temperature of a body, from the formulæ in v, given by M. Fourier, taking the formulæ as finally obtained, believing them to be accurate expressions of physical conditions. As, however, the letter v cannot, consistently with MM. Dulong and Petit's experiments, denote the thermometric temperature, but some exponential function of it, the author proposes, in order to prevent confusion, to employ the word " thermature" to denote that to which the flow of heat is proportional. Should his view of the matter be correct, investigations, similar to those given by M. Libri and others, in which the external radiation only is supposed to follow the exponential law of temperature, cease to represent physical facts. In order, therefore, to give an air of probability to the hypothesis, independently of that which it possesses arising out of the nature of the case, the author has tested it by the experiments of MM. Fourier and Biot, and finds that it applies equally well with the old hypothesis, which is confessedly a very close approximation to the truth for small differences of temperature. To complete the test, other experiments are wanted, such as those on the state of heat at one end of a short bar, corresponding to a given state of heat at the other. In this case, the old hypothesis totally fails ; but from want of a sufficiently definite statement of the data in the experiment given by M. Biot, the author is unable to say whether or not his own views are confirmed by it. They certainly are not, as the old hypothesis is completely at fault when applied to it. The author hopes that, by the labours of some person interested in the subject, this, or some other *experimentum crucis*, will ere long enable us to decide this matter.

A third communication by Professor Forbes, "On the Influence of the Mechanical Texture of Screens on the immediate transmission of Radiated Heat," was placed in the hands of the Secretary, and the reading of it postponed till next meeting.

Monday, 6th January 1840.

Sir T. M. BRISBANE, Bart. President, in the Chair.

The following Donations were presented :—

The Sixth Annual Report of the Royal Cornwall Polytechnic Society, 1838.—*By the Society.*

Abstract of the Returns of the Overseers of the Poor in Massachusetts for 1837 and 1838, prepared by the Secretary of the Commonwealth.

Abstract of the Returns of Insurance Companies, incorporated with Specific Capital in 1838.

Abstract exhibiting the condition of the Banks in Massachusetts, in February and October 1838.

Abstracts of the Massachusetts School Returns for 1837.

First and Second Annual Reports of the Board of Education.

Report of the Secretary of the Board of Education on the subject of School-Houses.

Report of the Committee on Education relative to the School-Fund.

Report and Resolves in relation to the North-Eastern Boundary in March 1838.

Report of the Bank Commissioners.

Schedule exhibiting the condition of the Banks in Massachusetts for every year from 1803 to 1837.

Report of the Commissioners on Codification of the Common Law.

Preliminary Report of the Commissioners on Criminal Law.

Annual Reports of the Railroad Corporations in the State of Massachusetts for 1838.

First Report on the Geology of the Public Lands in the State of Maine.

Report on a Re-examination of the Economical Geology of Massachusetts.

Statistical Tables exhibiting the condition and products of certain Branches of Industry in Massachusetts, for the year 1837.

Second Report of the Agriculture of Massachusetts.

Reports of the Commissioners of the Zoological Survey of the State of Massachusetts.

Reports on the Fishes, Reptiles, and Birds, of Massachusetts.—*By the Family of the late Dr Bowditch.*

Second Part of the twentieth volume of the Asiatic Researches.

Journal of the Asiatic Society of Bengal, for February and March 1839.—*By the Society.*

Transits as observed, and calculation of the Apparent Right Ascension at the Cape of Good Hope, 1834.

Zenith Distances observed with the Mural Circle, at the Royal Observatory, Cape of Good Hope, and the calculation of the Geocentric South Polar Distances, 1836 and 1837.

Bessel's Refraction Tables.

Observations of Halley's Comet, made at the Royal Observatory, Cape of Good Hope, in the years 1835 and 1836.—By Thomas Maclear, Esq.

On the Declinations of the Principal Fixed Stars, deduced from Observations made at the Observatory, Cape of Good Hope, in 1832 and 1833. By Thomas Henderson, Esq.—*By the Lords Commissioners of the Admiralty.*

Prospectus and Illustrations of the Natural History of the Scottish Salmonidæ. By Sir William Jardine, Bart.—*By the Author.*

The following communications were read :—

1. On the Effect of the Mechanical Texture of Screens on the immediate Transmission of Radiant Heat. By Professor Forbes.

The following memorandum was communicated at the former Meeting of the Society.

" On the 2d September 1839, M. Arago communicated to the Academy of Sciences a letter by M. Melloni, containing some very interesting experiments on the transmission of Radiant Heat. M.

Melloni finds, that rock-salt (which is well known to transmit rays from every source with equal facility) acquires, by being *smoked*, the power of transmitting most easily heat of low temperature, or that kind of heat stopped in greatest proportion by glass, alum, and (according to M. Melloni) every other substance. The experiments contained in the Third Series of my Researches on Heat, shew that this is equivalent to saying, that substances in general allow only the more refrangible rays to pass; and as M. Melloni had been led by his previous experiments to the same conclusion, his statement amounts to this, that, whilst rock-salt presents the analogy of white glass, by transmitting all rays in equal proportions, every substance hitherto examined acts on the calorific rays as violet or blue glass does on light, absorbing the rays of least refrangibility, and transmitting only the others.

" M. Melloni believes, that the first exception to this rule, or the first analogue of red glass, is rock-salt previously smoked. I desire, however, first to call attention to the fact, that, in a paper published in May 1838 (Researches on Heat, Third Series), I described a substance having similar properties, namely, mica split by heat to extreme thinness, such as I employ in polarizing heat. In the month of March 1838, I had established, by reiterated experiments, that the transmission of heat through glass, far from rendering it less easily absorbed by mica in this peculiar state, had a contrary effect, and also that heat of low temperature, wholly unaccompanied by light, was transmitted almost as freely as that from a lamp previously passed through glass.

" It even appears, from experiments I have since made with the same form of mica, that some specimens transmit *scarcely half* as much luminous heat from a lamp previously passed through glass, as that from a body below visible incandescence.

" Mica itself, not laminated by the action of fire, possesses, as I have shewn by contrasted tables in the paper referred to (Art. 23, 24), properties exactly the reverse; hence the effect is due to the peculiar mechanical condition of the body, and not to its elementary composition.

" It, therefore, at once occurred to me, on reading M. Melloni's communication, that the effect of smoking the salt might be merely owing to a mechanical change in the surface affecting the transmission.

" Roughening the surface was the most obvious experiment, and I found, as I anticipated, that heat of low temperature is very much easier transmitted by salt scratched by sand-paper in two directions at right angles, than luminous heat. Thus, a plate of salt which, when well polished, transmits 92 per cent. of heat derived from a lamp, and sifted by a glass plate, and also 92 per cent. of heat wholly unaccompanied by light, transmitted, when roughened, only 17 per cent. of the former and 45 per cent. of the latter.

" A thin plate of mica, when similarly scratched with emery-paper, so as merely to depolish it, transmitted much more nearly the same per-centage of heat from different sources than when *bright;* shewing, that the loss of polish affects the transmission of the more refrangible rays much more sensibly than that of the others.

" Yet this effect is not attributable to a variation in the ratio of the reflection of heat of different kinds at the surfaces of the plate. For, in the *first* place, I have proved, and already communicated the fact to the Royal Society (see Proceedings for April 1839), that reflection takes place at a polished surface, with almost, if not exactly, the same intensity for all kinds of heat; and, *secondly*, I have found, by direct experiment, that, at least for the higher angles of incidence, reflection is most copious from rough surfaces for heat of low temperature, or the same kind which is most freely transmitted, proving incontestibly that the *stifling* action of rough surfaces is the true cause of the inequality.

" That there is a real modification of the heat in passing through a roughened surface, as well as through laminated mica and the smoky film, appears from direct experiments which I have made on the heat sifted by these different media; which, when transmitted by any one of these, is found in a fitter state to pass through each of the others; and this modification is found to be more perceptible, as the character of the heat is more removed from that which these media transmit most readily, that is, as the temperature of the source is higher. Thus, heat derived from a lamp, has 36 per cent. transmitted by a certain smoked plate of rock-salt. But if the heat transmitted by the smoked salt has previously been sifted or analyzed by transmission through another plate of smoked salt, through laminated mica, and through roughened salt, the percentage is raised from 36 to 44 in the two former cases, and to $40\frac{1}{2}$ in the latter, proving incontestibly the specific action of these transmissions in arresting the more refrangible rays.

" I next considered, that, as a moderate number of scratches appeared to produce this modification, it might be practicable to obtain the effect by transmitting heat simply through fine wire-gauze.

I could not obtain it finer than sixty wires to the inch, and in this case I could obtain no indications of differences in the transmitted ratios of one or other kind of heat. The proportion transmitted to the direct effect, was, in every case, almost exactly that of the area of the interstices of the gauze to its entire surface.

" When fine gratings (used for Fraunhofer's interference fringes) made of cotton-thread were used, even in this case no difference was perceived; here, however, the thread having probably a certain degree of permeability, might mask the effect.

" When fine powders were strewed between salt plates, leaving minute interstices, the easier transmission of heat of low temperature was again apparent.

" Having procured delicate lines to be drawn with a diamond point on a polished salt surface, first dividing it into squares 1–100th inch in the side, then into parallel stripes 1–200th inch apart, and finally into squares of the latter dimension, in every case the effect resembled that of random scratches, and was made apparent as the surface was more furrowed.

" I have finally to observe, that the mere process of natural tarnishing by the exposure of salt to the air, produces a similar effect.

" These facts evidently point to phenomena in heat, resembling diffraction and periodic colours in light. I cannot doubt that the simple transmission through fine metallic gratings, would produce effects similar to those of the striated surfaces of rock-salt."

" *December* 16. 1839."

2. On the Functions of the Roots of the Spinal Nerves in corroboration of former observations, proving that the anterior roots are nerves of motion, and the posterior nerves of sensation. By Sir Charles Bell, K.H.

The instance produced was a case which had occurred in the Infirmary, in which the anterior roots of the nerves arising from the *cauda equina* were engaged in a tumour, and the consequence during life, was the loss of muscular power, sensibility remaining unaffected.

The following candidates were elected Fellows of the Society:—

Alan Maconochie, Esq.
Martyn J. Roberts, Esq.
Dr Daun.

Monday, 20th January.

Right Hon. Lord GREENOCK, V. P. in the Chair.

The following communications were read :—

1. On General Differentiation. Part II. By Professor Kelland.

" In the preceding memoir on this subject, the author had confined himself to the fundamental operations leading to the differential co-efficients of various functions. In the present paper, he offers an illustration of the entrance of such coefficients into the analysis of physical and geometrical problems. Having first established a general theorm, connecting finite integrals of a certain form with fractional and negative differentials, the author adapts it to represent the integrals actually occurring in several problems. By this means he wishes to shew that the theory of General Differential Coefficients will at some future period become a powerful instrument in the hands of analysts, by furnishing them with results comprehended under general forms, and thus opening another section of the science of comprehensive memory."

2. On the Means employed to prevent Forgeries of Bank Notes, Bills of Exchange, Cheques, &c. By Dr Traill.

" The author prefaced his remarks by a short history of Bills of Exchange, and other kinds of paper currency; in which he pointed out the economy and convenience of a well regulated *paper circulation.*

" The means usually employed to diminish the facilities to forgery are—

" 1. Colouring the paper, or the pulp of which it is manufactured, by various vegetable and mineral substances, either singly or combined. The best attempts of this sort have been imitated by a clever hand and a pencil.

" 2. Certain *water-marks* in the paper of the note or bill, as that employed by the Bank of England. A good imitation of this would perhaps require the connivance of a paper-maker; but successful imitations of *water-marks* have been made by gum and a pencil, or by pale tints of China ink to imitate a worn note.

" 3. Printing notes in different colours, from two or more wooden blocks, increases the difficulty of forging; instances of this were given in the coarse Excise paper stamp, and in the more elegant L.1 note formerly issued by the Bank of Ireland.

"4. The excellence of the engraving—a well executed imitation would require the aid of an able artist; and as engraving on copper and on wood produce these effects by *opposite* means, if designs from both were used on each note, the difficulty of engaging *two* eminent artists in such a nefarious trade would enhance the obstacles to successful forgery. The tracing on copper by an engine any series of curves, may easily be imitated by what is called engine-turning; but the most perfect specimen of this sort of engraving is that devised by Mr Perkins.

"5. Numbering each note has been adopted by all banks, and some number them both with impressions from copper and from wood. These have all been successfully imitated; yet this numbering often has led to the detection of forgery. The numbering-engine, used by the Bank of Ireland, is the most perfect which the author has seen, combining speed with accuracy, and registering its own work with unerring precision.

"6. The signatures of some of the officers of the bank have usually been added to the note, from the known difficulty of exactly imitating a handwriting.

"7. Frauds on bills and cheques have been committed by deletion of the common ink in which the amount of the bill has been written—the substitution of a larger sum. The author recommends the use of an ink, not effaced by chemical agents, without damaging the paper. For this purpose, he conceives that a carbonaceous ink, submitted by him to this Society some time ago, is well suited; especially when used on the softer kinds of paper, such as that made by the engine now used for making paper in one continuous sheet."

Monday, 3d February.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following paper was read:—

1. Observations on the Influence of various circumstances in Vegetation in modifying the Physiological Actions of Plants. By Dr Christison.

"The author commenced with some remarks on the various causes by which the actions of plants and of their products on the animal body may be modified, and on the great vagueness and uncertainty of the information at present possessed in regard to the influence of those causes which seem to arise in peculiar circumstances of vegetation, more especially climate, weather, soil, and the progress of vegetation. He then stated the sources of information on these points, namely, the curative or therapeutic action of drugs on man,—their effects on the healthy functions both of man and animals, either as medicines or as poisons,—their sensible qualities,—and their chemical analysis; and he assigned reasons for discarding the first of these from the inquiry, and for trusting, in a great measure, to the criterions derived from sensible qualities,—from the effects of poisons on the lower animals,—and from chemical analysis.

" The remaining part of the present paper was confined chiefly to the influence of the Progress of Vegetation on the activity of plants. Doubts were thrown by the results of his investigations on most of the current doctrines on this head; but the present state of the inquiry did not lead to any general inferences being drawn with confidence.

" An extended statement was made upon the influence of the progress of vegetation upon many of the active species of the natural family *Ranunculaceæ.* It was stated, that, in the acrid species of the genera Ranunculus, Anemone, and Clematis, the acridity, which is the same throughout them all in quality, is possessed in nearly equal activity by the leaves, from an early period in the spring until they are about to decay; but that it exists in the germens only while they are green, and disappears there entirely as the seeds ripen. In the acrid species of *Aconitum,* the acridity of the leaves, on the contrary, continues only until the seeds begin to form, and then gradually, but quickly, disappears as they ripen, while the seeds acquire precisely the same peculiar kind of acridity. The narcotic properties of the leaves, however, do not undergo the same singular change, but continue undiminished after the seeds are mostly ripe, and probably, indeed, as long as the leaves themselves retain their freshness. The acridity of the genus *Helleborus* is probably governed by circumstances different from any of those already mentioned; but the experiments already made are insufficient to point out the true rule.—In the course of these observations many remarks were also made on the nature of the acridity possessed by the different species, upon which incorrect ideas at present very generally prevail; several material corrections were also suggested as to the general opinions respecting the influence of heat, desiccation, and time, upon their acridity; and a short allusion was made to the properties of a remarkably crystalline principle which the author discovered in one of the species of Ranunculus, and which appeared to him to be the ingredient upon which the activity of that genus depends.

" The author next entered into some details regarding the influence of the progress of vegetation on narcotic plants, and commenced with the natural family *Amygdaleæ*, the leaves of several of which are eminently poisonous, in consequence of containing, or producing, when bruised, a hydrocyanated essential oil. He shewed that this oil abounds most in the leaves of the cherry-laurel (*Cerasus laurocerasus*), when they are young and undeveloped, and that it goes on diminishing gradually in proportion to their weight, as they increase in age and vigour, until the commencement of their second season, when the old leaves, though plump and luxuriant, do not contain above an eighth or tenth of what they contained in the infant state, or of what is contained in the young undeveloped leaves of the same period. This is a complete reversal of the generally-admitted law in respect of the formation of volatile oils in leaves.

" The consideration of this fact led to some statements upon the mode and form in which some essential oils, and other active principles, exist in the leaves of plants; and the conclusion was drawn, that in all probability many active principles, which are separated from plants by simple processes, do not exist ready formed in the leaves; but, as in the familiar case of the mustard-seed and bitter almond, are only developed when the structure of the leaves is broken up, and principles of a different kind, secreted in distinct cells, are brought in contact with one another, or with water.

" The remaining departments of the investigation were postponed; but further observations were promised, upon the influence of the progress of vegetation on the Solanaceous and Umbelliferous plants; and likewise on the effects of soil and climate."

2. A Specimen of *Clavagella Balanorum* (Scacchi), presented by Sir Thomas Brisbane, Bart., President of the Society, was laid on the table, with the following Remarks by Dr Traill.

" This is a rare and interesting species of *Clavagella*, now inhabiting the shores of Naples, presented by Sir Thomas Brisbane.

" When that part of Lamarck's work on *Invertebrata*, which contained the class *Conchiferæ*, appeared in 1818, among the order *Tubicolæ*, he introduced the genus *Clavagella*, of which he describes four species only, and they are all *fossil*. Even at the conclusion of his great work, in 1822, he appears not to have known any living species.

" Another species was described by Sowerby, from a specimen in the British Museum, and to these may, perhaps, be added a fossil species in my cabinet, which occurs in the vast shell limestone formation mentioned by Humboldt, as extending to some distance inland along the shores of the Mexican Gulf.

" The character of *Clavagella* is—An animal inhabiting a testaceous sheath or tube, open, but contracted anteriorly, and club-shaped posteriorly; sheath furnished with spinous tubes. Within the sheath is an equivalve bivalve shell, one valve of which is immoveably attached to the sheath, the other free, and united to the other by a cartilaginous hinge. Both cover the body. The animal is an inarticulate mollusque, without head or eyes; a concealed unarmed mouth; a large mantle, with two lamelliform lobes. External bronchial openings placed between the body and mantle on each side.

" It belongs to the division Crassipedes."

The following candidates were elected Fellows of the Society:—

R. Chambers, Esq.
James Forsyth, Esq.
Sir John Macneill, G. C. B.

F.

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1840. No. 17.

Monday, 17*th February* 1840.

Dr HOPE, V. P. in the Chair.

The following Candidates were elected Fellows of the Society :—

John Cockburn, Esq.
Sir William Scott, Bart.
Rev. C. H. Terrot.

The following Donations were presented :—

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, 1839. 2d Semestre, Nos. 23, 24, 25, 26, and 27. 1840. 1er Semestre, Nos. 1, 2, 3.—*By the Academy.*

Quarterly Journal of the Statistical Society of London. Vol. ii. Part 6. January 1840.—*By the Society.*

Bulletin de la Société de Geographie. 2me Series. Tome xi.—*By the Society.*

Flora Batava. Part 118.—*By the King of Holland.*

The following Communications were read :—

1. On the Cosmogony described in the Sixth Eclogue of Virgil, and on its relation to the theories of Modern Geology. By the Venerable Archdeacon Williams.

2. A brief notice relative to an Aërolite which was seen to fall near Juvinas, in the Department of the Ardêche in France, on the 15th June 1821. By Professor Forbes.

"When visiting the ancient volanoes of the Haut Vivarais, the author was led to make some inquiries relative to the fall of this remarkable meteor, which took place in broad day-light, almost in the midst of the scattered hamlet of Libounez, near Juvinas, and which was witnessed by many persons, some of whom still survive, and gave the account which the author presented.

"The stone fell on the 15th June 1821, at $4\frac{1}{2}$ P. M.; sky clear, and wind north. A long roll was heard, then an explosion like that of a cannon, five minutes before the stone fell. It touched the ground within a few feet of several men who were digging potatoes within a small enclosure. It perforated a *vertical* hole five and a half feet deep, and burnt the ground to a cindery state, no light having accompanied the noise or the fall. The stone had wedged itself between two others, and could not be removed without breaking it. It weighed 220 pounds.

"A specimen was exhibited, intended to be placed in the University Museum."

Monday, 2d March.

Sir T. M. BRISBANE, Bart., G. C. B., Pres., in the Chair.

The following Candidates were elected Fellows of the Society:—

Rev. R. Traill.
Mr R. Bryson.
Edward J. Jackson, Esq.

The following Donations were presented:—

Transactions of the Geological Society of London. Second Series. Vol. iv. Part 2; and Vol. v. Part. 2.—*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. 1840. 1er Semestre. Nos. 4, 5.—*By the Academy.*

Transactions of the American Philosophical Society held at Philadelphia for promoting Useful Knowledge. Vol. vi., New Series, Part 3.—*By the Society.*

Proceedings of the American Philosophical Society. No. 8.—*By the Society.*

Journal of the Society of Bengal for April and May 1839.—*By the Society.*

Philosophical Transactions of the Royal Society of London for the year 1839. Parts 1, 2.

Proceedings of the Royal Society of London. Nos. 37, 38, 39, 40. *By the Society.*

Voyage dans la Russie Méridionale et la Crimée, par M. de Demidoff (Partie Scientifique). Livs. 3 and 4 en 8vo, et Planches en fol.—*By the Author.*

The Journal of the Royal Geographical Society of London. Vol. ix. Part 3.—*By the Society.*

Ordnance Survey of the County Mayo in Ireland, in 125 sheets.—*By His Excellency the Lord Lieutenant of Ireland.*

The Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. No. 48, for March 1840.—*By the Society.*

The following Communications were read :—

1. On the Persian mode of making Malleable Iron direct from the Ore, by James Robertson, Esq. Communicated by Robert Bald, Esq.

2. On the Fatal Effects of Air drawn into the Veins during Surgical Operations on the Neck and Shoulder. By Sir Charles Bell, K. H.

" The author referred in this paper to the experience of Baron Larrey; also to operations performed by Baron Dupuytren and M. Roux, who, in removing the arm at the shoulder-joint, heard the air drawn in, and witnessed the effect in the instant death of their patients.

" He noticed the experiments made by the *Academie Royal de Medicine*, and conceived that they regarded too exclusively the influence of the heart and lungs. He explained the phenomenon to be owing to the elevation of the muscles of the neck, by which the atmospheric pressure was taken off, and the air drawn into the open vein.

" Observing that the alternate elevation and depression of the muscles of the neck attended every act of breathing, he drew attention to the circumstance of the entrance of the thoracic duct into the veins of the neck, whereby it was subjected to the alternation of suction and compression. Noticing at the same time that, in classes of animals which did not breathe with apparatus similar to man, the trunk of the absorbent system entered into other veins, and had a substitute for the alternate action of the muscles of the neck.

"He observed that, granting an action of inhaling by the lungs or the auricle of the heart, it would not explain the fact of air entering by the veins, since these vessels, having their sides delicate and pliant, would be sucked together and collapse.

"He further remarked, on the deadly effect of the air thus entering the circulating system, that it did not satisfy the inquirer to say that death was produced by impeding the circulation in the heart, or the oxygenation of the blood in the lungs; that we must keep steadily before us the fact that death took place suddenly, without a struggle or a groan, or one expression of anguish in voice or feature,—a transition suddenly, and without interval from life to death.

"Contemplating the phenomenon thus, there was but one organ or point which, being disordered, could at once terminate sense and motion, and voice and expression, viz. the *medulla oblongata;* and he therefore concluded that the air entering the vertebral arteries deprived this vital part of arterial blood; cutting off the source of all living power and causing death."

Monday, 16*th March.*

Right Hon. Lord GREENOCK, V. P. in the Chair.

The following Candidates were elected Fellows of the Society:—

John Shedden Patrick, Esq.
John Learmonth, Esq.

The following Communications were read:—

1. On Sulphuret of Cadmium, a New Mineral (first observed by Lord Greenock). By Arthur Connell, Esq.

"This mineral occurs in small crystals embedded in prehnite, at Bishoptown, in Renfrewshire. It had been long supposed to be a variety of zinc-blende; but was first distinguished from that mineral by Lord Greenock. Two small crystals of it, sent to the author for chemical examination by Professor Jameson, appeared to be six-sided pyramids, and had a wine-yellow colour, conchoidal fracture, splendent and vitreous lustre, hardness about that of calcareous spar, orange-red streak, and considerable transparency.

"When heated, it decrepitates, and acquires a fine carmine-red colour, and recovers its yellow colour on cooling. It does not fuse nor volatilize at a red heat.

"In powder it is readily soluble in heated muriatic acid, with strong smell of sulphuretted hydrogen; and the solution by evaporation affords a crystallized salt, not deliquescing in an ordinary atmosphere. Carbonate of soda causes in the solution a white precipitate, dissolved on adding ammonia. The precipitates by potash and by carbonate of ammonia are not dissolved in whole or in part by excess of the precipitants. Sulphuretted hydrogen throws down from the solution with excess of acid, a copious yellow precipitate; and after neutralizing by ammonia, during which operation a few flocks of sulphuret of iron fall, a renewal of the current of sulphuretted hydrogen causes no farther precipitation. Oxalate of ammonia, phosphate of soda, and prussiate of potash, cause white precipitates; and sulphuric acid does not occasion any at all. A piece of zinc throws down reduced metal as a grey ramification. These various reactions sufficiently prove that the mineral under examination is sulphuret of cadmium; and that it contains no zinc, and only a trace of iron.

"The author having obtained a larger crystal, of a reddish-yellow colour, and of similar crystalline form, from Lord Greenock, found its specific gravity to be 4.842 at 60° F. An analysis was also effected on 3.71 grains, principally of this crystal, by decomposing it by fuming nitric acid; precipitating the sulphur in the state of sulphuric acid by muriate of barytes; and throwing down the excess of barytes by sulphuric acid, and the cadmium as a carbonate by carbonate of ammonia, and converting it into the oxide by ignition. The constituents were thus found to be:

Sulphur, . .	22.56
Cadmium, . .	77.30
Iron, traces.	
	99.86

Agreeing completely with the theoretical composition of

1 Atom sulphur, .	201.16	22.40
1 Atom cadmium, .	696.76	76.59
	897.92	99.99

The mineral is thus a protosulphuret of cadmium, and is the first instance of a *separate* ore of cadmium, so far as the author knows.

"It is readily distinguished from transparent yellow zinc-blende, which it resembles, by its orange streak, that of yellow zinc-blende being white, and by its yielding with soda before the blowpipe a copious yellowish-red ring of sublimated cadmium, with no white sublimate. With borax it gives a yellow gloss.

"The specific name of Greenockite has been given to it by Professor Jameson, in honour of Lord Greenock."

2. On an Optical Illusion giving the idea of an Inversion of Perspective in viewing objects through a Telescope. By Professor Forbes.

" It has been noticed as a curious fact, first, it is believed, by Mr Whitwell, that *all* parallelograms seen obliquely appear distorted when magnified by a telescope. The effect is to render the space between the upper and lower parallel lines apparently greater as the distance increases,—thus annihilating the usual convergence to a vanishing point, or even reproducing it in an opposite direction. It is hardly necessary to add, that this Inversion of common perspective is only apparent; a fact conclusively established by measuring the angles subtended by the two extremities of a signboard or a row of windows, when the angle evidently diminishes with distance.

" The effect of magnifying power in apparently distorting objects, may, on the author's view of the subject, be thus concisely stated. The vanishing point of horizontal lines drawn in the same plane is determined wholly irrespective of the distance between them, or the size of the object to be represented. Farther, no movement of the plane nearer to, or farther from, the spectator, produces any variation in the position of the vanishing point in the perspective projection. But a telescope which magnifies an object, a signboard, for instance, magnifies the distance of the vanishing point from the point of sight in the same proportion. Hence the perspective is not true for the plane in which the object actually lies; and if the eye has taken cognizance of the position of the plane by previous inspection, it is easy to shew that it must infer the lines not to be *parallel*, but *diverging* from the nearer to the farther part of the parallelogram. On the other hand, if the plane of the object be not previously ascertained, it may appear still to be a parallelogram, but situated in a plane more nearly perpendicular to the line joining the observer's eye and the object than the true plane. Both these effects are really observed."

3. The following African Shells, collected by J. O. M'William, Esq., Surgeon R. N., were presented by that gentleman, to the Royal Society, through Dr Traill, who made a few remarks on each, especially the rarest, Nos. 3, 4, 5, 7, and 11.

1. Achatina Perdix—Accra, Gold Coast.
2. Achatina Scabra—Isle of Princes.
3. Achatina *Reversa* Purpurea—Isle of Princes.

4. Helix Polyzonalis—Madagascar?
5. Helix ?—Allied to H. Ungulina and H. Oculus.
6. Lymnæa Columna—Isle of Princes.
7. Ampullaria Corrugata—Madagascar.
8. Trochus Turbinatus—Isle of Princes.
9. Nerita Atrata— Do.
10. Neritina Puligera— Do.
11. Neritina Corona—Mozambique.
12. Turbo Muricatus—Isle of Princes.
13. Cypræa Moneta—Africa.
14. Patella Lacustris—Kafferland.
15. Patella Longicosta—Simon's Bay, Cape of Good Hope.
16. Patella Monopis— Do.
17. Patella Granatina— Do.
18. Crepidula Porcellana—Cape of Good Hope.
19. Voluta Volvacea—Africa.
20. A small Echinus— Do.

4. There was also presented by Professor Forbes, on the part of R. S. G. Kilbee, Esq., a collection of Fossil Shells, from the great deposit near Uddevalla, in Sweden.

This bed lies from 200 to 300 feet above the level of the sea, an arm of which extends to that town, but no shells are to be found upon its shores. It covers a space of several square miles, and is coated with soil, which in many places has been removed, the shells being taken to mend the roads, as well as for building purposes, and for manure. Such openings upon the surface are frequent on the hill just above the town, on the road to Gottenburg; but a mile or two on that to Wennersburg, and to the left, there is a large vertical opening, exposing to view from thirty to forty feet of the bed's depth, its entire depth being as yet unknown.

The mass of shells may be described as hard packed or pressed together, yet no where consolidated, nothing like order or arrangement being perceptible,—neither lines, veins, bands, nor strata,—alike from top to bottom, no earth, sand, or stones interspersed.

The species *pecten* predominates. Many of the mussels have strange forms; the mass is free, and is easily separated; many shells are already broken into fragments of every size, others delicate and yield to a slight pressure, while others again are fresh and hard, and clink as sharply as recent shells.

One is struck with their disorder; they are in every posture; the bivalves, which are most numerous, being no where in couples, nor horizontal, as when inhabited: a multivalve shell, peculiar to the locality, is in all cases found scattered, its parts being thrown asunder; the delicate sea-urchin, unable to stand the rush, is no where found perfect, though here and there many small portions may be gathered.

In short, the shells are as much confused and involved as if they had been sifted through large meshes; and thus it would appear as if the whole had been at once thrown into its present position by some mighty convulsion which violently overturned and interspersed them.

Monday, 6th April.

Sir T. M. BRISBANE, Bart., G. C. B., Pres., in the Chair.

The following Candidates were elected Fellows of the Society:—

G. A. Stuart, Esq.
Right Hon. T. B. Macauley, M. P.

The following Donations were presented:—

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, 1840. 1er Semestre. Nos. 6, 7, 8, 9.—*By the Academy.*

Astronomische Nachrichten. Nos. 380 to 386.—*By Professor Schumacher.*

Premier Memoire sur les Kaolins ou Argiles à Porcelaine, sur la Nature, le Gisement, l'origine et l'emploi de cette sorte d'Argile. Par M. Alexandre Brongniart, Professeur de Mineralogie au Museum d'Histoire Naturelle.—*By the Author.*

Memoires de l'Academie Royale des Sciences et Belles Lettres de Bruxelles. Tome xii.—*By the Academy.*

Bulletins de l'Academie Royale des Sciences et Belles Lettres de Bruxelles. Tome vi.—*By the Academy.*

Annuaire de l'Academie Royale des Sciences et Belles Lettres de Bruxelles. Sixieme Année. 1840.—*By the Academy.*

Annuaire de l'Observatoire de Bruxelles, pour l'an 1840; par le Directeur A. Quetelet.—*By the Author.*

De la Liberté Physique et Morale; par L. A. Gruyer.—*By the Author.*

Voyage dans la Russie Meridionale et la Crimée; par M. de Demidoff (Partie Scientifique). Livraison 5 en 8vo, et Planches en fol.—*By the Author.*

Nova Acta Physico-Medica Academiæ Cesareæ Leopoldino-Carolinæ Naturæ Curiosorum. Tome xix. Part 1.—*By the Academy.*

The Dedication of the Sanctuary; a Poem. By James Kennedy Bailie, M.D., M.R.I.A.—*By the Author.*

Observations on the Application of the Catadioptric Zones to Lights of the First Order in the system of Fresnel; with Tables of the Elements of Zones adapted to these Lights. By Alan Stevenson, LL.B., F.R.S.E.—*By the Author.*

The Journal of the Royal Geographical Society of London. Vol. x. Part 1.—*By the Society.*

Collection de Memoires et de Relations sur l'Histoire Ancienne du Canada.—*By the Lit. and Hist. Soc. of Quebec.*

The Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. No. 48, for March 1840.—*By the Society.*

The following Communications were read :—

1. Notice regarding the Growth of Plants in close Glazed Cases. By Allan Maconochie, Esq.

2. Results of Additional Experiments on Terrestrial Magnetism. By Professor Forbes.

" The author commences with some remarks on the degree of accuracy attainable by portable magnetic apparatus, and particularly by the use of dipping needles of moderate dimensions. A six-inch needle by Robinson of London, belonging to the Society, together with the Hansteen apparatus for horizontal intensity, were the chief instruments employed by him in a tour through Germany in 1837, in which (though magnetic investigations did not form his primary object), he endeavoured to obtain the approximate value of the elements of dip and intensity for several important stations, and also to carry out into the Eastern Alps the investigations he had already, in 1832, conducted in Switzerland.

"The following table contains some of the principal results:

Place.	Horizontal Intensity. That at Paris = 1.000.	Dip.	Total Intensity. That at Paris = 1.3482.
Edinburgh, .	.840	71°.55'.0	1.409
Greenwich, .	.938	69.11.5	1.375
Brussels, . .	.960	68.28.5	1.361
Bonn, . .	.979	67.51.3	1.353
Drachenfels, .	.939	...	...
Göttingen, . .	.978	67.53.5	1.354
Berlin, . .	.973	68. 5.5	1.358
Dresden, . .	1.001	...	...
Carlsbad, . .	1.020	66.40.7	1.342
Linz, . .	1.066	65.15.4	1.327
Ischl, . .	1.078	...	...
Salzburg, . .	1.073	65. 3.5	1.325
Bad Gastein, .	1.090	...	...
Windisch Matrei,	1.084	...	...
Inspruck, . .	1.077	64.48.7	1.318
Bormio, . .	1.087	...	...
Trent, . .	1.104	64. 5.5	1.315
Laybach, . .	1.127	63.23.6	1.311
Vienna, . .	1.080	64.51 0	1.324
Ratisbon, . .	1.040	65.52.3	1.325

A collection of Fossil Shells from Italy, presented by the Chevalier Michelotti of Turin, was laid on the table.

A collection of Organic Remains from the Airdrie Coal-measures was exhibited by Mr Bald.

Monday, 20th April.

Sir T. M. BRISBANE, Bart., G. C. B., Pres., in the Chair.

The following Candidates were elected Fellows of the Society:—

Gilbert Laurie Finlay, Esq.
John Mackenzie, Esq.
John Thomson, Esq.

The following Donations were presented:—

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, 1840. 1er Semestre. Nos. 10, 11, 12.—*By the Academy.*

Third Annual Report and Proceedings of the Botanical Society. Session 1838–39.—*By the Society.*

Specimens of Printing Types in the office of Neill & Co., Printers and Type-Founders.—*By Neill & Co.*

A collection of Fossil Organic Remains from Touraine was presented by Sir George Mackenzie, Bart.

Specimens of Fossil Vegetables and Shells from Shetland and Skye, by Professor Necker of Geneva, Hon. F. R. S. Ed.

The following Communications were made :—

1. " Sir Charles Bell requested leave to withdraw his paper *on the fatal effects of air admitted into the veins of the neck during surgical operations,* in order to make additions.

" He stated some interesting facts from veterinary practice. But the principal addition he desired to make was the notice of certain experiments made on the human subject after death, and which Dr Reid repeated and verified.

" A small incision being made in the lower part of the neck, the external jugular vein was found flat; but an incision being made into it on raising the shoulder and clavicle of that side, the vein opened. On holding open the integuments so that the wound might hold fluid, milk was poured into it: the milk remained stationary as in a cup; but on elevating the shoulder and clavicle, the milk descended into the vein and disappeared.

" The experiment was repeated and varied, but always to the effect of shewing that, by the elevation of the shoulder and clavicle, and the mastoid muscle attached, pressure was taken off the veins of the neck; while on the descent of these parts, the fluid sucked into the vein was conveyed downwards.

" These experiments Sir Charles maintained fortified the conclusion to which he had come by process of reasoning in his paper, viz. that air enters the veins of the neck during surgical operations when the veins are opened, and the patient shrinks and inspires deeply."

2. On the Origin and Progress of Grecian Sculpture. By Dr Traill. Part I.

" The author adduced arguments to prove, that the Egyptians were the real masters of the Greeks in the arts of Design. The Greek writers admit that, when their ancestors were barbarous, the Egyptian colonists of Argos and Athens imported with them the arts of a more polished people; that they brought into Greece images of the Gods; and that the most ancient sculptures mentioned by Pausanias and Pliny bore the impress of an Egyptian character; especially the wooden statues ascribed by Pausanias to the elder Dædalus and to Attalus, the celebrated colossal statue of the Amyclæan Apollo, and the lions still existing over the gate of Mycenæ.

" In tracing the progress of Grecian sculpture, the author endeavoured to shew that it was possible to divide it into schools and epochs, in a manner similar to that employed by the Italian writers on art to discriminate the different schools of painting, by peculiarities observable in each. From the notices of their sculpture which have reached us, and from existing remains, he conceives that we may distinguish the following great schools of sculpture:

" 1. The Egypto-Grecian.

" 2. The Ionian, including the Samian, Chian, and Rhodian.

" 3. The Sicyonian, including the Corinthian.

" 4. The Æginetan.

" 5. The Græco-Italian, comprehending the Hetruscan, Magna-Grecian, and Sicilian.

" 6. The Attic.

" 7. The Græco-Egyptian, or period of the Ptolemies.

" In this part of his essay the author briefly sketched the two first schools. The Græco-Egyptian is characterized by severity of style, constrained and little-varied attitudes; with the chief care bestowed on the heads and extremities, while the bodies and draperies are meagre and ungraceful. The Ionian school first began to give more freedom to the attitudes, to separate the limbs, and give energy to the figures. In its later periods it arrived at higher excellence in the most difficult branches of the art, the union of anatomical precision with grace, and noble composition in grouping with the utmost energy of action, as is well seen in *the Venus from the Bath* of the Pontifical collection, and *the Laocoon*; which are later productions of the Ionian school.

" It was this school which introduced into Greece itself the first great improvements on the *Egypto-Grecian* style."

3. Account of Earthquakes felt in Scotland during the Autumn and Winter of 1839. By David Milne, Esq.

" I. The first part of the paper described the number and intensity of the shocks felt between the 3d October 1839 and 13th April 1840, the point (situated near Comrie) from which they emanated, and the distance to which they extended.

" II. The next part of the paper was occupied with an account of the effects, both physical and moral, produced by the shocks.

Under the first class were described the different kinds of injury done to walls, according to their direction, and the nature of the ground on which they were built. Under the second were mentioned the alarm felt by the inhabitants of Strathearn during the great shock of 23d October, as also the quick perception of it by the lower animals, and the terror they evinced at it.

" III. The nature of the movement of the earth's surface which caused the foregoing effects was next noticed, and data were given illustrating the form of the undulation which was produced. The noises also that accompanied the shocks were fully described, and the probable cause of them stated.

" Various other concomitant phenomena of an unusual character were noticed, such as the evolution of electricity, the diffusion throughout the atmosphere of something which caused a smell, variously described as 'metallic,' 'sulphureous,' and like the 'washings of guns;' as also the appearance in various parts of Strathearn of a fine black powder, which appeared to consist chiefly of carbonaceous, and partly of siliceous and calcareous matter.

" IV. The last part of the paper was devoted to remarks on the way in which the undulation 'of the earth's' surface was caused, and the circumstances which may have produced the earthquakes.

" In reference to the first point, various reasons were assigned why the phenomena were more intelligible, on the supposition that they were caused by vibrations transmitted through the solid crust of the earth, than on the theory supported by many, that they were caused by undulations in the body of molten matter on which the earth's crust may be resting. These vibrations were probably caused by ruptures or explosions at a considerable depth beneath the earth's surface.

" In regard to the cause of these ruptures, it was observed, that the hills in the immediate neighbourhood of Strathearn are chiefly primitive, and of igneous origin, and that there are numerous greenstone and basaltic dykes, indicating renewed volcanic action at subsequent periods. There are apparently extensive fissures in the earth's crust in this part of Perthshire. It was also observed, that, during the month previous to the occurrence of the earthquake, the atmospheric pressure had been greatly less than usual; and that the quantity of rain which fell was almost unprecedented in the central parts of Scotland. There appeared to be some connection between the state of the atmosphere in both these respects, and the occurrence of the earthquakes, judging from some observations made last autumn, but more particularly from the frequent coincidence of shocks in former years, with a similar state of the atmosphere. Some views were offered as to the influence which these circumstances might have in giving rise to the earthquakes.

" Notice was taken of shocks which had been felt in other parts of Europe, at the time that shocks occurred in Scotland."

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1840–1841. No. 18.

Monday, 7th December 1840.

Sir T. M. BRISBANE, Bart. President, in the Chair.

The following communications were read :—

1. On certain Physiological inferences which may be drawn from the study of the Nerves of the Eyeball. By Dr Alison. Part First.

The principles which the study of the Nerves of Sensation and of Voluntary Motion within the Orbit is thought to illustrate, are :—

1. The peculiarity of the muscles of the Eyeball, that they receive few or no *sensitive* filaments, such as supply all other muscles of the body,—coupled with the peculiarity of their office, that they are designed, in the natural state, to be regulated, not by sensations excited in themselves by their action, but by sensations excited thereby in the Retina,—suggests an important reflection on the use of sensitive nerves and of sensations in guiding and regulating all voluntary and instinctive muscular motion ; the sensations which *result* from the commencing action in every case fixing the effort of the will on the right muscles, and regulating

the extent to which the contractions shall be carried; while experience in some cases, and instinct in others, teaches what motor nerves must act, in order to excite the commencement of these sensations.

2. The *consentience* of different nerves, and thereby different muscles, in the performance of complex actions,—for example, the exact consentience of the nerves of the same pair on each side of the body in the acts of deglutition, respiration, coughing, sneezing, vomiting, straining, &c., is partly to be ascribed to the cause assigned by Müller,—the "conducting power of the medullary substance at the roots of the nerves, whereby those which lie contiguous to each other are apt to be affected simultaneously;" and this is probably the reason why the action of rolling the one eye *outwards*, being always intended to be performed simultaneously with the rolling *inwards* of the other, is excited by distinct nerves (viz., the 4th and 6th) from those which excite this latter movement; whereas the motion upwards and downwards, being intended to be performed simultaneously by the two eyes, is excited through one pair of nerves only, viz. the 3d. But it appears, from attending to the actions of the 4th and 6th nerves,—those which roll the eye outwards,—that this proximity of origin cannot be the main cause of consentience of action in motor nerves, the opposite nerves of these pairs never acting together in the natural state, but each always acting with a portion of the 3d nerve on the opposite side. And it thus appears, that the truly efficient reason of the consentience of motor nerves in all cases, and the only one which can be assigned in this case, is the *identity of the resulting and guiding sensation.*

3. The remarkable combination of movement observed in the actions of the 4th and 6th nerves on one side of the body and of a part of the 3d on the other, is conclusive proof that neither connection of nerves at their root, nor union in their course, is concerned in producing such combinations, and that the plexuses of nerves cannot be instrumental in producing any of the combinations observed among the muscles of the limbs.

But the use of the plexuses as to muscular motion becomes sufficiently obvious when we observe, that by this contrivance the sensitive nerves of every muscle in the extremities are placed in connection with a large surface of the spinal cord, and, therefore, probably the guiding sensations resulting from their action are evidently more distinct; and again, that the motor nerves of every muscle are connected with a larger surface of the spinal cord, and may be acted on in consequence of the conducting power of the medullary substance, more energetically. The muscular sensations being more distinct, and the acts of the will being more energetic, the mind acts on the muscles thus supplied with more power and precision, and recollects and repeats the action, or succession of actions, with more certainty and uniformity than it otherwise could have done.

2. On the Plane and Angle of Polarization at the Surfaces of Crystals. By Professor Kelland.

The subject of Crystalline Reflexion has been treated by Mr MacCullagh and M. Neumann; but both these writers commence their investigations by assuming that certain equations hold true at the common surface of two media. The object of the present Memoir is to obtain such equations from mechanical considerations. To attain this, the following hypotheses are made:—1. That common light consists of vibrations, whose plane of motion is continually changing without law, or is indeterminate. 2. That light, polarized in a given plane, consists of vibrations perpendicular to that plane. 3. That the media consist of particles at sensible distances from each other, and acting mutually by a force which varies inversely as the square of the distance. 4. That, at the surface, a portion of the motion is destroyed by the sudden change from a motion in one direction to a motion in another. The nature of the medium which constitutes a crystal is defined by the direction which the ray takes within the crystal, as compared with its direction without. By means of these hypotheses, it is shewn that the following conditions result:—1. That the resolved parts of the motion in three directions are at the surface the same, whether estimated as belonging to the rays without or within the crystal; and, 2. That three other equations, derived from the former by a simple law of derivation, coexist with the above, and with them constitute the equations of relation between the incident, reflected, and refracted rays. These equations being solved give the position of the plane of polarization as determined by M. Neumann and Mr MacCullagh. They give also the polarizing angle in a form slightly differing from that obtained by the latter; but differing from it in such a manner as to agree (in the point of difference) with the formula of the former.

The following Donations were reported as having been received since the close of the last Session :—

The American Journal of Science and Arts. Conducted by Benjamin Silliman, LL.D. For January, April, July, and October 1840.—*By the Editor.*

Proceedings of the American Philosophical Society. January, February, May, June, July.—*By the Society.*

On the Heat of Vapours and on Astronomical Refractions. By John William Lubbock, Esq.—*By the Author.*

Researches in Embryology. (Second Series.) By Martin Barry, M.D., F.R.S.E.—*By the Author.*

Transactions of the Cambridge Philosophical Society. Vol. vii. Part 1.—*By the Society.*

Mémoires de la Société Physique et d'Histoire Naturelle de Génève. Tome viii. Part 2.—*By the Society.*

Transactions of the Society instituted at London for the Encouragement of Arts, Manufactures, and Commerce. Vol. lii. Part 2.—*By the Society.*

The Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. For June, September, and December.—*By the Society.*

Journal of the Asiatic Society of Bengal. For June, July, August, September.—*By the Society.*

Asiatic Researches; or Transactions of the Society instituted in Bengal for inquiring into the History, the Antiquities, the Arts and Sciences, and Literature. Vol. xix. Part 2.—*By the Society.*

De Graphite Moravico et de phænomenis quibusdam originem Graphitæ illustrantibus Commentatio. E. F. De Glocker. *By the Author.*

Proceedings of the Geological Society of London. Nos. 67 to 71. —*By the Society.*

Astronomische Nachrichten. Nos. 387 to 399.—*By Professor Schumacher.*

Memoirs of the Wernerian Natural History Society for the Years 1837–38. Vol. viii. Part 1.—*By the Society.*

Journal of the Royal Asiatic Society. May 1840.—*By the Society.*

Collecçao de Noticias para a Historia e Geografia das Naçoes

Ultramarinas que vivem nos dominios Portuguezes ou lhes sào visinhas; publicada pela Academia Real das Sciencias. Tomo v. No. 2.—*By the Royal Academy.*

Astronomical Observations made at the Royal Observatory, Edinburgh. By Thomas Henderson, F.R.S.E. Professor of Practical Astronomy. Vol. iii.—*By the Royal Society of London.*

Report on Education in Europe, to the Trustees of the Girard College for Orphans. By Alexander Dallas Bache, LL.D., President of the College.—*By the Author.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Van Der Hoeven, M.D., Prof. te Leiden, en W. H. De Vriese, M.D., Prof. te Amsterdam. Deel vi. St. 4. Deel vii. Stks. 1. 2.—*By the Editors.*

Bulletin de l'Académie Royale des Sciences et des Belles Lettres de Bruxelles, 1840. Nos. 1 to 8.—*By the Academy.*

Brevi Cenni di Alcuni Resti delle Classi Brachiopodi di G. Michelotti.—*By the Author.*

De Solariis in Supracretaceis Italiæ Stratis repertis. Auctore Joanne Michelotti.—*By the Author.*

Transactions of the Geological Society of London. (Second Series.) Vol. v. Part 3.—*By the Society.*

The Rod and the Gun. Being Two Treatises on Angling and Shooting, by James Wilson, Esq. F.R.S.E., and by the Author of the "Oakleigh Shooting Code."—*By the Authors.*

Madras Journal of Literature and Science. 1839. July, September, and December.—*By the Editors.*

Oryctographie du Gouvernement de Moscow. Publiée par Gotthelf Fischer De Waldheim.—*By the Imperial Society of Naturalists of Moscow.*

Einiges gegen den Vulkanismus. Von B. M. Keilhau.—*By the Author.*

Notice sur les Gallas de Limmon. Par M. Jomard.—*By the Author.*

Notation Hypsométrique ou Nouvelle Maniere de Noter les Altitudes. Par M. Jomard.—*By the Author.*

Quelques Recherches sur la Chaleur Spécifique. Par MM. les Professeurs De la Rive et Marcet.—*By the Authors.*

Deuxième Mémoire sur les Variations Annuelles de la Température de la Terre a différentes profondeurs. Par A. Quetelet. —*By the Author*

Second Mémoire sur le Magnétisme Terrestre en Italie. Par A. Quetelet.—*By the Author.*

Résumé des Observations Météorologiques faites en 1839, à l'Observatoire Royal de Bruxelles. Par A. Quetelet.—*By the Author.*

Mémoires Couronnés par l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xiv. 1ere partie.—*By the Royal Academy.*

Fisica de Corpi Ponderabili ossia Trattato della Constituzione Generale dé Corpi del Cavaliere Amedeo Avogadro. 2 vols. 8vo.—*By the Author.*

Memorie della Reale Accademia delle Scienze di Torino. (Serie Seconda.) Tomo i.—*By the Academy.*

Proceedings of the Linnean Society of London. Nov. 6. 1838 to March 17. 1840.—*By the Society.*

Transactions of the Linnean Society of London. Vol. xviii. Part 3.—*By the Society.*

Ancient Laws and Institutes of England; comprising Laws enacted under the Anglo-Saxon Kings from Athelbirht to Cnut, with an English Translation of the Saxon; the Laws called Edward the Confessor; the Laws of William the Conqueror, and those ascribed to Henry the First; also Monumenta Ecclesiastica Anglicana, from the seventh to the tenth century; and the ancient Latin version of the Anglo-Saxon Laws.—*By the Commissioners on the Public Records of the Kingdom.*

Ordnance Survey of Ireland—County of Carlow in 28 sheets; and King's County in 49 sheets.—*By the Lord Lieutenant of Ireland.*

Disquisizione delle Dottrine sulla Struttura e sulle Funzioni del cuore e delle Arterie. G. M. Zecchinelli.—*By the Author.*

Footsteps of the Cheirotherium as shewn on Slabs of New Red Sandstone from Storeton Hill Quarry, Cheshire; illustrated in 3 plates.—*By Dr Buckland.*

Elements of Chemistry. By the late Edward Turner, M.D. Enlarged and revised by Justus Liebig, M.D., Wilton G. Turner, and W. Gregory, M.D. Part 3. No. 2.—*By the Editors.*

Transactions of the American Philosophical Society held at Philadelphia for promoting Useful Knowledge. (New Series.) Vol. vii. Part 1.—*By the Society.*

Mémoires de la Société des Sciences Naturelles de Neuchatel. Tome ii.—*By the Society.*

Mémoires de l'Académie Impériale des Sciences de Saint Petersbourg. (Sciences Mathématiques, &c.) Tome ii. Liv[ns] 3, 4.

Do. do. (Sciences Politiques, &c.) Tome iv. Liv[ns] 4, 5.

Do. do. (Sciences Naturelles.) Tome iii. Liv[ns] 1, 2, 3, 4.

Recueil des Actes des Séances Publiques de l'Académie Impériale des Sciences de Saint-Petersbourg, tenues le 29 Dec. 1838 et le 29 Dec. 1839.—*By the Imperial Academy.*

Voyage dans la Russie Méridionale et la Crimée. Par M. de Demidoff. Liv[ns] 2, 3, des planches.

Do. do. (Partie Scientifique) Liv[ns] 6, 7, 8, 9, 10, en 8vo, et planches en folio.—*By the Author.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences de Paris 1840. 1[er] Sémestre No. 13, 14, 15, 16, 17, 18, 19.—*By the Academy.*

Mémoire sur la Formation de l'Indigo dans les Feuilles du Polygonum Tinctorium, ou Renouée Tinctoriale. Par Ch. Morren.—*By the Author.*

Recherches sur le Mouvement et l'Anatomie du Style du Goldfussia Anisophylla. Par M. Ch. Morren.—*By the Author.*

Twentieth Report of the Council of the Leeds Philosophical and Literary Society at the close of the Session 1839–40.—*By the Society.*

Essays and Heads of Lectures on Anatomy, Physiology, Pathology, and Surgery. By the late Alexander Monro, Secundus, M.D., F.R.S.E., upwards of fifty years Professor of Anatomy and Surgery in the University of Edinburgh. With a Memoir of his Life by his Son and Successor.—*By Dr Monro.*

Mr Greenough's Geological Map of England.—*By the Geological Society.*

A Collection of Specimens of Fossil Organic Remains.—*By Chevalier Michelotti of Turin.*

An Humble Address to her Majesty on the occasion of the Birth of the Princess-Royal was approved of, and directed to be transmitted for presentation to his Royal Highness the Duke of Sussex.

Monday, 21*st December.*

The Right Hon. Lord GREENOCK, V. P. in the Chair.

The following Communications were read:—

1. On the Polarization of the Chemical Rays of Light, by

Dr Sutherland, Liverpool. Communicated by the Secretary.

From a series of experiments made last summer, the author infers, in confirmation of the results obtained by Young, Berard, and Arago, that the chemical rays of light are subject to the same laws of interference and polarization as its luminous rays.

He found that the two images, produced by the sunbeam, and also by its extreme violet rays, when refracted through a calc-spar prism, quickly produce dark impressions, on being thrown upon photogenic paper, and that the extraordinary ray produces more effect than the ordinary one. He then observed, by alternately extinguishing and restoring the luminous rays with an analyzing apparatus of mica-plates, that the plane of polarization of the chemical rays, as indicated by the action on photogenic paper, corresponds with that of the luminous rays. He next ascertained, that, by means of a section of calc-spar rhomb, the polarized sunbeam, or the polarized violet ray, could be made to produce, on photogenic paper, a series of phenomena analogous to the coloured rings formed in the like circumstances by the luminous rays. But the effect of the violet rays was not so perfect as might have been desired, owing to the want of a contrivance for keeping the rays steadily for some time on the same part of the paper during the change in the sun's position.

The author farther found, that the chemical rays may be polarized by reflexion, and then equally exhibit the general properties which would be expected from a knowledge of those procured by the luminous rays. The sunbeam, reflected from a mirror of glass-plates upon an analyzing plate of flint-glass, and thence on photogenic paper, was observed to have scarcely any effect; but when the ray was rendered capable of reflection, either by turning the analyzing plate on its axis, or by interposing a plate of mica, a dark impression was soon formed.

Lastly, he ascertained that similar results might be procured by means of repeated single refraction, which was accomplished by two bundles of mica-plates so arranged in a tube as to admit of the planes of the bundles being either placed at right angles to one another, or made coincident. In the former case, the photogenic paper was not affected, but in the latter, it was speedily darkened. By a similar apparatus made of flint-glass, he succeeded in obtaining results of the same kind with the light proceeding from the sky.

2. On the Nutrition of Vegetables, by Dr H. R. Madden, Penicuik. Part First. Communicated by Dr Christison.

The object of the author in this part of his investigation, is to shew that the portion of the food of plants which they receive from the soil, and which he endeavours to prove is chemically combined with it,—although to appearance generically the same in all soils,—is not composed, as some imagine, of one single proximate principle, the same in all circumstances, but consists of several principles varying in their respective proportions in different soils. And he farther attempts to establish the general proposition, that the varying proportion of these principles may be one great cause of the relative fitness of different kinds of soil for the cultivation or nourishment of different kinds of vegetables.

In the course of explaining these views, which were supported chiefly by speculative considerations, but which the author hopes to confirm by experimental researches in which he is now engaged, he had occasion to refer to the doctrine recently advanced by Liebig, that the relative fitness of different soils to different plants seems to depend, not on the organic matter contained in them, but in a great measure on their relative composition as to saline ingredients corresponding or not corresponding with the composition and amount of saline ingredients in plants. The author controverts this proposition, and endeavours to prove by reference to the composition of those soils in which wheat reciprocally thrives or languishes, that Liebig's doctrine is untenable. It is well known that a sandy soil, which, after one process of manuring, will raise in succession an excellent crop of turnips, barley, hay, and oats, nevertheless does not answer at all well for wheat;—which, on the contrary, produces most abundantly on a clayey soil. Liebig holds the cause of this difference to be, that in sandy soils there is not enough of the saline ingredients, more especially of potash-salts, which are essential to the constitution of wheat. The author proves, however, by calculations founded partly on experiments by Liebig himself, and partly on experimental researches of his own, that sandy soil, after being properly treated with farm-yard manure, not only contains a much larger amount of saline matters, including potash-salts, than is required for the constitution of a superior crop of wheat-straw and grain, but likewise, that it actually supplies three times the quantity of salts, and among these, three times the quantity of potash, required for a fine wheat crop, to the turnips, barley, hay, and oats successively raised on it, and nearly double the quantity of potash necessary for the wheat to the turnips alone. These facts will appear from the following table :—

Salts in an imperial acre of—

		Total Salts.	Potash.
	Wheat, ...	358.3 lb.	50. lb.
The crops of a rotation after a single application of manure, viz. :—	Turnips, . . .	389.7 ...	92.4 ...
	Barley, ...	310.0 ...	40.0 ...
	Hay, ...	200.0 ...	20.0 ..
	Oats, ...	207.0 ...	20.0 ...
	Total,	1106.7...	172.4...

3. On the Fossil Fishes of the Old Red Sandstone of Orkney. By Dr Traill.

The author stated, that besides the original localities at Skaill, Ichthyolites have been found at Breckness, Quoyloo, and Kirkwall, in Pomona, in South Ronaldshay, and in Papa-Westray. The species already recognised from these localities are, 1. Osteolepis macrolepidotus. 2. Osteolepis microlepidotus. 3. Cheirolepis Traillii. 4. Cheiracanthus minor. 5. Diplocanthus crassissimus. 6. Dipterus macrolepidotus. 7. Platygnattus paucidens. 8. Coccosteus latus. 9. Plerichthys Milleri. 10. Diplopterus Agassiz.

All but the last have been named by M. Agassiz, who determined the generic characters from specimens in the author's possession. The characters of the Diplopterus Agassiz are the following. The genus Diplopterus has two dorsal fins, similar and opposite to two anal fins; vertebræ continued into the upper lobe of a nearly even tail; and a wide mouth armed with strong conical teeth. It belongs to the Sauroid family of Ganoid fishes. The species D. Agassiz may be distinguished by a rounded snout; a large head almost equal to a fourth of its whole length; a single row of trigonal, hatchet-shaped scales on the ridge of its back, and oblique rows of rhomboidal scales passing from these to the abdomen; smooth scales, and the dorsal and anal fins rounded at their extremities, and composed of slender rays.

4. Mr Milne made a verbal communication respecting Instruments for registering Shocks of Earthquakes.

The advantages of registering earthquake shocks were first briefly noticed. 1. Such registers would shew whether, as supposed, the shocks were more frequent and violent during certain states of weather, and particular months of the year. If this were ascertained, some light would be thrown on the cause of the shocks, in so far at least that it must be a cause which can be affected by atmospheric influences. 2. They would serve to shew whether the shocks that occur in this country coincide in time with those occurring in distant countries, and whether therefore they all originate from a common source, or are otherwise connected. 3. If there were instruments placed in different parts of an earthquaking district, the different effects of the same shock on these instruments would lead to the discovery not only of the precise spot on the earth's surface where the shocks were strongest, but likewise of the depth in the earth's crust from which they emanated.

The difficulty of devising proper instruments for registering the shocks, and especially of measuring their force, was next alluded to. As the instruments can only be made to operate by the movement of the earth's surface, the precise effects on the instruments cannot be anticipated, as the nature of that movement is as yet very imperfectly known. It seems probable from the observations made last year in Perthshire during the most violent shocks, not only that there is a change of level, but that there is also a slight progressive motion in the part of the earth's surface affected. In the construction of the instruments therefore, not only their gravitating tendency, but also their inertia, must be taken into account.

With the view of discovering what instruments could be employed for the purpose of registering the shocks, and of having them set in proper places, under the charge of careful and intelligent observers, a committee was appointed by the British Association at their last meeting in Glasgow.

A number of instruments had been proposed, several of which were explained; and three, recently constructed to be sent to Perthshire, were exhibited. Two of those exhibited were constructed on a principle suggested by Professor Forbes,—being an inverted pendulum, supported by a strong steel spring at the bottom, and loaded with a weight near the top, so that it should vibrate in the direction of the shock, whenever the floor of a house to which it may be attached shall change its horizontal position. The direction and the extent of vibration are indicated by marks left on paper by a soft black-lead pencil rubbing against it, affixed to the upper end of the pendulum. This instrument and most of the others explained appeared likely to be affected only by lateral or horizontal movements of the earth's surface. One or two were also suggested for the purpose of recording the vertical movements.

James Anstruther, Esq. was duly admitted an Ordinary Fellow of the Society.

The following Donations were presented :—

Elements of Chemistry, including the actual state and prevalent doctrines of that Science. By the late Edward Turner, M. D. F.R.S.L. & E. Edited by Justus Liebig, M.D., F.R.S.L. & E., and William Gregory, M.D., F.R.S.E.—*By the Publishers.*

A Tabular View of the yearly quantity of Rain which falls in different parts of Great Britain. By Joseph Atkinson, Harraby, near Carlisle.—*By the Author.*

Memoirs of the Royal Astronomical Society, vol. xi.—*By the Society.*

Astronomische Nachrichten,—Nos. 400 to 411.—*By Professor Schumacher.*

A Collection of Fossil Fishes from Orkney.—*By Dr Traill.*

4th January 1841.

Dr ABERCROMBIE, V.P. in the Chair.

1. On certain Physiological Inferences which may be drawn from the study of the Nerves of the Eyeball. By Dr Alison. Part Second.

The second part of Dr Alison's paper treated, *first*, of the inferences which may be drawn from the study of the Nerves of the Eyeball, touching the use of the Ganglia of the Sympathetic Nerve, which are now generally admitted to have essentially the same composition as the ciliary ganglion, *i. e.* to have motor as well as sensitive filaments from the spinal cord, besides the cords of communication with the other ganglia.

In the eye, as in other parts, the muscles supplied with nerves through these ganglia are muscles of *involuntary* motion. The supposition that this or any other part of the Nervous System is intended to *give* the power of motion to muscles, is quite hypothetical and opposed by facts; but there is nothing hypothetical in the assumption, that Sensations and Emotions of mind, which obviously affect the involuntary muscles, must do so through these ganglionic nerves; and therefore that the structure of these nerves and their ganglia must be designed to fit them for transmitting that kind of nervous action which attends those involuntary acts of mind, and to disqualify them for transmitting the direct influence of the will.

Taking this view of the subject, the following inferences are considered to be justified by facts known as to these ganglionic nerves in the eye and elsewhere.

1. That the vital endowments, both of sensitive and motor nerves, are much modified by passing through these ganglia,—that the influence of the will is not arrested by the ganglia, but is never felt to be exercised, and cannot be directed downwards to any specific object beyond them,—perhaps only because no distinct muscular sensations are transmitted upwards through these ganglia.

2. That muscles which have their nerves from the ganglia of the sympathetic may be affected by changes in the sensitive as well as in the motor nerves which enter those ganglia; and that the structure of the sympathetic nerve is fitted for *concentrating* on these involuntary muscles what the author terms *Sensorial Influence*, as distinguished from the effect of Volition; *i. e.* the influence of those changes in the nervous system which attend sensations and emotions of mind, and which obviously extend much more generally over the spinal cord and nerves than the effects of volition do.

Secondly, This part of the paper stated the appropriation of nerves of the fifth pair to the lachrymal gland, and the effects of section of that nerve on the nutrition of the eyeball, as clear proof, that those sensations and emotions of mind which affect the secretions and nutrition of the body, act downwards through the nerves of *common sensation*. The supposition of Müller and others, that the grey fibres of nervous matter are those destined to affect these organic functions exclusively, he regards as hypothetical, and opposed by pathological facts; but he assents to the opinion of Dr Marshall Hall, that it is probably with a view to the influence of emotion and sensation, passing *downwards* along the nerves of common sensation, that the ganglia are formed on the roots of those nerves.

The Secretary stated the substance of a communication by Mr Atkinson, on the subject of Rain-Gauges; and of another on an Instrument for Measuring the force of Winds.

The following Gentlemen were duly elected Ordinary Fellows of the Society:—

J. P. Muirhead, Esq.
James Hunter, M.D.
Colonel Morison, C.B. Madras Artillery.

The following Donations were presented:—

Bericht über die zur Bekanntmachung geeigneten Verhandlun gen der Königl. Preuss. Akademie der Wissenschaften zu Berlin. Juli 1839 bis Juni 1840.—*By the Academy.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. 1832. Thiels 3 and 4, and 1838.—*By the Academy.*

Flora Batava. No. 120.—*By the King of Holland.*

Annuaire Magnétique et Météorologique du Corps des Ingénieurs des Mines de Russie. Année 1838. Par A. F. Kupffer.—*By the Author.*

18*th January* 1841.

The Right Hon. Lord GREENOCK, V.P. in the Chair.

The following Communications were read :—

1. On the Mode in which Musket-balls and other Foreign Bodies become enclosed in the Ivory of the Tusk of the Elephant. By John Goodsir, Esq. Communicated by Professor Syme.

The author commenced by stating, that "in all the specimens he had examined, two circumstances were at once detected; first, That the balls were enclosed, not in the true ivory, but in an abnormal structure; and secondly, that the holes by which the balls entered were either partially or completely cicatrized in cases of wound of the socket; which led him to suppose that, as the tusk is an organ of double growth, the membrane of the follicle and the pulp both play important parts in the process of enclosure, and that there is no regeneration of true ivory,—an hypothesis which was afterwards verified by observation. From a consideration of the opinions of Camper, Blumenbach, Lawrence, and Cuvier, it appeared that doubts are entertained as to the existence of cicatrices after wounds of the tusk, and opinions held as to the impossibility of the occurrence of such phenomena in a non-vascular substance like ivory. To investigate this subject with success, two principles must be kept in view: first, that a tusk is formed from within outwards, as well as from without inwards; and secondly, that the ivory and cement are never changed by vital action in form or substance, after their original deposition." With these two principles, the author proceeded to explain the healing of different wounds of the tusk, and the mode of enclosure of balls and other foreign bodies, by describing in detail the development and structure of the bony mass which appears in the pulp after wounds. He stated, 1. That wounds of the surface of the pulp are followed by ossification round the injury; 2. That the track of a ball across the pulp ossifies at the two extremities, but not necessarily in the rest of its extent; 3. That the track ossifies when abscess ensues, or when it becomes fistulous; and 4. That balls and foreign bodies are always enclosed in a mass of ossified pulp. This ossified pulp, when examined in thin sections under the microscope, presents a formation identical with the irregular ivory which fills the pulp cavity of the tusks of the walrus, and the tusk of the cetacea, and consists of anastomosing Haversian canals, secondary medullary canals, and wavy bundles of Retzian tubes. These canals and tubes are situate in a clear matrix, in which there are occasional patches of coarse cells, through the medium of which the bundles of Retzian tubes communicate with one another, and with the tubes of the regular ivory. The formation of the irregular ivory which surrounds wounds, abscesses, and foreign bodies in the pulp, does not proceed indefinitely, but is limited by the closing up of the orifices of the Haversian canals, and the consequent separation of their contained ramifying pulp from the general system. The irregular ivory is then, in reference to the general pulp of the tusk, in the same relation as the regular ivory, and at length becomes enclosed in the latter by the transformation of the pulp on its surface. It was then stated that foreign bodies enter the pulp in three ways; 1. Through the base of the pulp, without wounding the ivory; 2. Through the free portion of the ivory; and 3. Through the sides of the socket. A case of the first kind is described by Mr Combe in the Philosophical Transactions. Wounds of the second kind, when there is no trace of the track of the ball, have, with the exception of the formation of the irregular ivory, been sufficiently explained by former authors. In reference to wounds of the third kind, Mr Goodsir demonstrated that cicatrices, partial and complete, do occur, and that they are produced by the plugging up of the hole from within by irregular ivory or ossified pulp, and from without by cement formed by the membrane of the follicle. In conclusion, it was stated that every case of wound, fracture, and enclosure of foreign bodies in ivory, might be explained by the facts, that a tusk was an organ of double growth, and that its follicle played an important part in the healing of wounds through the socket.

2. On the Theory of Waves. Part II. By Professor Kelland.

The present memoir is a continuation of that which the author presented to the Society in April 1839. It is divided into four sections. In the first (which is marked Section 4, in continuation of the preceding memoir) the general problem of wave motion is treated of, and the equations to the surface are obtained by two different processes, giving results which agree with those obtained in the former memoir. In the second, the problem of wave motion in a canal of constant width and constant depth in the direction of the width, but of variable depth in the direction of motion, is treated by the method of the variation of parameters. The following are the approximate results :—1. The length of the wave diminishes directly as the depth diminishes. 2. That the velocity of transmission at any point is directly proportional to the square-root of the depth at that point. 3. That, in a channel uniformly and gradually shelving, the whole time of transmission of the wave from end to end, is exactly double what it would be if the depth were uniform; and, 4. That the elevation of the crest of the wave is inversely as the depth of the fluid.

Such of these conclusions as admit of testing, the author has compared with Mr Russell's experiments, given in the seventh volume of the Reports of the British Association. The data are, however, insufficient for effecting a satisfactory examination of the formula. There is, however, a very general agreement between theory and experiment. Section 6th is devoted to the determination of the velocity and force of the wave in a canal, the section of which, perpendicular to the direction of transmission, is some given curve; whilst the depth estimated in the direction of motion is constant. In the former memoir (Section II.) an approximate solution of this problem had been given, on the hypothesis of parallel sections. The conclusions then arrived at agree remarkably well with experiment, but the hypothesis is too limited to be universally applicable. In the present section, the problem of motion is solved in all its generality, and the condition of the bounding section is introduced in determining the arbitrary constants. But, general as the solution in this case appears, it is nevertheless subject to a particular hypothesis, viz., that at the *side* of the canal, and near the surface, the equations of motion are *continuous*. This hypothesis can hardly be objected to, in all cases where the variation of depth is uniform or gradual. But it totally fails when the variation is abrupt, and can with difficulty be conceived to apply when it is subject to much fluctuation. If, for instance, the section is triangular, we can have no hesitation in applying it; if, on the other hand, it is triangular at the bottom, and rectangular at the top, it utterly fails. One remarkable feature in the results is, that the crest of the wave travels with the same velocity, whether at the edges or in the centre of the canal, provided the wave be of the simplest form. In a triangular canal, for instance, this is true. This result would, at first sight, appear to be utterly at variance with tide-observations; but the discrepancy will be less striking when it is remembered that observations of this kind are for the most part made in bays, or, as it were, small detached channels, and that consequently the times of high water registered are rarely those corresponding to the great tidal wave, but to a secondary to it, following at a considerable interval. However this be, Mr Russell states, that the conclusion coincides exactly with his experiments. Another result obtained in this section is, that the square of the velocity of transmission in a triangular canal is one-half that in a rectangular canal of the same greatest depth. This result was obtained in the former memoir, and agrees well with experiment. On adding further to the hypothesis, that the continuity extends to small distances below the surface, we find, as the result of an *accurate* solution (no longer using an approximation), that the approximate result is too great or too small, according as the breadth from the vertical, though the lowest point to the edge, is greater or less than the depth. The crest of the wave rises rapidly towards the shallow part of the fluid. The last section is occupied in deducing the circumstances of initial motion of a fluid.

3 Analysis of Berg-Meal from Umea Lapmark. By Dr Traill.

Professor Traill gave an account of the composition of a substance brought under the name of *Berg-Meal* from Swedish Lapmark by Mr Laing in 1838. It was found just under a bed of decayed mosses, forty miles above Degersfors, in Umea Lapmark. When examined by the microscope, it was found to consist of several species of minute organic remains, which Ehrenberg has considered as the siliceous skeletons of infusoria; the largest measured from 0.006 to 0.0005 of an inch. On analysis, Dr T. obtained 22 per cent. of organic matter, entirely destructible by a red heat; and he found the snow-white residue, which still retained the microscopic forms, to consist of 71.13 of silica, 5.31 alumina, and 0.15 oxide of iron. He considers the organic matter and the silica, as the essential ingredients, and the others probably as accidental. As a mixture with food, the quantity of organic matter in the Berg-Meal gives it a preference over the steatites and clays used for a similar purpose by some rude tribes.

John Miller, Esq. civil-engineer, was duly elected an Ordinary Fellow of the Society.

Professor Encke of Berlin, was admitted a Foreign Member of the Society.

The following Donations were presented :—

Journal of the Asiatic Society of Bengal. No. 97, 1840.—*By the Society.*

Madras Journal of Literature and Science. January to March, 1840 —*By the Society.*

Bulletin de la Société d'Encouragement pour l'Industrie Nationale pour les années 1838 et 1839.—*By the Society.*

Proceedings of the American Philosophical Society. No. 13.—*By the Society.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Van der Hoeven, M.D. en W. H. de Vriese, M.D. Deel 7. Stks. 3, 4.—*By the Editors.*

Experimental Researches on the Strength of Pillars of Cast Iron, and other Materials. By Eaton Hodgkinson, Esq.—*By the Author.*

1*st February* 1841.

Dr ABERCROMBIE, V. P. in the Chair.

The following communications were read :—

1. On the force of Solar Radiation in the Arctic Regions, by Dr Richardson. Communicated by the Secretary.

Dr Richardson has reduced more carefully the Observations published in the Appendix to Franklin's Second Journey on the Force of Solar Radiation. From observations on a thermometer in the shade compared with those on a thermometer with blackened bulb in the sun, he finds a tolerably regular daily curve of radiation having its maximum at noon. But when (after allowing as far as possible for the disturbing influence of the wind) different months are compared, it is found that in spring the radiation is more intense than in summer after the disappearance of the snow, which Dr Richardson is disposed to attribute to a greater purity in the air at the former period.

Professor Forbes remarked, that, though Dr Richardson's experience on the superior purity of the air in spring could not be disputed, yet it would require the most direct evidence to counterbalance the probability that the shorter path traversed by the sun's rays in summer would have the greater effect in determining their intensity. He considers the chief cause of the apparent anomaly to be, that the presence of the snow (to which Dr Richardson pointedly alludes), is mechanically effective in reflecting the solar light upon the sentient thermometer.

2. An attempt to reconcile the Theories of the Debacle and the Action of Glaciers, in accounting for the Distribution of Erratic Blocks. By Sir G. S. Mackenzie, Bart.

The author commenced by alluding to the disposition of geologists to draw conclusions of a general nature too hastily from the facts observed by them, illustrating this remark by referring to the various opinions successively promulgated, not only by geologists generally, but even by the same geological writer, on the subject of the till or boulder clay, the gravel, and sand, by which Great Britain is every where more or less covered. At one period, all these superficial deposits were referred to the action of water alone; now it is the fashion to explain them by the agency of glaciers.

In treating of the appearances presented by these deposits, the author observes, that those which at first sight might be thought to indicate tranquil deposition from water, might in reality be due to a different cause. There is sometimes the semblance of stratification, which arises from an internal movement and segregation of the different matters in the mass. As a proof that this phenomenon does often occur, the author mentioned that, in the old ramparts of Tours formed originally of rubbish, he observed that in a part where they were cut across to form a road, the materials had so arranged themselves as to exhibit stratified beds.

The author does not offer any positive opinion as to the truth of the theory, which implies that the above-mentioned superficial deposits are due to the erosion and movement of glaciers covering the whole surface of the country. He mentions, however, one locality in Ross-shire, where there are appearances on the lateral rocks of a valley strongly indicative of glacial erosion.

On the supposition that there are phenomena which indicate the action of water as well as of ice, in the formation of these superficial deposits, the author states the view which occurred to him, for embracing both of these agents, to be as follows:—He supposes that a volcanic eruption took place in the Icy Sea, some where to the north-west of the British Islands, which had the effect of breaking up the ice along the coasts, and that icebergs or sheets of ice loaded with cargoes of boulders, clay, and gravel, were driven or floated over the British Islands, where they dropped their cargoes, and, in many instances, stranded on the hill tops. At this period, the author supposes that the relative levels of land and sea were very different from what they are at present, a great part of the British Islands being then submerged. This theory, the author stated, was not the result of much reflection or observation, and he merely threw it out for the consideration of geologists.

3. Contributions to Optical Meteorology. No. I. On the Polarization of the Light of the Sky. By Professor Forbes.

The author began by recapitulating the observations already made known on this subject.

The facts generally admitted (principally on the authority of M. Arago) appear to be, (1.) That a clear sky reflects light polarized in planes passing through the sun, the eye of the observer, and the point of the sky observed. (2.) That this polarization is a maximum in a zone 90° from the sun. (3.) That in the parts of the sky nearly opposite to the sun, this description ceases to be accurate ; for the polarization, in a vertical plane passing through the sun and the observer, vanishes at an angle with the sun considerably less than 180°, —perhaps 150° or 160° (varying according to circumstances),— and gradually reappears in a plane perpendicular to the former, at greater angles than this. (4.) That the polarization is more intense in the neighbourhood of the horizon than of the zenith. (5.) M. Babinet has recently remarked that, under certain circumstances, there is a second neutral point in the neighbourhood of the sun.

Professor Forbes has verified these facts in nearly every particular, by the aid of a modification of Savart's polariscope, constructed of two plates of quartz, peculiarly cut and combined, together with Mr Nicol's single-image calc-spar prism, which the author has substituted with great advantage for the tourmaline commonly used in France.

With this instrument he finds, (1.) That a uniformly cloudy sky exhibits distinct traces of polarization. (2.) That rain-clouds generally polarize light ; but not, so far as he has observed, those charged with snow. (3.) That the common rainbow *entirely* vanishes in one position of Nicol's prism (the fact of its polarization was discovered by Biot). (4.) That the polarization of moonlight reflected by the sky is very sensible, and likewise the diffuse light, or *burr*, which surrounds the moon in cloudy weather. (5.) That the light reflected from dry clear air, between the observer and objects a mile distant, is sensibly polarized.

With respect to the planes of polarization of skylight, he considers that they may be represented by a fiction of this kind: That there is a certain amount of polarization due to the regular reflection of sunlight from the sky in meridional planes passing through the sun and the observer; the polarization being most intense towards azimuth 90°, and vanishing at 0° and 180°. Combined with this polarization is another, distinct from it, and represented by a more intense effect due to reflection *parallel to the plane of the horizon* in all azimuths, which unites with, modifies, and even overpowers the regular polarization in meridional planes just referred to.

The result will be the composition of the effects of the reflection of light at a concave spherical surface having the sun for one pole, with that due to reflection at a cylindrical surface perpendicular to the horizon.

If the latter be tolerably uniform in all azimuths, it will evidently overpower and replace the former in points nearly opposite to the sun, and which become visible when the sun is low.

The author stated his conception of the physical cause for such an arrangement of the planes of polarization to be, that whilst, at considerable elevations, the number of reflecting particles is not so great as near the horizon, the effect due to a single reflection will be the less intense; and, consequently, the horizontal reflection is generally stronger than that in any other plane. But further than this, many familiar facts shew that the horizontal vapours (or opaque particles, of whatever kind they be, which occur in air), are, like a sheet of paper, capable of receiving light and of emitting it, not necessarily in the plane of reflection; and such light, after *several* reflections nearly parallel to the horizon and completely encircling it,—as we often see it do when a slight whitish haze is visible all round,—reaches the eye, much enfeebled, no doubt, by numerous reflections, but more intensely polarized on that account, and reinforced by the number of the reflecting particles. The lights thus irregularly reflected or emitted by the horizontal strata of air, and again regularly reflected by other particles in the same strata, will come to the eye more or less polarized in planes parallel to the horizon. A similar action will produce M. Babinet's second neutral point towards sunset; and Mr Forbes has remarked generally, after sunset, that the planes of polarization no longer converge accurately to the luminary, but are more or less twisted into a forced parallelism to the horizon.

The following gentlemen were duly elected Ordinary Fellows of the Society:—

George Smyttan, M.D., late of the Bombay Medical Board.
James Hamilton, Esq.

The following Donations were presented:—

Researches in Embryology. 3d Series. By Martin Barry, M.D. —*By the Author.*

Quarterly Journal of the Statistical Society of London. Vol. iii. part 4. January 1841.—*By the Society.*

Flora Batava. No. 121.—*By the King of Holland.*

Voyage dans la Russie Méridionale et la Crimée. Par M. de Demidoff. (Partie Scientifique.) Livus 11 et 12, et planches.—*By the Author.*

The American Almanac and Repository of Useful Knowledge for the year 1841.—*By the American Philosophical Society.*

15*th February* 1841.

Dr ABERCROMBIE, V.P. in the Chair.

The following communications were read:—

1. Farther Researches on the Voltaic Decomposition of Aqueous and Alcoholic Solutions. By Professor Connell.

Since his last communication to the Society, the author has made a variety of experiments, with the view of farther testing the truth of the proposed law which limits the direct action of the voltaic current to the solvent, in solutions of primary elementary combinations in the more important solvents. All his researches have farther confirmed this law in regard to aqueous solutions. Amongst those which he has examined is an aqueous solution of iodic acid as a type of oxyacids; and he found that by connecting such a solution mixed with starch, with a solution of starch in water, by means of asbestus, no iodine was indicated when the starch solution was negative, but was immediately manifested when the iodic solution was negative from the reducing action of hydrogen. In the whole circumstances, he has no hesitation in concluding, "that when aqueous solutions of primary combinations of elementary bodies are submitted to voltaic agency, the dissolved substance is not directly decomposed by the current, but only the solvent."

From his farther experiments on solutions in alcohol and pyroxylic spirit, joined to those primarily detailed, he concludes, that "when solutions of primary combinations of elementary substances, in water and in those liquids, such as alcohol and pyroxylic spirit, which contain water, as an essential constituent, are submitted to voltaic agency, the dissolved substance is not directly decomposed by the current, but only the water of the solvent."

The author had formerly found, that pure ether, and all ethereal solutions then tried, resisted voltaic decomposition. He has since ascertained that when ether, charged with dry muriatic acid gas, is submitted to galvanic action, hydrogen is given off at the negative pole, whilst chlorine is produced at the positive. The cause may either be, that the ether suffers a certain degree of decomposition previous to voltaic action when charged with muriatic acid gas, as is indicated by the effects resulting when it is charged with hydriodic acid gas, water at the same time perhaps being formed, and subsequently undergoing voltaic decomposition; or that the *hydracid* itself, in an ethereal solution, suffers direct voltaic decomposition. But as the author sees no cause to depart from his former conclusion, that ether contains no water as such as a constituent, he thinks it better not to include ether in any general rule regulating the voltaic decomposition of solutions.

In order to shew from voltaic action that the haloid salts are dissolved in water as hydracid salts, the author does not now think it to be necessary to contrast the results with those obtained with alcoholic solutions. He conceives it to be sufficient to shew, that acid and alkali separate from the aqueous solution of a haloid salt, when the poles are plunged in distilled water on each side of it, so as to exclude a secondary action. A little attention will shew that we cannot otherwise account for the separation of the hydracid, when taken in connection with the facts, that the electro-negative constituent of the hydracid also appears at the positive pole, and a definite proportion of hydrogen at the negative when the poles are plunged directly in the solution.

It was found, however, that an aqueous solution of chloride of gold did not shew acid passing into the connected water with the power employed; and hence it is probable that, either from peculiarity of atomic constitution or from the feeble affinity of some metals for oxygen, their haloid salts do not decompose water. The test, however, was found to hold good in regard to chloride of zinc, and therefore in all likelihood in regard to all other metals of a more electro-positive character. The author believes, that even in alcoholic solutions of moderate strength, an ordinary haloid salt when dissolved, decomposes the water of the alcohol.

The conducting power of solutions is, generally speaking, favoured by the chemical changes which take place in them under galvanic action. Salts act by being resolved into their constituent acid and alkali. Acids and alkalies, in their separate state, act by being transferred to their respective poles in their aqueous solutions. Bromine and iodine are not so transferred; and when they promote the conducting power of their solutions, they act by uniting with the hydrogen of decomposed water.

2. On the Preparation of Paracyanogen, and the Isomerism of Cyanogen and Paracyanogen. By Samuel Brown, M.D. Communicated by Dr Christison.

After a short statement of the discovery of paracyanogen by Professor Johnston, and of its leading properties, the author proceeded to shew how, with certain precautions, cyanogen may be converted entirely, or nearly so, into the isomeric form paracyanogen. This he accomplished by exposing bicyanide of mercury suddenly to the temperature most favourable to the production of paracyanogen, which he found to be a low red heat, and employing also pressure, by confining the cyanogen gas which is at first expelled. By these means he succeeded in resolving the salt almost entirely into mercury and paracyanogen, the latter of which amounted in some trials to more than nine-tenths of the cyanogen contained in the bicyanide. The pressure required was not quite two atmospheres, namely 1.74.

The author further stated, that he had succeeded in proving that paracyanogen once formed cannot be again converted into cyanogen. Professor Johnston supposed the contrary, because he obtained cyanogen gas by exposing paracyanogen to a strong heat. But the author found that this arose from the latter having retained some cyanogen by absorption, that after the absorbed gas is removed heat subsequently expels nitrogen only, and that the same result is obtained from the first by using pure paracyanogen, prepared by dissolving the impure substance in concentrated sulphuric acid, and separating it in a state of purity by leaving the acid exposed to the air so as to attract humidity.

To these facts the author added some views as to the composition of cyanogen and paracyanogen, and their relation to one another. In order to account for the exceeding difference in properties prevailing between these two bodies, which appear nevertheless to consist of the same relative proportions of the same elements,—chemists generally consider the former to consist of one equivalent of carbon and two of nitrogen ($N C_2$) and the latter of two equivalents of the former and four of the latter ($N^2 C_4$). But the author endeavours to shew that the true constitution of paracyanogen is that in which it is regarded as a compound of two equivalents of cyanogen, that is, of two "equal and similar atoms" of the same body.

In conclusion, the author proceeded to apply these views to the constitution of the simple or elementary bodies; and endeavoured to shew that there is nothing unreasonable in the supposition, that,—as chemists are now acquainted with various instances of compound bodies which have widely different forms, different physical properties in general, and different chemical relations, although agreeing exactly in their intimate constitution,—so, in like manner, some of those bodies, which are at present accounted elements distinct from one another, may really be isomeric, that is, different forms of one common element. And he stated that he hoped to be able to adduce experimental evidence of such being the fact with two of the most familiar of the elements, which until now have been considered wholly distinct."

3. A notice was communicated by Mr Mylne from Joseph Atkinson, Esq. of results obtained with Rain-Gauges of different forms.

Graham Spiers, Esq. Sheriff of Edinburgh, was duly elected an Ordinary Fellow of the Society.

The following Donations were presented:—

Journal of the Asiatic Society of Bengal, 1840. No. 98.—*By the Society.*

On the Study of Natural History as a Branch of General Education in Schools and Colleges. By Robert Patterson, Vice-President of the Natural History Society of Belfast.—*By the Natural History Society of Belfast.*

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1841. No. 19.

Monday, 1*st March* 1841.

The Right Hon. Lord GREENOCK, V.P., in the Chair.

The following Communications were read :—

1. On the Sea-Level of the Neapolitan Coast. By Sir John S. Forbes, Bart.

This paper is intended to give an account of the more recent researches of the Italian antiquaries and geologists connected with the well-known temple of Jupiter Serapis at Pozzuoli, which have been verified in several particulars by the author, by personal inspection, and extended to other parts of the western coast of Italy, where traces of marine lithophagi have been found at a height, as alleged by Niccolini, of even 250 feet above the present sea-level.

The most interesting modern observations are those of Niccolini on the actual change of relative level of the sea and land, ascertained by a fixed gauge which he has observed frequently between 1823 and 1838. In that time the land appears to have risen through a height of 112 millimetres or 4½ inches; and this change has been progressively and not suddenly effected.

2. On the Supposed Progress of Human Society from Savage to Civilized Life, as connected with the Domestication of Animals and the Cultivation of the Cerealia. By John Stark, Esq.

The object of this paper is to controvert the generally received opinion, derived from the classical writers, and adopted by most philosophers, that human society, in its original state, was one of savage barbarism; and, that, in the supposed progress from savage to civilized life, three separate stages or gradations have been gone through, the one leading necessarily to the other. These stages,—or the *hunter's life*, when the food of man was procured by the chase of wild animals, the *pastoral state*, when flocks and herds formed his chief support, and the *agricultural state*, when grains were cultivated,—the author shews never had any existence, except in the fancies of poets or the theories of philosophers.

1. In regard to the assumption that man was created a dumb savage, the author states, that such a supposition is neither reconcilable with probability, nor consonant to reason, nor warranted by historical records. If he had been originally dumb, his race never could have acquired the power of speech; if he had been merely a frugivorous animal, his instinctive propensities would never have led him to feed on animals; and if such animals were his destined prey, it could never happen, in the ordinary course of things, that he was to become their protector. If he had been created a savage, a savage he must ever have remained.

2. With regard to the domestication of animals originally wild, according to the theories of poets, philosophers, and historians, who supposed this to have been the result of ages of experiment—an assumption which has remained uncontroverted till now—the author shews that the supposition of the domesticated races ever having been in a wild state, is not warranted by any thing recorded in sacred or profane history; that, as far as human history extends, the domesticated animals were man's companions; and that an instinct of sociability, or a particular disposition to dwell with men, exists in the nature of these animals, without which all attempts to tame them would have been in vain. The animals known as domestic were so from the earliest periods, and no addition to their number has been made through successive ages.

3. The cultivation of the *Cerealia*, which, according to the philosophical theory, was an invention of civilized man, and the result likewise of ages of experiment,—the author asserts to be an assumption without the shadow of foundation. He proved, from recorded facts, that the cultivated grains are nowhere found growing in a wild state to any useful extent; that they die out in a very few years when left to the care of nature alone; that their existence depends upon their continued cultivation, and that their cultivation was known to the progenitors of the human race.

The author considers himself to have established these propositions, 1. That man was at his creation a civilized being, endowed with all the physical and intellectual powers necessary to his state as a moral and intellectual agent; 2. That the domestic animals were created for his use, and obedient to his will from the beginning; 3. That the cultivation of the Cerealia was the earliest occupation of the human race; 4. That prior to the Deluge cities were founded and many of the useful arts practised; and, 5. That the survivors of the Deluge started with all the knowledge of their predecessors, the possession of the domestic animals, and the grains necessary to their processes of agriculture.

In place of the supposed gradation from savage to civilized life, the author asserts, from the history and monuments of all ages and nations, that the general tendency of the race is to degenerate from a civilized to a barbarous state of society. And that the desolation of the mightiest kingdoms and republics of antiquity,—their ruined cities and neglected fields,—teach the lesson, that neither science nor art, neither philosophy nor religion, has hitherto been effective in stopping this downward progress,—this descent to barbarism and savage life.

The following Donations were presented :—

The Quarterly Journal of Agriculture, and the Prize-Essays and Transactions of the Highland and Agricultural Society of Scotland, for March 1841.—*By the Highland and Agricultural Society.*

On the Constitution of the Resins. Parts 4 and 5. By James F. W. Johnston, Esq., A.M., F.R.S.—*By the Author.*

15*th March*, 1841.

Dr ABERCROMBIE, V.P., in the Chair.

1. On the Parallel Roads of Glen-Roy, with an Examination of Mr Darwin's Theory of their Formation, Part I. By Sir T. D. Lauder, Bart.

2. On the Polarizability of Heat from different Sources. By Professor Forbes.

The author of this paper states in it his belief, that the curious fact formerly announced to the Society of the greater permeability of mica, laminated by heat, to heat of low temperature, contrary to the usual character of the same substance (a property which he has since extended (see Proceedings, Jan. 1840) to changes of mechanical conditions of surface), may very probably explain, as M. Melloni anticipates, the difference in point of fact long contested between them as to the equal or unequal polarizability of heat from different sources.

3. Account of the Fossil Species of the genus *Solarium*, Lamarck, found in the Supercretaceous group in Italy. By M. le Chev. Michelotti of Turin. Communicated by Dr Traill.

This genus of shells belongs to the Class GASTEROPODA of Cuvier, and to the family TURBINACEA of Lamarck, of which the general character is to have the shell turreted or conoid, with the aperture rounded or oblong, and the margin disunited.

M. Michelotti was induced to undertake the examination of the fossil Italian species of this genus, from the doubts prevailing regarding the identity of some of the species in the writings of authors. He describes in all ten species, which are found in the neighbourhood of Turin, of which four have not been previously noticed. The four newly described species are *Solarium neglectum*, *S. pulchellum*, *S. Lyellii*, and *S. humile*. Two of the other species described, viz. *S. Stramineum*, Lamarck and *S. luteum*, have their living prototypes,—the first in the Indian and Mediterranean Seas, and the second in the seas of New Holland. The other species are,—

Solarium pseudo-perspectivum, Brocchi.
...... umbrosum, Brongniart.
...... millegranum, Lamarck.
...... canaliculatum, Lamarck.

In illustration of his paper, M. Michelotti has sent drawings of each of the species he describes, in three different positions, so as to shew all the characters of the shell. The references to authors who have mentioned the species (or synonyms) seem very complete

The following Donations were presented :—

Journal of the Asiatic Society of Bengal. No. 100. 1840.—*By the Society.*

Mittlere Vertheilung der Wärme auf der Erdoberfläche, nebst Bemerkungen über die Bestimmung der mittleren Temperatur. Von Wilhelm Mahlmann.—*By the Author.*

Memorie della Reale Accademia delle Scienze di Torino. (Serie Seconda). Tomo ii.—*By the Academy.*

Philosophical Transactions of the Royal Society of London for the year 1840. Parts 1, 2.—*By the Royal Society.*

Proceedings of the Royal Society 1840. Nos. 41, 42, 43, 44, and 45.—*By the Royal Society.*

Report of the Ninth Meeting of the British Association for the Advancement of Science, held at Birmingham in August 1839.—*By the British Association.*

A Supplementary Report on Meteorology, presented to the Meeting of the British Association in 1840. By Professor Forbes. —*By the Author.*

5*th April*, 1841.

Sir T. M. BRISBANE, Bart., G. C. B., Pres., in the Chair.

1. On the Parallel Roads of Glen-Roy, with an Examination of Mr Darwin's Theory of their Formation, Part II. By Sir T. D. Lauder, Bart.

This paper consists of a critical investigation of a recent paper by Mr Darwin upon this subject, and the author's object is to prove that Mr Darwin's views are untenable ; and that his own explanation of the appearances in Glen-Roy, given in his paper in the Transactions of this Society, and ascribing them to successive subsidences of a fresh-water lake, is still the only view reconcilable with the facts.

James Spittal, M.D., Fellow of the Royal College of Physicians of Edinburgh, was duly elected an Ordinary Fellow.

2. On the Visibility of rapidly revolving Lights, made in reference to the Improvement of Light-Houses. By Alan Stevenson, LL.B , Civil Engineer.

These experiments consisted in a comparison of the visibility of lights from lenses when at rest, and when revolving with such rapidity as to produce an apparently continuous impression on the sense of sight. They were undertaken at the suggestion of Captain Basil Hall, who had himself in the spring of last year made some trials of a similar kind, in the expectation that the eye would be so stimulated by the bright flashes, that not only the almost imperceptible intervals of darkness would have no effect in impairing the visibility of the rapidly recurring flashes, but likewise the eye would actually be stimulated by the contrast of light and darkness, in such a manner that the effect of the rapid series would be greater than that of the same quantity of light equally distributed over the whole horizon by the refracting zones at present used in fixed lights, which only refract the light in the vertical direction, without interfering with its natural horizontal divergence. Mr Stevenson shewed that this expectation was at variance with what would be predicted from a consideration of the laws of the physical distribution of the light; and the experiments proved that the visibility of the rapidly revolving series was greatly inferior, not only to that of the lens at rest, but also to that of the light equally distributed by the refracting zones. From the results of the experiments, the author drew the following general conclusions:—

1. That continuity of impression in the sense of sight is scarcely obtained by producing ten flashes in a second of time; and that the visibility of the light decreases in a most remarkable degree with the velocity of the series.

2. That this decrease of visibility, although partly owing to a loss of intensity, is chiefly caused by deficiency of volume in the visual object, which at the most rapid velocity became so small

that few observers at the distance of fourteen miles could detect it with the naked eye, while the light from the zones was large and distinct.

3. That the rapid passage of the visual object over the eye causes this decrease in its volume, by diminishing the amount of irradiation, which, according to the theory of M. Plateau, is, within certain limits, proportionate to the duration of the impulse of light in the retina.

The following Donations were presented :—

Mémoire de la Société Géologique de France. Tome iv. Ptie 1. —*By the Society.*

The Transactions of the Royal Irish Academy. Vol. xix. Part 1. —*By the Academy.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. 1841. Nos. 6, 7, 8, 9, 10.—*By the Academy.*

Proceedings of the Geological Society of London. Nos. 74 and 75.—*By the Society.*

The American Journal of Science and Arts. Conducted by Professor Silliman ; for January 1841.—*By the Editor.*

E'tudes Géologiques dans les Alpes. Par M. L. A. Necker, Tome i.—*By the Author.*

Maps of the Ordnance Survey of England and Wales. Nos. 75, 76, 79, and 82.—*By the Board of Ordnance.*

19*th April* 1841.

The Right Hon. Lord GREENOCK, V. P. in the Chair.

The following Communications were read :—

1. On the Theory and Construction of a Seismometer—an instrument for Measuring Earthquake Shocks and other Concussions. By Professor Forbes.

The plan of this instrument was submitted amongst others to a Committee of the British Association appointed to devise means for registering earthquake shocks. A heavy pendulum, suspended from a frame, will evidently have its bob left behind by its inertia when the frame is moved forwards by any concussion. To render such an instrument very sensible, however, the pendulum must be of great length, which presents many inconveniences in practice. The author, therefore, proposed an inverted pendulum, sustained by a steel wire, on the principle of the noddy invented by Mr Hardy, for ascertaining the stability of clock cases. The balance of gravity and elasticity (which act, the former to displace, the latter to redress, the pendulum) may be rendered as nice as we choose, and hence the sensibility of the instrument is wholly independent of its dimensions.

The author has shewn, by a mathematical investigation, that the extent of deviation due to a given concussion, within moderate limits, depends solely upon the time of vibration of the pendulum,—that, for any sudden forward motion of the machine, the greatest displacement of the bob of the pendulum may become equal to that motion,—but if the motion continue uniformly for a short space and then cease, the displacement may be doubled in amount.

The self-registering part of the apparatus consists of a pencil at the extremity of the inverted pendulum, which travels over a prepared concave surface of paper, and marks at once the direction and extent of the displacement of the pencil, which is evidently contrary to the movement of the ground. The author also points out how, by varying the position of the bob upon the rod of the pendulum, and at the same time altering the elasticity of the spring, the deviation of the pencil may be increased in any proportion to the actual movement of the ground, and this irrespectively of the dimensions of the instrument.

Lastly, he shews how, by employing two instruments of the same kind, but *whose sensibility* (determined by the time of one vibration) *differs in a known proportion*, the duration of a shock and the extent of lateral movement of the ground may be calculated; and he gives a table for this purpose. It is to be understood, however, that this and other results of the mathematical investigation are only true in so far as the fundamental hypothesis is correct,—viz. that an earthquake is a lateral movement of the ground in one direction, through a short space, and with a uniform velocity.

Similar instruments might, no doubt, be applied to measure the lateral concussions of railway trains.

2. On the Circulation of the Blood, and the Difference of the Laws of Fluids moving in living and dead tubes. Part I. By Sir Charles Bell.

The author commenced with a eulogy of Mr Hunter, and of his experiments upon the arteries; and proceeded to illustrate the elasticity and muscularity of an artery.

The author's experiments were made on the human frame, by taking advantage of the amputated limb on the instant of its separation from the body. He made a section of the artery so as to present a piece in the form of a ring,—he slit this ring, and it sprang open to a certain extent. Putting it in water, it was found in the morning reversed or bent the other way. On taking a larger portion of the artery, which was straight, and slitting it up, it immediately bent backwards in a semicircular form.

The author gave this explanation of these facts:—On the circular portion of the artery being cut up, the elastic power prevailed to a certain degree; but continuing to be opposed by the circular muscular fibres until the vital power was exhausted, then the elasticity so entirely prevailed as to bend the ring in the reverse position.

But on slitting up the long straight piece of the artery, it immediately curled back, for there are no longitudinal muscular fibres to prevent the elasticity having instant effect.

The author then went into a description of the different mode and time of action of the muscular fibre, shewing that we must not retain the idea first presented to us in the voluntary muscles, but contemplate the same property of action in the muscular fibre, where it enters into the composition of particular organs, and when it is made subservient to the function, acting in a different time and mode, and being sometimes not excitable by acrid or mechanical stimulus: hence inferring, that we must not expect to excite the muscular coat of an artery by irritating it as we might do a voluntary muscle.

The author took a portion of an artery of a square form, and found that, by appending weights, it was equally elastic in all directions; on which he argued,—Since the artery is full of blood when it receives the systole of the heart, on the acknowledged laws of hydraulics, that an impulse upon fluids is propagated equally in all directions, it must follow that the artery dilates in the transverse as well as the longitudinal direction.

He proceeded to shew, that, as the artery is elastic, the impulse of the heart cannot reach every branch at the same moment,—that undulations, or partial distention, must characterize the progress of the heart's impulse along the artery.

He argued against the opinion that there is no other quality than that of tonicity in the circular fibres of the artery. For tonicity, according to the definition of physiologists, being a permanency of action, which admits of no relaxation, it would follow that the artery had two properties exactly the same; for tonicity and elasticity would present exactly the same kind of resistance to the blood impelled by the heart.

But,—granting to these fibres the vital property of muscularity,—since the healthy action of a muscular fibre is characterized by relaxation as much as by contraction, we perceive that the higher muscularity of the extreme vessels implies that they are more easy of dilatation, as well as more powerful in contraction; and that the dilatation and contraction of successive portions of the artery must, like an increasing wave, bestow a higher degree of activity in the vessels remote from the heart. Sir Charles deferred the reading of the Second Part of his paper.

The following Donations were presented:—

The Transactions of the Linnean Society of London. Vol. xvii. Parts 2, 3, 4; and Vol. xviii. Part 1.

The Proceedings of the Linnean Society of London. Nos. 8 and 9.—*By the Society.*

Transactions of the Society for the Encouragement of Arts, Manufactures and Commerce. Vol. liii. Part 1.—*By the Society.*

Journal of the Asiatic Society of Bengal. Nos. 99, 101, and 102.—*By the Society.*

Travels in the Himalayan Provinces of Hindustan and the Punjab. By William Moorcroft and George Trebeck. Edited by H. H. Wilson, Esq. 2 vols. 8vo.—*By the Asiatic Society of Bengal.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome x. Nos. 19 to 26; Tome xi. and Tome xii. Nos. 1 to 5.—*By the Academy.*

Mémoires de l'Académie Royale des Sciences de l'Institut de France. Tomes xiv. xv. xvi. and xvii.

Mémoires présentés pars divers Savants à l'Académie Royale de l'Institut de France. Tome 5.—*By the Academy.*

Voyage dans la Russie Méridionale et la Crimée. Par M. de Demidoff. (Partie Scientifique.) Livr^{ns} xiii. et xiv. des planches. —*By the Author.*

Transactions of the Zoological Society of London. Vol. i. Part 3.

Proceedings of the Zoological Society of London. Nos. 73 to 90. —*By the Society.*

3d May 1841.

Right Hon. Lord GREENOCK, V.P., in the Chair.

The following Communications were read :—

1. Experimental Researches on the Production of Silicon from Paracyanogen. By Samuel Brown, M.D. Communicated by Dr Christison.

In his paper on Paracyanogen read to this Society at an earlier period of the present session, the author announced that he considered he had succeeded in proving, that two familiar bodies, universally believed to be distinct elements, are modifications of one and the same elementary form. In the present paper, he announced that the bodies in question are carbon and silicon, and gave a detailed statement of the investigations by which he had been led to this conclusion.

1. Silicon may be obtained from uncombined paracyanogen.—When paracyanogen, prepared from bicyanide of mercury by heat under pressure, as described in his former paper, was subjected to prolonged heat in a closed tube of German glass, a dark-brown substance was obtained, which presented all the diagnostic characters of silicon. More especially, it was incombustible before the blowpipe, underwent no change on being projected into fused chlorate of potash, but dissolved with effervescence in fused carbonate of potash, forming a white saline substance, in which silica was detected by its ordinary reagents. The same experiment was performed with the like result on a larger scale in a porcelain crucible; and the quantity of silicon produced came within a very small amount of the carbon contained, by theory, in the paracyanogen employed. When paracyanogen is heated with carbonate of potassa, silicic acid is obtained at once. A variety of experiments were described, the purpose of which was to obviate all fallacy that might be supposed to arise from silica being present in the vessels employed.

2. Siliciurets may be obtained by the reaction of paracyanogen on metals.—When bicyanide of mercury was heated in tubes

of copper or iron in the way followed for obtaining paracyanogen, the interior of the tubes was found to be lined with scales, which consisted, not of paracyanide or carburet of these metals, but of their siliciuret. And when paracyanogen was heated in a platinum crucible several times in succession till the crucible would absorb nothing more, a compound was obtained which was a siliciuret of platinum, containing four per cent. of silicon.

3. When paracyanogen is decomposed in the preceding experiments, the nitrogen given off corresponds with what is contai by theory in the compound which yields it. A variety of experiments of analysis were mentioned to this effect; from which a further corroboration was derived of the conclusion derived from the author's previous researches, that the silicon could come only from the carbon of the paracyanogen.

4. A siliciuret may be obtained from the paracyanide of iron. Under this section, the author first described the process by which a pure paracyanide of iron may be obtained from ferrocyanide of potassium; and stated that he had found this compound to consist of one equivalent of nitrogen, two of carbon, and one of iron. He then observed that he had been led to suppose this compound to be the true compound radicle of the so-called ferrocyanides; on which subject he proposed to make ere long a distinct communication to the society. He next proceeded to explain the results of numerous experiments on the influence of heat on the paracyanide of iron; from which it appeared that, under a high temperature and pressure, a compound was obtained, in which carbon could not be detected, but instead of it silicon, in the proportion of 28.5 per cent. To these remarks were added others on ferrocyanide of potassium, which he considers to be resolved in the process into cyanide of potassium evolved by sublimation, and paracyanide of iron, which at the same time is decomposed, and yields disiliciuret of iron. The product obtained in these two ways is in general partly in the form of a coaly powder, partly in fused obsidian-like masses. But if the ferrocyanide of potassium be heated with its own weight of cyanide of potassium, as a non-reactive flux, the disiliciuret is obtained in a semicrystalline form, which in fine powder is colourless, and is seen before the microscope to be transparent like glass; and sometimes there is an approach to a crystalline form, nay, small particles may be discovered with the microscope which are regular octahedres. The disiliciurets of iron thus produced were treated of by the author in

his Inaugural Dissertation in 1839, as carburets of the metal. (See Trans. Brit. Assoc. 1839, vol. ix.) Experiments were added under the present section, which satisfied the author that every conceivable source of silicon, except from the paracyanogen, was provided against by the manner in which the experiments of conversion were performed. Among other facts thus elicited, it appeared, that, by successive operations in the same vessel, a greater weight of disiliciuret of iron might be obtained than the weight of the vessel itself.

5. Silicic acid may be obtained by a direct process from the paracyanide of iron. The conversion thus accomplished might appear, as the author conceived, more satisfactory to most persons, than any of the previous operations, on account of the large scale on which the experiments were performed. When paracyanide of iron was mixed with four times its weight of carbonate of potash, and ignited in a shut crucible of hammered iron for four hours at a full white heat, a rose-red saline product was formed, from which a transparent solution was obtained with water; and when this was supersaturated by hydrochloric acid, a bulky precipitate was thrown down, which, when purified from adhering metallic oxide by fusion with carbonate of potash, solution of the product in water, neutralization with hydrochloric acid, evaporation, desiccation, and ignition, and elutriation with water to remove chloride of potassium,—presented all the distinctive characters, physical as well as chemical, of silicic acid. Five grains of paracyanide of iron thus gave 3.04 of silicic acid; and 30 grains of ferrocyanide of potassium, similarly treated, gave 5.4 grains of silicic acid. The iron crucible used in these operations did not yield a particle of silicic acid when heated to a white heat with pure carbonate of potash,—the same salt employed in the preceding cases of conversion. A large crucible was worked seven successive times with 9334 grains in all of ferrocyanide of potassium; and 1240 grains of silicic acid were produced.

The author added that, in the course of several of these operations, more especially those of the last section, he found the iron to undergo conversion as well as the carbon; and in a subsequent paper he proposes to state in detail the facts which lead him to the conclusion that this metal is a variety of the same elementary form with rhodium.

2. On the Anatomy of the *Amphioxus lanceolatus* of Yarrell. By John Goodsir, Esq. Communicated by Professor Syme.

After a short statement of the labours of Yarrell, Couch, Retzius, and Müller, the author gave a detailed description of the structure of *Amphioxus*, as observed in the dissection of one of two specimens taken by Mr Forbes in the Irish Sea. The abdominal folds, and the anterior and posterior anal fins, were described, and the existence of a fin in front of the anus illustrated by an observation made by Professor Agassiz, of the temporary existence of a similar fin in the embryos of certain fresh-water fishes.

The osseous system presented two divisions,—the true or neuro-skeleton, and the intestinal or splanchno-skeleton. The true skeleton consisted of a chorda dorsalis, equally pointed at both extremities, without the slightest trace of a cranium, and destitute of any of the peripheral vertebral elements, with the exception of a row of cells—germs of interspinous bones and fin-rays—along the base of the dorsal and anal fins. The tissue of this neuro-skeleton was not even cartilaginous, consisting merely of membrane and globular nuclei, derived from the original elementary cells. The splanchno-skeleton consisted of a hyoid apparatus, and of 70 to 80 pairs of elastic filamentous ribs. The hyoid apparatus—in two divisions, with 17 pieces in each—exhibited 34 rays, pointing inwards, and each springing from one of the 34 basal elements of the hyoid bone. These rays the author looked upon as developments of the tubercles and teeth of the central aspect of the branchial apparatus of the higher fishes, and not as branchiostegal rays. The ribs were enveloped in the mucous membrane of the intestine, and each alternate pair bifurcated below, to enclose the abdominal longitudinal vessel or heart. From these circumstances, and from other considerations, the author looked upon the ribs of *Amphioxus* not as true ribs, but as splanchno-ribs—repetitions of the hyoid bone—analogues of the tracheal and bronchial cartilages of the higher Vertebrata. The tissue of the splanchno-skeleton is more advanced than that of the neuro-skeleton; the ribs are cartilaginous; the hyoid bones hollow cartilages, with isolated cells or nuclei in their interior.

The nervous system presents nothing more than a spinal cord, without a trace of cerebral development, and from 60 to 70 pairs of spinal nerves. The spinal cord was in the form of a ribbon, pointed at both ends, with a dorsal median groove, and a line of black or grey matter; was composed of nucleated cells, without tubes or fibres, and gave origin to the nerves in single roots only. The nerves were all symmetrical, dividing into dorsal and ventral branches. The second pair sent back a dorsal and a ventral branch, to join the corresponding branches of the other nerves, along the sides of the body, and along the bases of the dorsal and anal fins; from which distribution the author was inclined to believe, that although the second pair in *Amphioxus* presented certain resemblances to the vagus, it was, in reality, the trifacial.

The vascular system consisted of a straight abdominal vessel, the branchial artery or heart, without any trace of valves or division into cavities. This vessel sent off lateral branches, which, passing up on the internal surface of the intestine, along the ribs, communicated by a capillary respiratory system of vessels with a dorsal trunk or aorta.

The intestinal tube was straight from mouth to anus, its anterior half dilated, strengthened by ribs as described above, and its entrance guarded by the hyoid rays. This dilated portion of the canal received sea-water, as in the *Ascidiæ*, to act on the respiratory vascular ramifications on its internal surface, which is undoubtedly ciliated in the living animal. The digestive portion of the canal is narrow, and presents not a trace of a liver, or of any other assistant chylo-poietic viscus.

As there was no trace of branchial fissures—as the ribs were too numerous to be looked upon as true branchial arches (branchial arches alternating with branchial fissures)—and as the other organic systems were in the condition of those of an embryo before the appearance of branchial clefts, the author was led to the conclusion that the *Amphioxus* had never had, at any period of its existence, branchial clefts;—that it was an animal which had arrived at its perfect development before the branchial clefts had appeared, and, consequently, with an undeveloped osseous and nervous system, without a liver, and with an unilocular heart.

After examining the generative organs, and other departments of its anatomy, the author entered upon the consideration of the zoological position of *Amphioxus*, which he observed could no longer be ranked with *Petromyzon* and *Myxine*, but must take an ordinal place in any new arrangement of the class. In conclusion, he remarked, that although genera allied to *Amphioxus* might now be rare, yet in the ages which have passed since the development of organic forms commenced, *Abranchiated* fishes may have been more common, and may yet afford subjects of research to the palæontologist

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1841–1842. No. 19.*

Monday, 6th December 1841.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following communications were read :—

1. On the Circulation of the Blood, and the Difference of the Laws of Fluids moving in Living and Dead Tubes. Part Second. By Sir Charles Bell.

He recommenced with the statement of the difference with which water flowed from a reservoir through tubes of equal calibre, but unequal lengths; and of the effect of pressure on elastic tubes, shewing that the impediment to the transmission of fluid through them was proportioned to their length. He stated that the obstruction at the turn of a tube, was proportioned to the acuteness of the angle. He then inferred that the arteries were in circumstances to render the delivery of blood unequal, unless there was a living property additional to the hydraulic laws.

Then, referring to the effect of capillary attraction, he argued, that if the law prevailed in the animal body as in dead tubes, then, on estimating the length of vessels of capillary size, and the attraction existing between solid and fluid, the circulation could not go on.

He then stated the surprising living qualities in the animal surfaces, of repelling, attracting, selecting; hence inferring, that in the surface of the arteries, there did not prevail that attraction which caused the capillary phenomena in dead tubes.

Proceeding to illustrate his position by the phenomena exhibited by the microscope, and by the occurrences familiar to the surgeon during operation, he concluded that the inner surface of the bloodvessels had an influence on the blood contained, of preserving it fluid, and of resisting attraction: But that, when the vitality of their coats was diminished or disturbed, as by the violent tearing of the artery; then coagulation of the blood, and attraction of the blood to the sides of the artery, took place, by which the hæmorrage was stopped.

2. On a Peculiar Structure observed by the Author in the Ice of Glaciers. By Professor Forbes.

This structure, which appears to have escaped the notice of authors on the subject, is a veined or ribboned appearance which pervades the whole ice of many glaciers. The veins or bands are occasioned by the alternation of ice more or less compact; that which is porous approaching to white or whitish green, the denser ice having a bluish tint. The thickness varies from a fraction of an inch to several inches, and the parallelism may be considered as complete through considerable spaces. It extends in more or less complete development from the *névé*, or uncompacted glacier, down to the inferior termination; and during the greater part of this space, in the case of the lower glacier of the Aar, the bands were parallel to the lofty walls by which the glacier was bounded laterally; their position was generally vertical, but sloping from below upwards and outwards as the distance from the sides of the glacier diminished. Towards the lower end of the glacier the structure became very obscure, and for a time nearly vanished. It appears, however, that these bands or veins change their direction from longitudinal to transverse, their outcropping being parallel to the end of the glacier, the apparent strata there dipping inwards at an angle of 10° or 20°. It is this appearance which has given rise to the mistaken idea of horizontal stratification in glaciers. The veined structure rises towards the sides or supporting walls, and has altogether the appearance of being determined by the contour of the ice, and perhaps by the lines of greatest pressure in its interior. In the case of the lower part of the glacier of the Rhone, the veined structure forms conical surfaces, widening upwards, and more and more obtuse as we recede from the centre of pressure, from which the descending glacier is spread out in all directions; its extension producing fissures which extend like radii, and which appear to be always perpendicular to the direction of the structural planes.

Without attempting to explain the process by which so peculiar and interesting a phenomenon is produced, the author remarks, that its existence and production is highly important in two points of view:—(1.) As defining in some respects the nature of icy structure in glaciers, which has been so keenly contested by later writers, and on which so much of the theory of the progression of glaciers depends; and, (2.) As illustrating by analogy the mysterious geological phenomena of cleavage planes, which have been attempted to be accounted for by the presence and energy of polar and crystalline forces, without any evidence having been adduced how such a structure could result from them. The structure of a glacier is daily forming; its analysis falls within the proper domain of physical inquiry; and however hopeless direct experiments in the laboratory must be on such a subject, the required evidence may be perhaps attained by the careful study of glacier crystallization.

James Kinnear, Esq., recommended by Dr Borthwick, was duly elected an Ordinary Fellow.

The following Donations were reported as having been received since the close of last Session:—

Astrononomical Observations made at the Royal Observatory, Greenwich, in the years 1838 and 1839, under the direction of George Riddell Airy, Esq. 2 Vols.—*By the Royal Society of London.*

Journal of the Royal Geographical Society of London. Vol. x. Part 3.—*By the Society.*

Report of the Tenth Meeting of the British Association for the Advancement of Science, held at Glasgow in August 1840. —*By the British Association.*

Bulletin de la Société Géologique de France. Tome x. Feuilles 24–29. Tome xi. et Tome xii. Feuilles 1–11.—*By the Society.*

Proceedings of the Meteorological Society during the Sessions 1838–39 and 1839–40.—*By the Society.*

Quarterly Journal of the Statistical Society. Vol. iv. Part 1–2. —*By the Society.*

Proceedings of the American Philosophical Society. Nos. 14' 15, 16, 17, 18.—*By the Society.*

Transactions of the American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge. New Series. Vol. vii. Parts 2, 3.—*By the Society.*

Flora Batava. No. 122.—*By the King of Holland.*

Produzioni relative al Programma di tre quistioni Geometriche proposto da un nostro professore.—*By the Author.*

Problema Fondamentale per le polari Coniche Reciproche Geometricamente Risoluto da Nicola Trudi.—*By the Author.*

Boston Journal of Natural History, containing Papers and Communications read to the Boston Society of Natural History, and published by their direction. Vols. i. ii. and vol. iii., Parts 1, 2, 3.—*By the Boston Society of Natural History.*

The Quarterly Journal of Agriculture; and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. Nos. 53, 54, and 55.—*By the Highland and Agricultural Society.*

The American Journal of Science and Arts, conducted by Professor Silliman and Benjamin Silliman jun. For April, July, and October 1841.—*By the Editors.*

Lectures on Agricultural Chemistry and Geology. By James F. W. Johnston. Nos. 1 to 11.—*By the Author.*

Mémoire sur la Chaleur Solaire, sur les pouvoirs Rayonnants et Absorbants de l'air atmospherique, et sur la temperature de l'Espace. Par M. Pouillet.—*By the Author.*

Bulletin de la Société d'Encouragement pour l'Industrie Nationale pour 1840.—*By the Society.*

The Article on the Silurian System, from the Edinburgh Review for April 1841. By W. H. Fitton, Esq.—*By the Author.*

Catalogue de l'Ecole des Vignes de la Pepiniere du Luxembourg. —*Par le Duc Decaze.*

Commentatio de usu Experientiarum Metallurgicarum ad disquisitiones Geologicas adjuvandas. Auctore J. F. L. Hausmann.—*By the Author.*

Illustrations of the Affinity of the Latin Language to the Gaelic or Celtic of Scotland. By T. Stratton, Esq.—*By the Author.*

Madras Journal of Literature and Science. April to September 1840.—*By the Madras Literary Society.*

Mémoires de la Société Geologique de France. Tome iii. and Tome iv. premiere partie.—*By the Socicty.*

Proceedings of the London Electrical Society. Session 1841-42. Nos. 1, 2.

The Transactions and the Proceedings of the London Electrical Society. Vol. i.—*By the Society.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Van Der Hoeven, M.D., en W. H. De Vriese, M.D. Deel viii. St. 2, 3.—*By the Editors.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome xii. Nos. 25, 26, et Tome xiii. Nos. 1–18. —*By the Academy.*

Traité Elémentaire des Fonctions Elliptiques. Par P. F. Verhulst.—*By the Author.*

Analyse Raisonnée des Travaux de Georges Cuvier, Précédée de son Elogé. Par P. Flourens.—*By the Author.*

Des moyens de soustraire l'Exploitation des Mines de Houille aux chances d'explosion. Recueil de Memoires et de Rapports publié par l'Academie Royale des Sciences et Belles Lettres de Bruxelles.

Annuaire de l'Observatoire Royal de Bruxelles, pour l'an 1841. Par le Directeur, A. Quetelet.

Annuaire de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. 1841.

Bulletin de l'Académie Royale de Bruxelles. Tome vii. Nos. 9, 10, 11, 12. Tome viii. Nos. 1–6.

Nouveaux Memoires de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xiii.

Memoires Couronnés par l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xiv.—*By the Academy.*

Annuaire Magnetique et Meteorologique du Corps des Ingenieurs des Mines de Russie pour l'année 1839. Par A. T. Kupffer. —*By the Author.*

The Eighth Annual Report of the Royal Cornwall Polytechnic Society. 1840.—*By the Society.*

Journal of the Asiatic Society of Bengal. Nos. 105, 106, 107, 108, 109, 110, 111.—*By the Society.*

Proceedings of the Geological Society of London. No. 76.

Transactions of the Geological Society of London. New Series. Vol. vi. Part 1.—*By the Society.*

Bulletin de la Société de Geographie. Deuxieme Serie. Tomes 13, 14, 15.—*By the Society.*

Recueil de Voyages et de Memoires publié par la Société de Géographie. Tome vi.—*By the Society.*

Natuurkundige Verhandelingen van de Hollandsche Maatschappij der Wetenschappen te Haarlem. (Second Series.) Deel i.—*By the Society.*

The Oily Acids, forming the first Supplement to the Seventh Edition of Dr Turner's Chemistry. By Justus Liebig, M.D., and William Gregory, M.D.—*By the Editors.*

Annuaire du Journal des Mines de Russie, pour les Années 1835, 36, 37, et 38, et Introduction. 5 Tomes.—*By General Tchefskine.*

Transactions of the Botanical Society of Edinburgh. Vol. i. Parts 1, 2.

Fourth and Fifth Annual Reports and Proceedings of the Botanical Society of Edinburgh.—*By the Society.*

Eighteenth Report of the Whitby Literary and Philosophical Society, presented at the Annual Meeting, November 4. 1840. —*By the Society.*

Dictionarium Anamitico-Latinum, primitus inceptum ab illustrissimo et Reverendissimo P. J. Pigneaux, Vicario Apostolico Cocincinæ, et dein absolutum et editum a J. L. Taberd, Episcopo Isauropolitano, &c.—*By the Editor.*

Dictionarium Latino-Anamiticum, auctore J. L. Taberd, Episcopo Isauropolitano, &c.—*By the Author.*

Abstract of the Magnetic Observations made at the Trevandrum Observatory, during the month of May 1841. By John Caldecott, Esq., Director.—*By the Author.*

Museo Numismatico Lavy appartenente alla R. Accademia delle Scienze di Torino. Parts 1, 2.—*By Chevalier P. Lavy.*

Descriptive Account of the Antiquities and Coins of Affghanistan. By H. H. Wilson.—*By the Honourable the Directors of the E. I. C.*

Archives de l' Electricité. Par N. A. de la Rive. No. 1.—*By the Author.*

Det Kengelige Danske Videnskabernes Selskabs Naturvidenskabelige og Mathematiske Afhandlinger. 8 Vols.—*By the Academy.*

An Abridgement of the Acts of the Parliament of Scotland from 1424 to 1707. By William Alexander, Esq., W.S , F.R.S.E. *By the Author.*

Transactions of the Philosophical Society of Cambridge. Vol. vii. Part 2.—*By the Society.*

Annals of the Lyceum of Natural History of New York. Vols. i. ii. iii. iv. Parts 1, 2, 3, and 4.—*By the Directors of the Lyceum.*

Voyage dans la Russie Méridionale et la Crimée. Par M. Anatole de Demideff. Planches. Liv[ns] 6, 7.—*By the Author.*

Commentationes Societatis Regiæ Scientiarum Gottingensis Recentiores. Vols. 7 and 8.—*By the Society.*

Reports presented to the Legislature of the Commonwealth of Massachusetts on Wheat and Silk, Invertebrate Animals, Herbaceous Plants and Quadrupeds.—*By the Bowditch Family.*

Æsop's Fables, written in Chinese by the learned Mun Mooy Seen-Shang. Translated by Robert Thom, Esq.—*By the Translator.*

Ancient Laws and Institutes of Wales.—*By the Commissioners on Public Records.*

Novorum Actorum Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum. Vol. 18. Supplement.—*By the Academy.*

Monografia de genere Murex ossia enumerazione delle principali specie. Per Giov. Michelotti.—*By the Author.*

List of the Instruments and Apparatus belonging to the Royal Society.

List of the Portraits in possession of the Royal Society.

Report of the Committee of Physics, including Meteorology, on the objects of Scientific Inquiry in those Sciences.

Catalogue of the Scientific Books in the Library of the Royal Society.

Catalogues of the Miscellaneous Manuscripts and of the Manuscript Letters in the possession of the Royal Society.

Statutes of the Royal Society. 1840.

Proceedings of the Royal Society of London. Nos. 46, 47, 48.

Philosophical Transactions of the Royal Society of London for 1841. Part 1.

Astronomical Observations made at the Royal Observatory, Edinburgh. Vol. 4. By Thomas Henderson, F. R. SS. L. & E., &c. —*By the Royal Society of London.*

Rara Mathematica; or, a Collection of Treatises on the Mathematics and Subjects connected with them. Edited by J. O. Halliwell.—*By the Editor.*

Mémoire sur differens Procédés d'Integration. Par J. Plana, à Turin.—*By the Author.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. 1839.

Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Konigl. Preuss. Akedemie der Wissenschaften zu Berlin. Juli 1840 bis Juni 1841.—*By the Academy.*

The American Almanac and Repository of Useful Knowledge for 1841.—*By the Phil. Society of America.*

Proceedings of the Zoological Society. Oct. 13. 1840 to July 27. 1841.—*By the Society.*

Letter-Press to the First Part of the Natural History and Illustrations of the Scottish Salmonidæ. By Sir William Jardine, Bart.—*By the Author.*

Ordnance Survey of Ireland. County Galway.—*By His Excellency the Lord Lieutenant.*

Monday, 20th December.

Dr HOPE, V.P. in the Chair.

The following communications were read:—

1. Report of a Committee on the Papers of David Hume, bequeathed to the Society by the late Baron Hume. Communicated by the Council.

The Committee to whose examination the papers bequeathed to the Royal Society of Edinburgh by the late Baron Hume, has been intrusted, in the view of suggesting what might be the most proper and useful plan for their future disposal, consistently with the peculiar character and functions of the learned body to which they now belong, having proceeded to examine their contents with care, have now to offer, though not without considerable hesitation, the views that have occurred to them.

Independently of some valuable and interesting autographs of Mr David Hume, to be mentioned in the sequel, the important part of this bequest, to which the attention of the Committee has been more particularly directed, consists of a miscellaneous and very broken mass of letters, which may, in general, be described as the Private and Confidential Correspondence of that illustrious philosopher and historian. Of these letters, about one hundred and forty-five are written by Mr Hume; the number of those addressed to him is about five hundred and fifty; making a total of nearly seven hundred letters.

Mr Hume's epistolary correspondents appear to have been very numerous, especially in the later periods of his life, when his literary fame had been established, and he had become personally known in a very extensive circle of acquaintance both at home and abroad; among whom are to be found many persons of the most distinguished ranks in society, as well as of the highest eminence in science and learning. In many instances, indeed, the letters addressed to Mr Hume are little more than complimentary expressions of homage to an illustrious writer, and derive any interest they possess from the evidence they afford of the extensive diffusion of his fame as a philosopher and historian. But the greater and more valuable part of the collection consists of the correspondence of those with whom he lived on terms of intimate friendship, to whom he was in the habit of communicating his thoughts and feelings with a singular degree of openness and playful simplicity, and by whom he appears to have been beloved and caressed with a fondness of attachment that affords the most pleasing testimony to the truthfulness and amiability of his character in private life, and a striking contrast to the impressions that may have been received by those to whom Mr Hume is known only in his metaphysical and historical writings. The letters, in general, are not controversial or discursive; there are occasionally introduced discussions on topics of permanent interest; but even in his correspondence with those to whom his peculiar opinions were the most offensive, there prevails the same mutual kindliness and forbearance with which he appears to have inspired his more intimate associates.

Such being the general character and description of the papers in question, it appears to your Committee that the value they possess is chiefly to be derived from the illustrations they might furnish of the literary history of Mr Hume. Whatever diversity of opinion may exist as to the tendency of his philosophical or political speculations, it must on all hands be admitted that he has attained, and must continue to occupy, a station in the literature of his country that cannot fail to make the formation of his character and the progress of his literary labours to be regarded as objects of more than ordinary interest. In that view, these papers may be justly esteemed of great value. The series is indeed very imperfect, and probably its defects cannot now be fully supplied from any other sources; but enough is preserved to throw some curious and interesting lights on even the earliest period of Mr Hume's career; and the materials may here be found for tracing his subsequent progress through life with the most minute accuracy.

In what manner these materials ought now to be employed, is a question which, to your Committee, appears to be of considerable difficulty. In the terms of Baron Hume's bequest, no particular object or definite purpose is expressed; nor, in the ultimate disposal of these papers, has the Society been fettered by any limitations or conditions. His motives, however, in selecting the Society as the depositary of these remains of his illustrious kinsman, must have been at once to secure their preservation in the most effectual manner, and to prevent any injudicious or indiscreet use of them, to the risk of which they might otherwise have been exposed.

In discharging the duty imposed on the Society by their acceptance of this bequest, there can be no doubt that the whole of the documents thus acquired must be carefully and faithfully preserved. It may be true that in the general mass there are some articles apparently of little value, which may have owed their preservation to accident or oversight; but your Committee can by no means encourage the idea, that in attempting to separate these from what they might deem truly valuable, the Society would be safe in exercising any discretion whatever; for, most assuredly, however judicious the selection might be, it would not fail to expose them hereafter to misrepresentation and reproach.

On the more difficult question as to the disposal of these manuscripts, the Committee have not arrived at any clear or decided opinion. Thus far, indeed, they conceive it to be evident, in the first place, that the property must remain inalienably in the Society, and that to convert it into a subject of pecuniary speculation would be an abuse of the confidence reposed in them by the testator; and in the second place, that to undertake directly, and in their own name, the publication of the whole or of any portion of these manuscripts, would not be in accordance with the proper character and functions of that learned Body. If in these respects the views entertained by the Committee shall be deemed correct, the only obvious alternative seems to be, to await the opportunity of entrusting the use of these manuscripts to an Editor, who may in all respects be thought worthy of the confidence of the Society, and who may intend to employ them either as the Illustrations of a Life of Mr Hume, or as a separate publication of his Private and Confidential Correspondence. There appears to your Committee to be no good reason for any hurry or impatience in accomplishing such an arrangement; and, in the mean time, it is obviously proper that these papers should be accessible to the inspection of such persons, Members of the Society or others, as may apply to the Council of the Society for that purpose; all due precautions being taken against any abuse of the liberty so to be conceded.

Having said so much on what the Committee regard as the more important portion of the Hume Papers, it remains to take notice, in a few words, of the other parts of this bequest. Among these there is what may be regarded as in the nature of a Common-place Book, written evidently at an early period, which would be found to furnish some useful hints to a biographer in tracing the progress of Mr Hume's studies, and the formation of his opinions. Besides these, and a few other miscellaneous papers of no great importance, there are the original manuscripts of the earlier part of the History of England, of the Dialogues on Natural Religion, and of his own Life. Of these, the chief value is derived from the highly instructive exhibition they afford of the infinite care and pains with which Mr Hume revised and corrected all his compositions, and by means of which he succeeded in giving to his style not only its minute accuracy, but much also of its characteristical force and spirit. The successive editions of his works are well known to afford abundant evidence of his uncommon anxiety and care in these respects, and their collation has been found to furnish most useful lessons to the students of English style; but in these manuscripts the process of revisal and correction becomes still more apparent and remarkable, and renders them of considerable curiosity.

THO. THOMSON.
JOHN ABERCROMBIE, M.D.
ALEX. MACONOCHIE.
JAMES PILLANS.
JOHN SINCLAIR.

The following postscript has since been added by order of the Council:—

POSTSCRIPT.

It may be proper to add to the statements in the preceding Report, that among the original letters comprehended in Baron Hume's bequest, there are a few that have already been printed. Of these, the most important are some of the letters relative to Mr Hume's ill-fated connection with M. Rousseau, published either at the time by himself and others, or in a volume entitled his Private Correspondence, printed at London in 1820. The only others here deserving of particular notice are a few of the letters written by Mr Hume near the close of his life, and communicated by Baron Hume to the editor of the Literary Gazette, and published in London in the year 1821. It is scarcely necessary to add, that there still exist many other valuable letters of Mr Hume, the originals of which had not come into the possession of his executors, and that a considerable number of these have appeared in various biographical and periodical publications.

2. On the Optical Properties of Greenockite, by Sir David Brewster, in a letter to Lord Greenock.

Greenockite has the form of a regular six-sided prism, with pyramidal summits, the faces of the pyramid being inclined 36° 20′ to their base. The pyramids are sometimes truncated on their summit.

The crystallization is often composite.

The index of refraction of Greenockite is 2.6882, corresponding to the middle of the green space, and to the ordinary ray. Hence Greenockite exceeds the *Diamond* in refractive power, and also *chromate of lead*, which I had found to surpass the diamond in this respect.

The double refraction of Greenockite is comparatively small, which is not usual in substances of a high refractive power. It is so small, indeed, that owing to its great dispersive power it is exceedingly difficult to separate the two images.

The polarising angle of Greenockite is 68° 36′ for the *red* rays, which corresponds to an index of refraction for that light of 2.5517.

I found it very difficult to establish the existence of an *uniaxal* system of rays along the axis of the prism; but I succeeded in doing this by light of the condensed rays of the sun, by which it can alone be established; for when in biaxal crystals one of the axes is very weak, as in nitre, its influence on the rays is scarcely visible in crystals of little thickness, such as those we meet with in Greenockite.

The uniaxal system of rings is *negative*, as in calcareous spar.

The light left at the polarising angle is blue and pink.

Professor Forbes, after reading the foregoing communication, remarked that the uniaxal structure of Greenockite was ascertained by himself with the aid of concentrated gas-light, and that his notice on the subject was published in the Philosophical Magazine for July 1840.

3. On the Results of the most recent Experiments on the Conducting Power for Heat of different Soils. By Professor Forbes.

The author gave, in continuation of a former paper (see Proceedings of the Royal Society of Edinburgh, 3d Dec. 1838), an account of the continued systematic prosecution and annual reduction of the observations of temperature at different depths (3, 6, 12, and 24 French feet) below the surface of the ground, in various geological formations near Edinburgh, viz. the trap rock of the Calton Hill, the incoherent sand of the Experimental Garden, and the coal formation sandstone of Craigleith Quarry. The weekly observations at all these stations have been projected into curves, which present the most remarkable concordance of general features for the four years now complete, and give a just confidence in the comparability of the results obtained. The thermometric readings have all been rigorously corrected for the expansion of the alcohol in the tubes; and, starting from these data, the results in the following tables have been obtained, partly by graphical methods, partly by calculation. The quantity marked A is the log. range at the surface. The quantity B (which is the most interesting result) marks the rate of diminution of the range as we descend, and is proportional to the square root of the specific heat of the soil divided by its conducting power. M. Regnault of Paris has kindly undertaken to determine the specific heats by direct experiment, whence the conductivity will become known; and the comparison of the results for four years proves that we have already obtained a near approximation to its value, which is well defined for the different formations, but especially for the Sandstone, when contrasted with the other two. The results of Tables III. IV. and V. are deduced from the numbers in Table I.; and for the sake of comparability with the foreign observations, the French foot and centigrade degree have been employed as units. So well do the observations of the different thermometers for any one station accord together, that, taking any two of the thermometers and combining their results by pairs, we should obtain nearly the same conclusions. These conclusions are also in accordance with those which the Epochs in Table II., and the rate of Progress of Heat downwards in Table VI., present; the best conducting soil (that for which B has the smallest numerical value) transmitting the heat fastest.

TABLE I.—Range in Centigrade Degrees.

	3 Feet.			6 Feet.			12 Feet.			24 Feet.		
	Trap.	Sand.	Sandst.	Trap.	Sand.	Sandst.	Trap.	Sand.	Sandst.	Trap.	Sand.	Sandst.
1837	10.53	11.23	9.58	6.61	8.30	7.72	3.05	4.19	5.22	0.80	1.16	2.28
1838	9.83	11.30	10.29	6.22	8.10	7.91	2.80	3.94	5.16	0.70	1.0	2.13
1839	8.64	10.55	9.14	5.73	7.76	7.40	2.69	3.95	4.64	0.76	0.79	2.20
1840	8.29	10.14	18.98	5.70	7.35	7.28	2.50	3.72	4.63	0.89	1.06	2.07

TABLE II.—Epochs of Minima.

1838	Feb. 26	Mar. 3	Feb. 23	Mar. 14	Mar. 19	Mar. 3	Apr. 20	Apr. 22	Mar. 20	July 18	July 8	May 12
1839	Mar. 14	Feb. 24	Feb. 24	Mar. 27	Mar. 25	Mar. 4	Apr. 30	Apr. 22	Apr. 1	July 12	June 24	May 12
1840	Mar. 1	Feb. 25	Mar. 1	Mar. 14	Mar. 15	Mar. 8	Apr. 19	Apr. 18	Mar. 21	July 5	June 26	Apr. 30

Epochs of Maxima.

1837	Aug. 6	July 31	Aug. 5	Sept. 2	Aug. 24	Aug. 19	Oct. 17	Oct. 6	Sept. 11	Jan. 8	Dec. 30	Nov. 11
1838	Aug. 8	Aug. 6	Aug. 16	Sept. 6	Aug. 31	Aug. 23	Oct. 19	Oct. 14	Sept. 19	Jan. 5	Jan. 4	Nov. 2
1839	Aug. 1	July 30	July 30	Aug. 26	Aug. 19	Aug. 14	Oct. 10	Oct. 3	Sept. 11	Jan. 8	Dec. 26	Nov. 4
1840	Aug. 23	Aug. 18	Aug. 18	Sept. 4	Sept. 2	Aug. 23	Oct. 6	Sept. 30	Sept. 9	Jan. 3	Dec. 18	Oct. 26

TABLE III.—Values of A.

	Trap.	Sand.	Sandstone.
1837	1·164	1·176	1·076
1838	1·173	1·217	1·114
1839	1·086	1·182	1.049
1840	1·073	1·155	1·044

TABLE IV.—Values of B.

1837	—·0545	—·0440	—.0316
1838	—·0641	—·0517	—·0345
1839	—·0516	—·0498	—·0305
1840	—·0550	—·0470	—·0308

TABLE V.—Annual range reduced to 0·01 Cent.

1837	58·1 F. Feet.	72·2 F. Feet.	97·3 F. Feet.
1838	49·3	61·8	91·
1839	59·2	63·5	100·
1840	55·9	67·1	98·8

TABLE VI.—Velocity of Propagation of Heat downwards.

Maxima.

		Trap.	Sand.	Sandstone.
1837	1 foot (French) in	7·5 days.	7.1 days.	4·9 days.
1838		6·8	6·8	3·6
1839		7·8	7·2	4·6
1840		6·6	5·95	3·5

Minima.

		Trap.	Sand.	Sandstone.
1838	1 foot in	6·5 days.	5·8 days.	3·6 days.
1839		6·0	5·1	3·6
1840		6.1	5·7	3·05

James Thomson, Esq., Civil Engineer, proposed by Dr Thomas Thomson of Glasgow, was duly elected an Ordinary Fellow of the Society.

The following Donations were presented to the Society since last Meeting :—

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome xiii. Nos. 19, 20, 21.—*By the Academy.*

Verhandelingen over de Natuurlijke Geschiedenis der Nederlandsche Overzeesche Bezittingen, door de Leden der Natuurkundige Commissie in Oost Indie en Andere Schrijvers. Afleverings 1, 2, 3.

Nouveaux Mémoires de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xiv.—*By the Academy.*

Mémoires couronnés par l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xv. Ptie. 1.—*By the Academy.*

Astronomische Beobachtungen auf der Königlichen Universitäts Sternwarte in Königsberg. Von F. W. Bessel. 20te Abtheilung.—*By the Author.*

Proceedings of the Royal Society. No. 49.

Catalogue of Miscellaneous Literature in the Library of the Royal Society. 8vo.—*By the Society.*

An Account of the Vegetation of the Outer Hebrides. By J. H. Balfour, M.D., F.R.S.E.—*By the Author.*

Descriptive and Illustrated Catalogue of the Physiological Series of Comparative Anatomy contained in the Museum of the Royal College of Surgeons in London. Vols. 4, 5. 4to.—*By the Royal College of Surgeons.*

Monday, 3d January 1842.

Dr HOPE, V.P. in the Chair.

The following communications were read :—

1. On the Cultivation of the Sugar-Cane in Spain. By Dr Traill.

He prefaced it by a short sketch of the knowledge which the ancients had of this plant, of its introduction into Europe, and from thence into the American Islands. He endeavoured to shew, from Spanish authorities, that very soon after the discovery of America, the Spaniards carried the sugar-cane, among other useful plants, with them to the West Indies, and sedulously cultivated it; and he considered the speculations of *Labat* and *Lafitau*, on the supposed American origin of the cane, as very inconclusive.

The author's remarks on the Spanish cultivation of the cane were the results of his personal observations during a residence of some months in Spain in the year 1814, and of some statistical information afforded to him by the late Wm. Kirkpatrick, Esq. of Malaga. The sugar-cane culture was introduced by the Moors, soon after their conquest of Spain, and flourished exceedingly even after the overthrow of their empire in the Peninsula. Its first serious check was from the cruel and impolitic expulsion of the Moriscoes in 1609; its second, from the enormous extension of sugar plantations in the West Indies and South America. Yet, notwithstanding the capricious oppressions of a tyrannical government, it has subsisted to the present time as a considerable branch of Spanish agriculture, with periodic fluctuations in its prosperity, for two hundred years since the expulsion of the most industrious inhabitants of Spain.

He described the district producing sugar, at the period of his visit, as extending along the shores of the Mediterranean, from *Adra* to *Manilba*, a distance of 130 miles. The breadth of this track, however, is small—not more, on an average, than four or five miles, being hemmed in on the west and north by the rugged mountains of Andalusia. These ranges screen it from the west and north winds; but as the most lofty are crowned with perennial snow, occasional frosts are injurious to the sugar planter. The general climate of Andalusia was shewn by Dr T. to be remarkably mild throughout the year; as is proved by the luxuriant growth of *Chamærops humilis*, *Cactus Opuntia*, *Agave Americana*, the orange and the lemon, and the date-palm, in Southern Andalusia.

Along the track in question there are many sugar plantations, and a considerable number of sugar-mills, moved either by water or by mules. Most of the plantations are small; but one estate made 4600 loaves of white sugar annually, each of the value of ten dollars. Most of the Spanish sugar, however, was either *Muscovado* or *clayed* sugar. The statistical remarks shewed that a well-managed estate, near Marbella, returned in the worst years 7 per cent. on the capital employed, in middling years 11 per cent., and in good years from 16 to 20 per cent., after deducting all charges.

2. On the Theory of the Parallel Roads in the Glens of Lochaber. By Sir G. S. Mackenzie, Bart.

Sir George Mackenzie read a paper on the Theory of the Parallel Shelves in the Glens of Lochaber, in which he first noticed the objections to the theories that ascribed the origin of these appearances to fresh-water lakes, the barriers of which had been destroyed at different periods; and to the ordinary action of the sea when the land was at a lower level than at present. The causes supposed to have removed the barriers, in the first case, being violent disruptions, the preservation of level and parallelism is totally inconsistent with such operations. In the second case, the shelves being confined to the single locality of these glens, while, supposing them to have been sea-beaches, the appearances of such shelves should be frequent and to be seen every where; it becomes necessary that the elevation of the land should have been confined to a narrow locality, and to have exhibited a boundary no where to be found. In this case, also, the elevation of the land must have been sudden, otherwise the traces of the action of the sea would have been seen continuous all over the sides of the glens. Sudden elevation being therefore necessary, it is not at all probable that the levels and parallelism could have been preserved so perfectly as to be in accordance with the curvature of the earth.

Sir George alluded to the researches of Sir James Hall in reference to the debacle or flood that appears to have passed over the country; and to the notions of Professor Agassiz, that ice, a universal glacier, had produced the phenomena which had been attributed to the debacle. He denied that these phenomena could have been the effects of glaciers properly so called; though, as stated by him in a paper read last session, masses of ice may have been, and most probably were, brought from the Arctic Regions by the debacle, and may have been arrested in the narrow passes among the mountains, forming temporary glaciers, if such an appellation may be applied to them, and producing effects not easily accounted for without such assistance. Sir George then pointed out a singularity in the localities of the Lochaber glens, in reference to the demonstrated course of the debacle, which had led him to attribute to that catastrophe the formation of the shelves. The openings of the glens face that course, and they turn towards the north, so as to become nearly parallel to the Great Glen. The highest summit level is between Glen Gluoy and Glen Roy, and the other lower summit levels are between Glen Roy, Glen Spean, and the valley of the Spey. The debacle coming from the NW. would fill these glens, and flow over the summit levels. As soon as it subsided below that of Glen Gluoy, that glen would be in the condition of a lake or arm of the sea, and defended from the great tumult of waters by the mountain ridge betwixt it and the Great Glen, while the agitation would be sufficient quickly to produce the highest of the shelves. When the waters subsided below the summit level of Glen Roy, then the highest shelf in that glen would begin to be formed. As the subsidences would be irregular, in consequence of the agitation of the waters, and the influence of the varied surface of the land, and as also the tides would contribute in a considerable degree to this irregularity, Sir George conceived a sudden subsidence, and a sudden stoppage for a time, amply sufficient for the formation of the imperfect terraces or shelves, the sections of which clearly indicate something very different from the comparatively tranquil operations of the sea on the coast. The lowest shelf appears to have formed on the subsidence of the water below the summit level betwixt Glen Spean and the valley of the Spey. The shelves disappear at the points where the agitation of the waters may be supposed to have been too great for their formation, on account of vicinity to the Great Glen; and, consequently, we may expect the diluvium to assume the appearance in that locality which it exhibits in many others, and modified by the shape of the surface. This modification is beautifully exhibited whenever the effects of the land on the movement of the waters is taken into account, and which it has never been sufficiently, when the theory of a debacle has been discussed.

Sir George admitted fully the probability that masses of ice, brought by the debacle, may have rested at the openings of these glens, and acted as barriers to a certain extent; but this, he considered, does not affect his general theory, while it rather strengthens it. The erratic blocks found on the shelves may have been deposited by ice; and if rounded pebbles, brought in evidence by Mr Darwin against Sir George's theory, could not have been produced by such a vast torrent, the great abundance of ready-made pebbles to be found in the masses of conglomerate over which the flood had to pass, would sufficiently remove the objection. Sir George expressed himself as by no means anxious about the fate of his theory, because a philosophical examination of it, if condemnatory, would remove obstacles in the way of arriving at truth; and if laudatory, would lead to a correct explanation of facts still in a somewhat anomalous state.

3. On the Results obtained with different forms of Rain-Gauges. By Joseph Atkinson, Esq. Communicated by David Milne, Esq.

The objects proposed were—

First, To discover the difference which the *height* of Rain-Gauges above the surface makes in the amount of rain received by each gauge.

Second, To try the effect of an *Inclined* Funnel, which always presents itself towards the wind.

Third, To test the action of a *Globular* Gauge or Sphere.

Fourth, To investigate whether any and what difference the *size* of the funnel made in the quantity of rain received.

The number of gauges used to accomplish these objects was six;—of which three were horizontal funnels, 12 inches in diameter, placed respectively 0, 3, and 6 feet above the surface; one was a copper sphere, 36 inches in circumference, placed 6 feet above the surface; one was a funnel, 12 inches in diameter, placed at an angle of about 45 degrees, and 6 feet above the surface—a vane was attached to the rim of this funnel, and this last moved upon a pivot over the receiver; and the sixth gauge had a funnel of 18 inches diameter, placed horizontally, and six feet above the surface.

The results obtained from these gauges in twelve months, beginning with November 1840, were as follows:—

First, The excess of the surface gauge over that which was three feet above the ground, was nearly identical with the excess of the latter over that which was six feet above; the excess in the first mentioned case being 1.816 inches—in the latter, 1.865 inches.

Second, The inclined and moveable funnel always took more rain than the horizontal funnel on the same level during strong winds, and less during calm winds. The difference between these two gauges was, in twelve months, only 1.887 inches. In that period, the horizontal funnel on the surface had taken 1.804 inches more rain than the inclined funnel, the latter being placed 6 feet above the surface.

Third, The globular gauge, instead of receiving more rain than the common horizontal funnel at the same level, as might have been expected, received 0.560 inches less in the twelve months. In the first six months, it received more rain than the horizontal funnel, but during the warm months it received considerably less. During the cool months it represented very fairly the mean of the horizontal funnel and the inclined funnel; but during the summer months it failed in doing so, that failure being greatest in August, when it had taken 0.536 inches less than the mean of the other two gauges. In the twelve months the globular gauge had taken 1.503 inches less than the mean of the other two gauges.

Fourth, The funnel, which had a diameter of 18 inches, received 2.505 inches less rain than a funnel 12 inches in diameter, which was placed at the same height. And this difference was not the effect of one or two months; for it will be observed, on reference to the Table, that the quantity received by the larger funnel was uniformly less than the quantity received by the smaller.

These results were obtained at Harraby, near Carlisle.

NUMERICAL RESULTS—SUMMARY.

1840–1.	12-inch Funnel on the Surface. 1.	12-inch Funnel 3 feet above Surface. 2.	12-inch Funnel, horizontal, 6 feet above Surface. 3.	12-inch Funnel at an angle, and with Vane, 6 feet above Surface. 4.	Sphere, 36 inches in circumference, 6 feet above Surface. 5.	18-inch Funnel, horizontal, 6 feet above Surface. 6.
Nov.	3.089	3.112	2.709	3.158	2.877	2.709
Dec.	0.439	0.429	0.369	0.393	0.405	0.291
Jan.	3.182	2.594	2.364	2.668	2.560	2.129
Feb.	1.569	1.477	1.249	1.681	1.337	1.167
March.	2.728	2.571	2.407	3.550	3.042	2.153
April.	2.587	2.576	2.429	2.915	2.481	2.324
May.	2.406	2.261	2.172	2.435	2.181	2.074
June.	3.380	3.405	3.243	3.193	2.882	3.013
July.	3.270	3.180	3.166	2.666	2.717	2.902
Aug.	6.597	6.456	6.210	5.651	5.394	5.780
Sept.	3.941	3.901	3.863	3.405	3.507	3.377
Oct.	6.035	5.444	5.360	5.713	5.598	5.117
	39.222	37.406	35.541	37.428	34.981	33.036

The sum of the Sphere (5.) *less* than the mean of the Horizontal and Vane (3. and 4.) by 1.503.

The sum of the Surface (1.) *more* than the sum of the Vane (4.) by 1.804.

The sum of the 18-inch Funnel (6.) *less* than the sum of the 12-inch Funnel (3.) by 2.505.

The following Donations were presented to the Society since the last meeting :—

Mémoires de l'Académie Imperiale des Sciences de Saint Petersbourg. (Sciences Mathematiques et Physiques.) Tome ii. Livns 5, 6.

Do. do. (Sciences Naturelles.) Tome iii. Livns 5, 6, et Tome iv. Livns 1, 5.

Do. do. (Sciences Politiques, Histoire, Philologie.) Tome v. Livns 1, 4.

Do. do. (Par divers Savans, et lus dans ses Assemblées.) Tome iv. Livns 3, 4.

Recueil des Actes de la Séance Publique de l'Académie Impériale des Sciences de Saint-Petersbourg, ténue le 29 Dec. 1840.—*By the Imperial Academy.*

Bullétin de la Société Imperiale des Naturalistes de Moscow, 1840. Nos. 1, 4, et 1841. No. 1.—*By the Society.*

Ueber den Galvanismus als chemisches Heilmittel gegen örtliche Krankheiten, von Dr Gustav Crusell.—*By the Author.*

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1841-42. No. 20.

Monday, 17th January 1842.

Dr ABERCROMBIE, V. P. in the Chair.

The following communications were read :—

1. On the Identity of the Animal Matters which form the Basis of the Animal Fluids and Solids. By James Stark, M.D., F.R.C. Phys.

The author, after referring to the late researches of Mulder, Vogel, Liebig, &c., whose experiments proved the close analogy between albumen, fibrin, and casein, and their almost identity in composition, stated that, in consequence of some experiments he had performed a few years ago, he was led to entertain the idea that all the animal fluids and solids consist of modifications of one and the same prototype animal matter. The following considerations seemed to confirm this opinion.

1. Experiments on the blood, and the fact of all tissues of the body, however differing in appearance and chemical properties, being formed from that albuminous fluid. 2. The formation of the chick in ovo, albumen and oil being the only matters from which all the tissues and fluids are derived; whilst the chick being shut up in a calcareous covering and tough membrane, which becomes denser as incubation advances, would appear to prevent any of the usual

supposed changes being produced, which could allow albumen to be converted into gelatin. 3. The continuity of tendon and muscle. The author stated, that if a fine fibre of tendon be carefully removed, it brings away with it its continuation in the muscle, or *vice versa*, and that, when this was examined by means of a powerful microscope, the continuity of the ultimate fibres appeared to him to be capable of being traced. 4. The mode in which a ruptured tendon is repaired,—the fibrinous matter which is thrown out, apparently by simple condensation, seeming to assume all the characters of true tendon. 5. The early food of the young of all the Mammalia, consisting, like that of the chick in ovo, of a kind of albuminous matter and oil, viz. milk. 6. Experiments on the nutrition of animals, which shew, that though fed with gelatin, fibrin, and albumen, the lacteals contain a simply albuminous fluid. 7. The similar effects produced by maceration on all the tissues of the body.

The author then briefly narrated the chemical details, which satisfied him that all the solids and fluids of the body (fatty and nervous matters excepted), might be reduced to a prototype or basic animal matter, which exhibited none of the characters naturally belonging to any of the fluids of the body ; and he shewed how the albumen in the serum of the blood seemed to be instantly resolved into this basic animal matter by a few drops of solution of caustic potash. He also found that the potash solution had a similar action on all the constituents of the blood, the fibrine as well as the albuminous matters not only preventing the blood from clotting but also from depositing its red or coloured particles. The author pointed out the effect of ether in removing this basic animal matter in a state of purity from its chemical solutions, and remarked that it acted similarly on solutions of albumen and of gelatin. He also stated, that this prototype animal matter appeared, in certain states of the system, to be secreted in its basic form along with the urine, and had been formerly described by him under the name of Gravidine.

The author therefore proposed to adopt from Mulder, for this basic animal matter, the name of *Protein*, as expressing the Proteus-like forms it is capable of assuming.

The author next proceeded to observe, that being desirous of ascertaining what effect chemical agents exerted on the tissues of the body in producing their solution, he was induced to examine the solutions by means of a powerful microscope, with a magnifying power of 800 diameters. He then observed that these were composed of an infinite number of minute globular particles floating in the clear fluid. These globules were many times smaller than the globules of the blood, and from their very minute size the author was only able to guess at their diameter. These globules, in the author's opinion, are not to be confounded with those described by Edwards, Baer, Sir E. Home, and others, who also stated the tissues to be composed of globular parts; because the globules of these observers were of the same size as the blood corpuscles. These minute globules the author regarded as the ultimate particles of animal organization; and though they seemed to consist of an external coat, and an enclosed transparent fluid, he thinks this is a deceptive appearance, and that it is more likely the particles are solid, as they apparently remain unchanged in size or form on drying. When the animal matters were removed from their chemical solutions in a state of purity by means of ether, and again examined, the author stated that these minute globular particles were even more distinctly seen than before, and that they retained their original globular appearance and general character apparently unchanged. He also stated that the blood to which potash had been added, was wholly reduced to its component globular particles floating either singly or in small irregular agglomerations; but not a single blood corpuscle was visible; all had been apparently resolved into thin constituent globular particles.

The author then stated, that he was induced to extend his examinations to the natural solids and fluids of the body, in order to ascertain whether any similar globular appearance could be detected in them. On a careful examination, almost all the tissues seemed to him to be composed of filaments of extreme tenuity, of the very same diameter as the minute globules he had previously observed in the chemical solutions; and these filaments could, in many instances, be seen to be formed of globules or molecules arranged in lines. When the fibre or membrane was stretched, the globular or molecular appearance of the filaments appeared to be destroyed, but, when relaxed, the peculiar appearance became again distinctly visible.

On examining the fluids of the animal body, the author remarked that the fluid fibrin which rises to the top of new-drawn blood was composed of a multitude of minute globules of the same size and appearance as those previously seen in the tissues and in the chemical-solutions. He further conceives, from his microscopic examinations, that the corpuscles of the blood are very compound bodies, composed of the same minute globules arranged in concentric rings. The serum of the blood of the lower animals also seemed to him to be filled with minute very transparent globules, but those in human serum were not always so easily detected. The pus and mucus corpuscles were also described as consisting of agglomerations of similar minute globules. The casein globules were also described.

The author stated that his observations had been made with a very excellent common compound microscope, but that he had verified every observation by means of crystal lenses of high power, simple globules of crystal, a garnet lens, with a magnifying power of 1000 diameters, and a Wollaston's doublet, adapted to the microscope.

2. On the Parasitic Fungi found growing on the Bodies of Living Animals. By John Hughes Bennett, M.D. Communicated by Dr Graham. Part 1. *See Proceedings of the next Meeting.*

The following Donations were presented to the Society since last Meeting.

Ordnance Survey of the County of Wexford in Ireland. 56 sheets. —*By his Excellency the Lord Lieutenant.*

Proceedings of the Linnean Society of London. Nos. 10, 11, and 12.

Transactions of the Linnean Society of London. Vol. xviii. part 4. —*By the Society.*

Monday, 7th February.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following communications were read :—

1. On the Parasitic Fungi found growing on the Bodies of Living Animals. By John Hughes Bennett, M. D. Communicated by Dr Graham. Part 2.

The author's object was, 1*st*, To confirm and extend the investigations of Gruby concerning the mycodermatous vegetations growing in the crusts of the cutaneous disease called *Porrigo lupinosa* ;—2*d*, To describe a plant he had himself found growing on the living membrane and tubercular matter of *Phthisis pulmonalis* ;—3*d*, To describe the structure of a plant found infesting the skin and gills of the gold-fish ;—and, *4th*, To inquire into the pathological state which furnishes the conditions necessary for the growth of fungi in living animals.

1. In July last, the author examined the crusts of *Porrigo lupinosa*, readily detected the cylindrical and ramified appearances described by Gruby, and confirmed his account of the development of the disease. In some cases, the appearance of the crusts containing the vegetations was preceded by pustules; but as nothing of the kind would be observed in other instances, this seems an accidental, not an essential character of the disorder. The crusts appear in seven or eight days, in the form of minute, yellow, depressed spots, consisting of a smooth, cup-shaped capsule. This capsule, as seen with a magnifying power of 300 diameters, gives off from an amorphous granular matter numerous jointed tubes, which discharge from their extremities many round or oval bodies, the sporules or prolific germs of the plant. The appearance of the Porrigo-capsule was always preceded by desquamation of the cuticle. Hence it is probable that the sporules insinuate themselves into the crevices, instead of springing up originally below the cuticle, or in its substance, as Gruby supposes. The author was not more successful than Gruby, in communicating the disease by inoculation ; but nevertheless considers that the doctrine of its contagious nature, generally held by medical men, is sufficiently proved by other evidence. He thinks it is not confined to the human race only, as he has lately detected precisely the same appearances on the face of a common house-mouse.

2. While investigating the nature of pulmonary tubercles, the author observed a vegetable structure in the sputa expectorated during life, as well as in the tubercular matter found in the lungs after death, in a case of phthisis with pneumothorax. The structure consisted of jointed tubes branching dichotomously, between $\frac{1}{100}$ and $\frac{1}{200}$ of a millimetre in diameter, and springing from an amorphous granular mass. They gave off round or oval corpuscles, which appeared to be sporules, arranged in bead-like rows. These vegetations seemed to have existed during life, both because they were seen in fresh sputa, and because those seen in the lungs could scarcely have attained their actual development in the short space of thirty-six hours, which elapsed between the patient's death and the examination of the body. The plants resembled Link's *Penicillium glaucum*.

3. The gold-fish is known to be subject to a disease, accompanied

with the formation of a cottony substance around its gills, and on other parts of its body. In a specimen put into his possession by Mr Goodsir, the author found that the cottony substance presented under the microscope both a cellular and a non-cellular structure. The former consisted of long tubes divided into elongated cells, at the proximal end of which there was a transparent vesicle or nucleus about a 100th of a millimetre in diameter. Some cells were filled with a granular matter ; others were empty, as if they had discharged their contents. Besides this structure, there were also long filaments, about a 600th of a millimetre in diameter, which sprung from the tubes, and seemed to consist of a diaphanous sheath, and a solid transparent matter. This structure, as in the two previous instances, sprung from a finely granular amorphous mass.

The author next gave a condensed view of the history of his subject, describing more especially the observations and discoveries of Bassi, Audouin, and Johanys relative to the Muscardine, or fungous disease, of silk-worms,—those of Hannover and Stilling, on the Confervæ which infest reptiles,—those of Ehrenberg, Goodsir, and Cooper, on the mycodermatous vegetables of fishes,—those of Owen and Deslongchamps, on birds,—and those of Schœnlein, Fuchs, and Langenbeck, Gruby, and others, on man. And from all the facts hitherto collected on the subject, he inferred, that the vegetations in question are not the cause, but the result of disease in animals,—that they grow on unorganized matters, apparently albuminous or tubercular in nature, which are effused into the healthy textures,—that they occur only in animals previously weakened by circumstances inducing imperfect nutrition,—and that their growth is to be counteracted partly by invigorating the body and partly by local applications hostile to vegetable life.

The paper was accompanied with drawings of the appearances described.

2. On the Action of Water on Lead. By Dr Christison.

The author, after briefly stating the results of his Experimental Inquiries, published on this subject in 1829, proceeded to describe two instances which had recently come under his notice, illustrative of the solvent action of certain terrestrial waters on lead, and of the danger of using this metal for conducting water in pipes, unless with a due regard to the circumstances which promote or prevent its corroding property. In one instance, the water of a spring, conveyed in a lead-pipe from a distance of three quarters of a mile, was found to act so powerfully on the lead, that in a short time the cistern in which the water was collected became covered with loose carbonate of lead, and the metal could easily be detected in the state of oxide dissolved in the water. In this case, the action was found to depend on the spring being of extraordinary purity, its total saline ingredients being only a 22,000th part. In the other instance, water conveyed half a mile in a lead-pipe, was impregnated exactly in the same way, and with the very same phenomena,—but with the additional circumstance, that, in consequence of the impregnation not having been detected in time, as in the previous case, the disease, *Colica pictonum*, broke out in the house supplied with the water. In this case, the water was by no means pure, as it was found to contain no less than a 4,500th part of saline matter. But there was scarcely any other salt present except muriates, which the author had ascertained in his former researches not to prevent the action of water on lead, unless present in much larger quantity.

He next proceeded to explain in what manner the action of the water was put an end to in both these cases. In similar instances, the only remedy formerly thought of was the substitution of iron-pipes. In the former of the two cases which fell under his notice, the water was left at rest in the pipe for four months, till a firm crust of mixed carbonate and sulphate of lead had crystallized on the lead; after which no farther action took place. In the latter instance, the same end was attained by keeping the pipe full of a solution of phosphate of soda, consisting of a 27,000th of the salt.

The author appended an analysis of the compound formed by the action of distilled water on lead. Guyton-Morveau and others considered it a hydrated oxide; the author himself, in 1829, thought it a neutral carbonate; and, in 1834, Captain Yorke first considered it a hydrated oxide, and eventually concluded from his analyses, that it is an irregular mixture of hydrated oxide and carbonate of lead. The author finds that the product is a hydrated oxide, when the action goes on without the access of carbonic acid; but that, when the action proceeds in the usual way, under exposure to the atmosphere, the product is a crystalline body, of which the primitive form seems to be the regular octahedre, and which is composed of two equivalents of neutral carbonate, united with one equivalent of hydrated oxide ($2\ PbO\ CO^2 + PbO\ Aq$).

He then stated the following to be the general conclusions to be drawn in a practical point of view, from his present and previous inquiries as to the use of lead for conveying water :—

1. Lead-pipes ought not to be used for the purpose of conveying water, at least where the distance is considerable, without a careful chemical examination of the water to be transmitted.

2. The risk of a dangerous impregnation with lead is greatest in the instance of the purest waters.

3. Water, which tarnishes polished lead, when left at rest upon it in a glass vessel for a few hours, cannot be safely transmitted through lead-pipes without certain precautions.

4. Water, which contains less than about an 8000th of salts in solution, cannot be safely conducted in lead-pipes, without certain precautions.

5. Even this proportion will prove insufficient to prevent corrosion, unless a considerable part of the saline matter consist of carbonates and sulphates, especially the former.

6. So large a proportion as a 4000th, probably even a considerably larger proportion, will be insufficient, if the salts in solution be in a great measure muriates.

7. In all cases, even though the composition of the water seems to bring it within the conditions of safety now stated, an attentive examination should be made of the water, after it has been running for a few days through the pipes. For it is not improbable, that other circumstances, besides those hitherto ascertained, may modify the preventive influence of the neutral salts.

8. When the water is judged to be of a kind which is likely to attack lead-pipes, or when it actually flows through them impregnated with lead, a remedy may be found, either in leaving the pipes full of the water, and at rest for three or four months, or by substituting for the water a weak solution of phosphate of soda, in the proportion of about a 25,000th part.

The following Donations were presented to the Society since last Meeting.

Proceedings of the American Philosophical Society. Vol. ii. No. 19. —*By the Society.*

Laws, Regulations, and Annual Report of the Leeds Philosophical Society for 1840–41.—*By the Society.*

Journal of the Asiatic Society of Bengal, 1841. Nos. 112, 113, and 114.— *By the Society.*

Ordnance Survey Maps of England and Wales. Nos. 77, 78, and 87.—*By the Master-General of the Ordnance.*

Karten der Isothermen-Curven auf der Nordl. Hemisphære. Von Wilh. Mahlmann.—*By the Author.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome xiii. Nos. 22, 26. Tome xiv. Nos. 1, 2, 3. —*By the Academy.*

Monday, 22d February.

The Right Hon. LORD GREENOCK, V.P., in the Chair.

1. On the Necessity of the Sense of Muscular Action to the full Exercise of the Organs of the Senses. By Sir Charles Bell, K.H.

Referring to the nerves of touch, as distributed to the points of the fingers, the author proceeded to shew that something more was necessary than the exposure of the nerve. For example, the tongue being the most perfect organ of touch, resulting from the fine supply of nerves, is yet incapable of receiving certain impressions;—so that although it could distinguish the finest hair, so fine as not to be felt by the finger, yet if applied to the artery at the wrist, it conveys no sense of pulsation.

Part, therefore, of the organization of the finger consists of a ball of elastic matter, under the nerves, peculiarly suited for receiving pulsation; and being moulded by pressure, by this means conveying the sensation of form. It could not be that the variety in sensation results from the depth to which the impression is conveyed, for the nerves of sensation are on the surface, and the deeper parts do not feel. It must then be the change or moulding of the elastic cushion, consequent on pressure, that is conveyed to the nerve.

After shewing that weight so little different as that of a sovereign and a shilling could be distinguished when placed on the tip of the finger (although no distinction could be made when the pieces of money are laid upon any other part of the surface of the body, however delicate the sensation), he went on to shew the happy combination of the muscular action of the hand and fingers with these *palpi*.

Referring to the sense of muscular action, he gave reasons for the opinion that we had a consciousness of it independent of the sense of touch, or of any of the other senses. He illustrated this by the effect of a species of paralysis, in which the sense of muscular motion was lost, whilst the power of action remained.

Referring to the experiments of Weber and others, by pricking the skin, he stated, that on pricking certain parts of the body with two sharp points at the same moment, there was a sensation of one point only, whilst, on other parts, the sensation of the two points was distinct. Those experimenters drew the conclusion that this capacity of distinguishing the two points resulted from the greater concourse of nervous filaments. He stated, on the contrary, that the capacity of distinguishing the two points, or, in fact, of distinguishing the form of bodies, did not result from the mere sensibility of the part; for example, that the back of the hand was painfully pricked, and yet was not capable of distinguishing the two points from the one. He contended, on the contrary, that the capacity resulted from the junction of sensibility and motion. It was limited to the hand, the tongue, and the lip.

Pricking the cheek with two points gave no distinct sensation, but on approaching the lower lip the points become distinct. And not only the sensibility to *form*, but to *weight* also, results from the combination of muscular motion. Hence the sovereign and the shilling may be distinguished by their weight on being placed on the lip or tongue, though not by any less moveable part.

The author proceeded to consider the motions of the eye, arguing, that to the full exercise of the organ in vision the action of the recti muscles of the eye was necessary, and that a sense of their action was combined with the impression on the retina.

After some instances drawn from the *musci volitantes*, and the experiments of Dr Wells, he stated, that when the impression was permanent on the spot of the retina, the eye being closed, the perception of place was received from the sense of the action of the recti muscles. But if the ball of the eye was moved by the point of the finger, or by the oblique muscles, there was no apparent change in the place of the image. On this subject, he referred to the case of the *nystagmus bulbi*, in which there was an incessant motion of the eyeball, whilst the person saw distinctly, and could perform most minute works with the needle or the pencil.

The fact on which the author placed the greatest stress was the effect of cutting one of the recti muscles. He referred to a late volume of the Phil. Trans. of London, descriptive of a case, in which a lad, blind from birth, had at eighteen years of age the sight of one eye restored. But the eye being distorted towards the nose, the rectus internus muscle was cut across. The consequence of this was, that he no longer saw objects in their right position. They appeared placed to that side on which the muscle had been cut. The author's explanation is, that the tendon of the muscle being cut off from its attachment to the ball of the eye, the muscle contracted, and sensibility to this contraction being associated with the impression on the retina, produced a false perception of the place of objects.

The author concluded by expressing his doubt whether his course of study fitted him to be a competent judge of some of those matters. He could not resist the conclusion, that these required the exercise of a double sense, and an operation of the mind of the nature of comparison, to rouse to consciousness and the knowledge of external existences.

2. Geological Notes on the Alps of Dauphiné. By Professor Forbes. Part 1st. *See Proceedings of the next Meeting.*

The following Gentlemen were duly elected Ordinary Fellows of the Society :—

John Davy, M.D. ;
Robert Nasmyth, Esq., F.R.C., Surg.

The following Donations were presented to the Society since the last Meeting :—

Twelfth Report of the Scarborough Philosophical Society. 1841. —*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome xiv. Nos. 4, 5, 6, 7.—*By the Academy.*

Report of the Commissioners appointed to consider the steps to be taken for Restoration of the Standards of Weight and Measure.—*By the Commissioners.*

Letter to the Right Honourable George Earl of Aberdeen, on the State of the Schools of Chemistry, in the United Kingdom. By W. Gregory, M.D., F.R.S.E., &c.—*By the Author.*

A faithful Record of the Miraculous Case of Mary Jobson. By W. Reid Clanny, M.D., F.R.S.E.—*By the Author.*

Bien-Etre et Concorde des Classes du Peuple Français. Par Le Baron Charles Dupin.—*By the Author.*

Vie d'un Bienfaiteur du Peuple, A. P. de la Rochefoucauld. Par Le Baron Charles Dupin.—*By the Author.*

Monday, 7th March.

Sir T. M. BRISBANE, Bart., President, in the Chair.

1. On the most recent Disturbance of the Crust of the Earth, in respect to its suggesting a Hypothesis to account for the Origin of Glaciers. By Sir George Mackenzie, Bart.

In this paper the author pointed out that the force, which had protruded granite and other matter among the strata, could not have been the same in point of time with that which broke up the crust of the earth into its present shape; because the matter in veins which we now see exposed to view on the faces of precipices, having been fluid at the time of protrusion, must have run out of the fissures on the rock being raised up. It appeared, therefore, that all matter filling fissures in rocks, had become solid before the most recent cataclysm had taken place. There being no appearance of any matter having been protruded from below at the time of the surface being forced into its present disrupted state, it was assumed that the expanding force which broke the crust, was that of vapourable matter, chiefly steam, confined between the solid crust and the igneous mass in the interior; and also filling up the place of the enormous masses of matter which had been, at a former period, forced up from below, and which we now see in the shape of veins and dykes, and also of those very extensive ranges of country wholly composed of trap beds, admitted to have been submarine lavas. The vapourable matter having increased, and also its expansive force, the crust at length yielded; and the vapourable matter being set free, two consequences were supposed to have followed. First, the vapourable matter must have carried with it a vast amount of heat, so as to cause a considerable refrigeration of the broken crust, and to which its exposure to atmospheric influences, and perhaps also to the rushing of the waters, would contribute. Secondly, supposing the cataclysm to have taken place in the winter season, the extraordinary quantity of vapour forced by expansive impulse into the atmosphere, would speedily arrive at a region whence it would fall back in a frozen state. This would probably have taken place even in the summer season, at least in so far as to load the mountain summits and valleys lifted above the line of perpetual congelation. A change of climate having been effected by the disruption of the crust, the winter influences would, for a long time, have greater power, so that the whole surface within the sphere of a cataclysm might have become covered with ice, until the crust should begin to recover its temperature from the internal source of heat, and the influence of the sun conjointly. The author supposed that, on account of the surface having had, probably, but little elevation previous to the cataclysm, the heat of the crust was so considerable, as, joined to the influence of the sun, to be sufficient to have induced on the temperate zone a climate more nearly allied to that of the tropics, and such as to have admitted of the residence of those animals requiring a comparatively warm climate, and whose remains have given rise to much difficulty in geological speculations. As a subsidiary source of vapour, the author supposed that at the moment of the cataclysm, much water would have been admitted to contact with the interior heated surface. He was not aware, at the time he read his paper, that in a recent work by Charpentier on glaciers, this geologist had appealed to the same thing as the only source of the vapour ; so that the author's hypothesis of the escape of pent up vapour, as the chief source for producing glaciers, still remains his own ; and in conjunction with that of Charpentier, it seems to furnish a theory of glaciers, which, in the present state of discussion respecting glacial action, is a desideratum.

2. Geological Notes on the Alps of Dauphiné. By Professor Forbes. Part 2d.

The district proposed to be described, in so far as it was studied by the author in two journeys in 1839 and 1841, is an out-lyer or appendage to the main Alpine chain, which occupies a considerable portion of the old province of Dauphiné, and the modern departments of the *Hautes Alpes* and *Isére.* It is bounded, roughly, by the rivers Arc and Isére on the north, and by the Durance and the Drac in other directions. Its nucleus is essentially granitic, against which sedimentary deposits of limestone, of different ages, and especially of lias and chalk, repose in highly elevated or contorted strata ; and it not unfrequently happens, that the dislocation of strata has been so great, that the gneiss or granite rocks are superimposed upon the secondary formations.

The granitic mountains of Oisans, which are amongst the highest of the second order of European chains, attain a greater elevation at their culminating point, the Mont Pelvoux, than any of the Alps between Mont Blanc and the Mediterranean. Even Mont Iseran and Monte Viso are surpassed in height by this summit, which measures 13,468 English feet. The ravines by which the chain is intersected have a corresponding depth and ruggedness, so that the *cols*, or passages from one valley to another, are generally covered with perpetual ice and snow, and present, besides, more continuous and inaccessible precipices than are common in any part of Switzerland. The author shortly described several journeys made through the central part of this district, in which it became necessary to cross *cols* of above 10,000 feet in height, from whence alone an intimate knowledge of the structure of these mountains can be obtained.

Guided by the interesting memoir of M. Elie de Beaumont, on the geology of the *Montagnes d'Oisans*, and by the admirable map of Bourcet, he was enabled, in a great many particulars, to verify the observations of the first named distinguished geologist, especially as refers to the phenomena visible at the contact of the calcareous and granitic rocks, which left no doubt on the author's mind that the superposition of the latter to the former is undeniably true. No more can it be doubted, that, as M. E. de Beaumont affirms, we have here evidence of the extensive elevation of previously deposited sedimentary rocks, probably by the appearance from below of the granite itself. Professor Forbes feels some hesitation in admitting, with M. de Beaumont, the *crateriform* nature of this elevation, as indicated by a *quâ-quâ-versal* dip of the stratified rocks round a central point in the neighbourhood of the Mont Pelvoux, and by the radiation of the vallies from that centre. He considers that the observations of the great French geologist, when analyzed, as well as his own, rather point to an anti-clinal axis passing through the point in question, and prolonged in a NN.W. and SS.E. direction; accompanied, however, with various minor lines or centres of dislocation, especially that which elevated the mountain of Grande Rousse to the northward, of which the geology has been ably described by M. Dausse. The interference of this elevation with the previous one (roughly parallel to the torrent of the Veneau), probably produced the excessive disturbance of the strata of lias near La Grave, which have been jostled between the two granite masses.

These views are supported, partly by a consideration of the external *contour* of the group, and partly by direct observations of the bearing and dip of the strata.

The following Donations were presented to the Society since the last Meeting:—

Lexicon Syriacum Chrestomathiæ Kirschianæ denuo editæ accommodatum a Georgio Henrico Bernstein. Part 2.—*By the Author.*

Madras Journal of Literature and Science. Oct. and Dec. 1840. —*By the Madras Lit. Society.*

Letter to the Right Honourable the Chancellor of the Exchequer from J. E. D. Bethune, Esq. on Weights and Measures.—*By the Author.*

Address delivered at the Anniversary Meeting of the Geological Society of London, on the 19th of February 1841; and the announcement of the award of the Wollaston Medal and Donation Fund for the same year. By the Rev. Professor Buckland, D.D. &c.—*By the Author.*

The American Journal of Science and Arts, conducted by Professor Silliman, for January 1842.—*By the Editor.*

Mémoires de la Société Géologique de France. Tome 4, ptie. 2.—*By the Society.*

A Lecture on the employment of the Microscope in Medical Studies. By John Hughes Bennett, M.D.—*By the Author.*

Notes sur le Développement de Nerfs Particuliers à la surface du Cervelet. Par le Docteur Bennett.—*By the Author.*

Monday, 21st March 1842.

Dr ABERCROMBIE, V. P., in the Chair.

The following communications were read:—

1. On a New Species of British Grass of the genus Holcus, and Observations on some of the more closely allied species of Grasses found in the Neighbourhood of Edinburgh. By Richard Parnell, M.D., F.R.S.E.

This grass of the genus Holcus was stated to be new to the British Flora, since no mention of it is made in the works either of Sir James Smyth or Sir William Hooker; and as the author was unable to find it noticed in the continental works, he proposed for it the name of *Biaristatus*, as illustrative of the species. Several specimens gathered in the neighbourhood of Edinburgh were exhibited, and the characters by which it differed from *Holcus mollis* and *Holcus lanatus* were pointed out.

Specific Characters.—Both florets awned ; sheaths of leaves smooth ; joints slightly hairy. (See Plate I.)

Description.—The *Holcus biaristatus* grows to the height of two feet or more, but more frequently of about eighteen inches. The root is perennial, fibrous, somewhat creeping. The stem round, smooth, and striated, bearing four or five leaves with smooth sheaths ; the upper sheath crowned with a prominent obtuse ligule. Joints five in number, furnished with a few delicate hairs with their points directed downwards. Leaves flat, broadish, acute, of a light green with whitish rough margins, both surfaces soft and slightly roughish to the touch. *Inflorescence* mostly simple panicled. *Panicle* erect, the rachis and branches hairy. *Spikelets* pendulous, rather large and few. *Calyx* of two glumes nearly of equal lengths, membranous, acute, hairy at the keels ; lower glume the smaller ; upper glume with a prominent green rib on each side. *Florets* two, both awned, of two paleæ, the outer palea of the lowermost floret about the same length as the small glume, pedunculated, of a lanceolate ovate form, smooth and glossy, with two delicate lines or ribs on each side ; keel slightly hairy towards the upper half, the base furnished with a few slender white hairs ; the upper or inner palea membranous, about equal in length to the outer palea, and minutely fringed at the margins. The upper floret sometimes wanting, but when present of about the same size and appearance as the one below, and elevated on a smooth peduncle about one-third the length of the floret. *Awn* rough, arising from a little beneath the apex of the outer palea, about equal in length to the palea, mostly straight, and projecting conspicuously beyond the calyx.

Holcus biaristatus differs from *Holcus mollis* and *Holcus lanatus* in the following respects :—In *Holcus mollis* (see Plate I.) the lowermost floret is of an ovate form, about half the length of the small glume, without a long dorsal awn or lateral ribs, whereas in *Holcus biaristatus* the lowermost floret is ovato lanceolate, about equal in length to the small glume, furnished with a long dorsal awn, and the sides with two lines or ribs.

In *Holcus lanatus* (see Plate II.) the lowermost floret has no dorsal awn, the uppermost floret with a short curved, smooth awn,

PLATE I

Holcus ~~[illegible]~~ *biaristatus*

Holcus mollis

M.F. del. & sculp.

Printed by J. Gellatly.

Holcus mollis
Variety

Holcus lanatus

...ll M.D. delt et sculp^{t}
Printed by ...

whereas in *Holcus biaristatus* the lowermost floret has a long dorsal awn, and the uppermost floret has a long straight rough awn.

An unusual variety of *Holcus mollis* was at the same time exhibited, differing only in the spikelets being much smaller and the panicle more compact (see Plate II.). Dr Parnell concluded the paper by making a few remarks on some of the more closely allied species of grasses. Fig. 1, spikelet; fig. 2, florets; fig. 3, glumes.

2. On the Ultimate Secreting Structure of Animals. By John Goodsir, Esq. Communicated by Professor Syme.

After referring to the labours of those anatomists who had verified Malpighi's doctrine of the follicular nature of gland ducts, the author alluded to Purkinje's hypothesis of the secreting function of the nucleated corpuscules of these organs. In a rapid sketch of the results of inquiries since the appearance of Müller's work "De Penitiore Structura Glandularum," and more particularly of the observations of Henle and others on the closed vesicles which are situated at the extremities of certain ducts, Mr Goodsir stated, that no anatomist had hitherto "proved that secretion takes place within the primitive nucleated cell itself, or had pointed out the intimate nature of the changes which go on in a secreting organ during the performance of its function."

Numerous examples were now given of secretions detected in the cavities of nucleated cells of various glands and secreting surfaces. Among these secretions were the ink of the Cephalopoda, and the purple of *Janthina* and *Aplysia*, bile in an extensive series of animals, urine in the mollusk, milk, &c.

The wall is believed by the author to be the part of the cell engaged in the process of secretion. The cavity contains the secreted substance, and the nucleus is the reproductive organ of the cell. A primitive cell engaged in secretion is denominated by the author a primary secreting cell; and each cell of this kind is endowed with its own peculiar property according to the organ in which it is situated. The discovery of the secreting agency of the primitive cell does not remove the principal mystery in which the function has always been involved; but the general fact that the primitive cell is the ultimate secreting structure is of great value in physiology, inasmuch as it connects secretion with growth as phenomena regulated by the same laws; and explains one of the greatest difficulties in the science, viz., why a secretion flows from a free surface only of a secreting membrane,—*the secretion exists only on the free surface enclosed in the ripe cells which constitute that surface.*

The author then proceeded to the consideration of the origin, the development, and the disappearance of the primary secreting cell—a subject which necessarily involved the description of the various minute arrangements of glands and other secreting organs. After describing the changes which occur in the testicle of *Squalus cornubicus* when the organ is in a state of functional activity, and in the liver of *Carcinus mænas*, it was stated that these were selected as examples of two orders of glands denominated by the author vesicular and follicular.

The changes which occur in the first order consist in the formation and disappearance of closed vesicles or acini.

Each acinus might be, first, a single cell, denominated by the author the primary or *germinal* cell ; or, secondly, of two or more cells enclosed in the primary cell, and produced from its nucleus.

The enclosed cells he denominates the secondary cells of the acinus, and in the cavities of these, between their nuclei and cell-walls, the peculiar secretion of the gland is contained. The primary cell with its included group of cells, each full of secretion, is appended to the extremity or side of one of the terminal ducts, and consequently does not communicate with that duct, a diaphragm formed by a portion of the primary cell-wall stretching across the pedicle. When the secretion in the group of included cells is fully elaborated, the diaphragm dissolves or gives way, the cells burst, and the secretion flows along the ducts, the acinus disappearing and making room for a neighbouring acinus, which has in the mean time been advancing in a similar manner. The whole parenchyma of glands of this order is thus, according to these observations, in a constant state of change, —of development, maturity, and atrophy,—this series of changes being directly proportional to the profuseness of the secretion.

In the second order of glands, the follicular, as exemplified in the liver of *Carcinus mænas,* the germinal cell or spot, is situated at the blind extremity of the follicle, and the secreting cells, as they advance along the follicle, become distended with their peculiar secretion.

Among other general conclusions deducible from these observations, it appeared that ducts are to be considered as intercellular passages, into which the secretions formed by cells are cast.

Finally, the author inferred from the whole inquiry, 1. That secretion is a function of the nucleated cell, and takes place within it; and, 2. That growth and secretion are identical—the same process under different circumstances.

The following gentlemen were duly elected Ordinary Fellows of the Society:—James Millar, Esq. F.R.C. Surg.; Sir James Forrest, Bart. Lord Provost of Edinburgh; James Stark, M.D., F.R.C. Phys.; John Adie, Esq. Optician.

Monday, 4th April 1842.

Sir T. M. BRISBANE, Bart., President, in the Chair.

1. On the Theoretical Investigation of the Absolute Intensity of Interfering Light. By Professor Kelland.

This Memoir is the prosecution of a subject on which the author had previously touched in a paper which is printed in the seventh volume of the Transactions of the Cambridge Philosophical Society. It has for its object the investigation of the quantity of light which is received on a screen of unlimited dimensions, after passing through a certain aperture, or suffering reflexion at two mirrors. The end for which the investigation is undertaken is to ascertain the *constant* which must be introduced in using Huygens's principle. From the fact, that each vibration at the aperture is multiplied by an area, on finding the effect on the screen, it is evidently requisite that a divisor of two dimensions is required to render the vibration at a point on the screen, similarly expressed with that at the aperture. According to the author's investigation, it appears that the divisor is the product of the length of a wave, and the perpendicular distance between the screen and the aperture. Hence, in reference to such questions, the enunciation of Huygens's principle is as follows:—

The vibration, at a given point, caused by a given wave, is found by taking the front of the wave, dividing it into an indefinite number of small parts, considering the agitation of each of these parts as the origin of a wave whose maximum of vibration, on reaching the point, is equal to the quotient of that at the disturbing point, divided by the product of the length of the wave, and the perpendicular from the disturbed point on the front of the wave.

2. On the Quarantine-Classification of Substances, with a View to the Prevention of Plague. By John Davy, M.D., F.R.S., L. & E.

In this paper, the author, after having noticed the ordinary quarantine classification of substances, into susceptible, non-susceptible, and doubtful, states as the result of his inquiries conducted in Turkey and the Mediterranean, that the distinctions involved in this arrangement have been made in a very unsatisfactory manner, not after careful research and deliberation, but rather during a period of panic, and hastily, in comparatively remote and ignorant times, and by men, for the then state of knowledge, ill qualified for the task, even had they entered upon it with all the calmness and caution that the subject required.

He next enumerates the principal substances constituting the three different classes, and then comments on each of them. His remarks tend to shew that the class of so-called non-susceptible articles, as glass, wood, metal, pottery, &c., since they have not any power of destroying, repelling, or preventing the adhesion of animal matter, ought rather to be considered as susceptible of conveying the matter of plague, in the same way that they are capable of conveying vaccine lymph, *i. e.*, if dried, or in tubes from which air is included; on the contrary, that the substances arranged in the class of so-called susceptible articles, as cotton, wool, fur, feathers, &c., articles abounding in atmospheric air,—the great promoter of the decomposition of putrescible animal matter,—are least entitled to be held fit to preserve and convey the matter of contagion, an inference confirmed by what is known relative to the preservation of animal matter generally, and especially vaccine lymph, and further confirmed by accumulated inference in lazarettos; according to which it would appear that there is no well authenticated instance on record of plague having been produced within the walls of a lazaretto, amongst those persons whose duty it is to examine and expose to the air the so-called susceptible articles imported from the Levant, and especially cotton and silk. In commenting on the subject, the author takes for granted that plague is propagated by a fixed matter of contagion, according to the commonly received views of the contagionists, as it is only on this ground that the quarantine system itself can be supported, or any discussion of the question of the classification of substances be called for. He points out, at the same time, that, preliminary to a searching investigation into the qualities of substances for the practical purposes of quarantine, certain points of the first importance, at present unsettled, ought to be determined *in limine*,—as whether the plague be truly contagious or merely an epidemic disease; whether it is even endemic, independent of contagion; and whether, if arising from local circumstances, it is capable of becoming contagious. He remarks how the quarantine system has been unfortunately established on a basis of suppositions rather than on well ascertained facts, and how, consequently, it is held by all those who have given it their careful attention, to be, as a sanatary system, most unsatisfactory, troublesome, expensive, and insecure. He concludes with the expression of the hope that the time is not far distant when a thorough inquiry into the subject will be demanded preliminary to a revision of the quarantine laws, should the results of that inquiry be that plague is a contagious disease, or capable of becoming so. In the form of an appendix, he relates some particular instances in illustration of his remarks on the quarantine classification of substances, shewing how the distinctions are acted on practically, and how they tend to vitiate the present system of quarantine, supposing it to be otherwise perfect.

3. Results of Experiments on the Specific Heat of Certain Rocks. By M. Regnault of Paris. Communicated by the Secretary.

Professor Forbes observed that, in his communication to the Royal Society on the Conductivity of Soils for Heat, on the 20th December last (see Proceedings, page 343*), he had referred to the separation of the conductivity and specific heat, which are involved in the results of the thermometric experiments on subterranean temperature. In order to eliminate the effect of specific heat, M. Regnault of Paris (well known by his experiments on this subject) undertook, at the request of M. Elie de Beaumont, to ascertain the specific heats of the soils in which the different sets of thermometers are sunk. These are communicated in a letter from M. E. de Beaumont to Professor Forbes, as follows:

	Specific Heat.
Porphyry of the Calton Hill, ...	0.20654
Another experiment, ...	0.20587
Mean. . . .	0.20620

		Specific Heat.
Sand of the Experimental Garden,	. . .	0.19432
Sandstone of Craigleith Quarry,	. . .	0.19257
Another experiment,	. . . .	0.19152
Mean,	. . .	0.19205

Some correction would no doubt require to be made for the quantity of moisture contained in the rocks.

4. On the Effect of Snow in apparently increasing the Force of Solar Radiation. By Professor Forbes.

Referring to a communication made by him to the Society on the 1st February 1841 (see Proceedings, page 322), the author reminded the Society that he had then endeavoured to account for certain anomalous facts observed by Dr Richardson, connected with solar radiation in the Polar Regions, by adverting to the intense radiating effect of a covering of snow. The disappearance of this snowy covering in the month of May, the author had observed to be synchronous with the anomalous diminution of solar radiation, ascertained by a blackened thermometer, in the months of June and July, compared with the months of April and May.

Professor Forbes endeavoured to verify his conjecture, by direct experiments on the force of the sun amongst the snowy mountains of Switzerland; and it was so completely borne out, that the limited range of his instrument (Leslie's photometer) was in clear weather always outrun, when it was exposed on a snowy surface; and even when placed upon a dark rock (on the moraine of a glacier), the reflected light from the neighbouring snowy summits was so intense as to give extraordinarily high indications. Owing to the construction of the instruments, he was unable to estimate their readings correctly; but he hopes to make more accurate observations during the ensuing summer. Sir John Herschel's actinometer gave a value of the solar radiation nearly independent of its position upon snow or rock.

The following Donations were presented to the Society since the last Meeting:—

Annuaire de l'Observatoire Royal de Bruxelles. Par A. Quetelet, Directeur de cet Etablissement. 1842.—*By the Author.*

Nouveaux Catalogue des Principales Apparitions d'Etoiles Filantes. Par A. Quetelet.—*By the Author.*

Annuaire de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Pour l'An. 1842.

Bulletin de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. 1841, Nos. 7–12; et 1842, Nos. 1, 2.—*By the Academy.*

Magnetische und Meteorologische Beobachtungen zu Prag. Herausgegeben von Karl Kriel. Erster Jahrgang.—*By the Author.*

Philosophical Transactions of the Royal Society of London, for the Year 1841. Part 2.—*By the Society.*

Examination Papers of the University of London for 1841.—*By the University.*

Plausible Reasons and Positive Proofs, shewing that no portion of the Devonian System can be of the age of the Old Redstone. By the Rev. D. Williams, A.M., F.G.S.—*By the Author.*

The Reminiscences of an Old Traveller throughout different parts of Europe. By Thomas Brown, Esq.—*By the Author.*

Monday, April 18, 1842.

The Right Hon. Lord GREENOCK, V.P., in the Chair.

The following communications were read:

1. On the Structure, Formation, and Movement of Glaciers; and the probable cause of their former extension and subsequent disappearance. By James Stark, M.D., F.R.S.E.

The author endeavoured to prove, from the recorded facts stated by different writers, that the crystalline particles of which the ice of glaciers is composed do not sensibly enlarge after being consolidated into compact ice; that the crystals have been shewn to be fully and perfectly formed in the course of a few nights in the Polar Regions; and that they have a position perpendicular to the layer of ice which they form,—their length being thus determined by the thickness of that layer.

The author next considered the different forms of stratification met with in glaciers, and stated that the greatest confusion prevailed on this point, different forms of stratification being confounded together. He therefore considered glaciers as composed of—

1. *Horizontal Strata*, or layers lying in the position in which they were first deposited, and only seen in the upper regions of the mountains. He stated that these strata were usually regarded as

marking the additions which the icy mass had annually received, each layer being the accumulated snow of one year; but that, as the Meteorological Tables kept at the Hospice of the Great St Bernard shewed that from 300 to 700 inches of snow fell during the six winter months, it seemed possible that each layer marked the separate storms of snow; or, if they marked the annual accumulations, they apparently proved, what had not previously been suspected, that snow and ice waste nearly as rapidly in the upper as they do in the lower regions.

2. *Vertical and Longitudinal Strata.* The author stated that these strata were always of great tenuity, were more or less perpendicular, but had always a direction parallel with the retaining wall or length of the glacier. Their mode of formation he attributed to the onward movement of the glacier leaving narrow spaces intervening between the sides of the already formed icy mass and the flanks of the valley, which, being filled up with the loose and softened snow lying on the sloping flanks, was, from the falling of the temperature during the night, and from contact with the already formed icy mass, converted into a layer of solid ice. From the thinness of these layers, the author regarded them as marking the additions which had been daily made to the glacier. The author also stated that it would, in all probability, be found that, wherever pillars, pyramids, or needles of ice were met with, this structure would be found present; as the fissures, which always crossed the glacier from side to side, divided it into transverse sections, which, when unequally supported below, would split into smaller fragments in the planes of their stratification, so that each fragment would necessarily assume the form of a vertical prismatic column.

3. *A combination of the Horizontal with the Vertical and Longitudinal Strata.* The author stated that, as the mass composed of the horizontal strata of the upper regions slowly advanced to the lower ones, it received, in the manner above stated, a lateral increase, which, at the same time that it increased its breadth, probably also added to its depth. That, as the glacier continued to advance, the horizontal strata, which lay uppermost, would melt away first, so that at one point they would only be observed in the middle of the glacier, and lower down even completely disappear. He mentioned several facts which seemed to prove his position.

4. *Transverse more or less inclined Strata.* The author stated

that this variety of stratification had not been recognized as a distinct form, but had been confounded with the horizontal stratification. He stated that this form would only be met with when the original structure of the glacier had been broken up and destroyed by some obstructing barrier or other cause. He instanced as the most marked example of this the terminal portion of the Rhone glacier, after it pours into the valley of the Rhone over its rocky barrier or precipice. He described the strata as being formed close to the icy mass on which the icy cataract descends, originally parallel to each other, and with a dip of 70° ; but that, as new layers are formed, and the first formed layers are pushed forwards, they lose their parallelism to each other, and assume angles of dip less and less as they approach the termination of the glacier. This change of dip and of parallelism the author attributed to the forward movement and plasticity of the mass, together with the greater amount of friction below, where the ends of the layers were in contact with the ground, and the constant deprivation of support anteriorly and below, from the continued melting of the ice at these parts, which would give the layers a constant tendency to fall forwards.

The author then proceeded to shew that fissures or crevices in glaciers could not be produced in consequence of the unequal expansion of the ice itself, nor in consequence of the expansion of the air contained within its pores ; but that in every case crevices were produced in censequence of the movement of the glacier over the inclined plane on which it rested.

The author next passed to the second division of his subject, the Movement of Glaciers, and first commented on the Dilatation Theory. He endeavoured to prove that none of the phenomena observed in glaciers could be accounted for by that theory. That a glacier was not retarded in its movement though riddled with crevices; that the supposed dilatation did not alter the form of the walls of these crevices; that it did not close them at their upper extremity nor widen them out below ; that it did not give rise to any convexity of the surface of the glacier ; that the icy mass did not require to touch the rocky walls of the valley through which it passed; that it could move onwards for miles quite unsupported on its margins ; that during a whole summer, whilst its movement was greatest, it never dilated even the few feet requisite to fill up the spaces intervening between its margin and the rocky walls of the valley ; that it advanced during the heat of the day, and during winter, when it is allowed no dilatation can take place; that it was unlikely water could percolate during the course of one day through a solid mass of ice, more than 100 feet thick, especially when that ice was colder than the freezing point of water; that pools of water (in the Polar Regions) remained unfrozen for whole weeks during the summer whilst their progressive motion was greatest. For these and other reasons, the author arrived at the conclusion " that glaciers do not advance in consequence of a process of dilatation of their icy mass."

The author next enquired into the proofs of the truth of the sliding theory, and stated, that he had satisfied himself that every phenomenon known to occur in glaciers could be explained by it. He brought forwards, as explanatory circumstances, the descent of avalanches;—the descent of trees, along the slide of Alpnach;—the fact proved by the meteorological tables kept at the Hospice of the Great St Bernard, when compared with the descent of Hugi's hut on the Aar Glacier,—that the greater the fall of snow in the upper regions during winter, the greater is the descent of the glaciers during the following summer;—and lastly, the fact that the higher the mountain range (and of course the greater the quantity of ice or snow), the lower was the level to which glaciers descend. He also endeavoured to shew that the glaciers, or icy masses, covering the mountains, and filling their vallies, at no part of their course are frozen to the soil on which they rest; and that the temperature of the soil covered with deep masses of snow or ice, was probably never below 32° Fahrenheit.

The author made a short digression here, to account for the probable cause of the former extension of glaciers, and their subsequent disappearance. He endeavoured to shew, that the scattered boulders, &c. marking the former extension of glaciers, were all over the surface of the older alluvium (diluvium of Buckland) and he hence endeavoured to ascertain at what period that alluvium was formed. After a full examination of the subject, and especially from the examination of the fossil remains found in that alluvium, he arrived at the conclusion, that the waters of the deluge were the cause of the formation of that alluvium; and he accounted for the former extension of glaciers, by the known effect of water, in the act of evaporating, producing cold, especially when acted on by a brisk wind, which was the state of the earth immediately after the deluge. The increased moisture in the atmosphere at this period, he thought, would furnish ample supplies of snow and ice for the purpose, and being first deposited on the elevated peaks, would rapidly spread over all those extended surfaces which glaciers are thought once to have covered. Their subsequent disappearance he accounted for, by supposing that the icy or snowy covering prevented the loss by radiation of the heat received by the earth's crust from the interior of the earth; since this heat, gradually accumulating below, would in time melt the icy masses at their lower extremities faster than they could be supplied from above, and thus reduce them to their present dimensions. He illustrated this view, by mentioning the fact, that the angular boulders, &c. are pretty equally scattered over all the extended surfaces which glaciers are thought formerly to have covered, but are rarely seen to form the dykes or moraines seen at the terminations of glaciers at present in existence; this fact apparently proving that they must have commenced their decay very shortly after their formation.

The author stated several other arguments in favour of the truth of the sliding theory; from all which he inferred, that the movement was not a continuous, but an interrupted process;—that when the melting of the sides of the mass detached it from its attachment to the sides of the valley, and it became undermined below, by the melting of its base, the force of gravity, unresisted by friction, was brought into play, and it made a sudden progressive movement (which might be only an inch or several feet), when it remained at rest, till the same causes produced a renewal of the same result. He shewed, that though many parts of these icy masses were nearly level, all the upper portions, and many of the lower, were lying over such inclined planes, that gravity could exert its full power in their propulsion; and as the whole icy mass was tolerably solid and continuous, the greater movement of one portion was communicated more or less throughout its whole length, and tended to urge forwards and downwards those parts which had less tendency to move onwards of themselves.

The author also endeavoured to account for the advance of one glacier, and the retirement of another along side of it, by supposing that it was caused by the snows being drifted away from the one valley exposed to the blast, and from which the glacier, which was retiring, descended, and being deposited in deep wreaths in the other, which was probably more sheltered, and from which descended the glacier, which was making destructive advances. The increased accumulation of snow, by furnishing a supply greater than the waste caused the one glacier to advance, whilst the other retired, in consequence of the waste at its lower extremity exceeding the supplies from above.

2. On Plague, in relation to the question of its Nature, whether or not a Contagious Disease. By John Davy, M.D., F.R.S.S. L. & E.

The author, after adverting to the methods of investigating the subject, generally and specially, and expressing preference for the latter method; and, after pointing out how desirable it is in inquiries of an obscure nature, to find out *instantiæ crucis*, brings forward and details some facts, which he considers as such, on the question of the contagion of plague.

In June 1841, when there was plague in Egypt, but not in Constantinople or its neighbourhood, which had been free from the disease three entire years, a ship from Alexandria arrived in the Bosphorus, having plague on board. Of the crew and passengers, 18 out of about 96 died during the voyage; and of the remainder, 9 out of 16 who were taken into the Lazaretto. Moreover, certain persons of Constantinople, employed in the duties of the Lazaretto, contracted the disease,—four altogether, of whom three died.

As the disease, with which they were attacked was the same as that imported, and as this was unquestionably plague, and was isolated in the Lazaretto, these instances seem to be demonstrative, that plague can be propagated by contagion, and that therefore (if there be, as it is presumed, a certain consistency and constancy in diseases) it must be considered a contagious disease, although, on many occasions, owing to obscure interfering causes, it may not spread from person to person, and become epidemic.

The author, till he visited the Levant and became acquainted with these cases, was sceptical as to the contagion of plague; and in consequence, before he allowed them to weigh on his mind as evidence, he examined into them most carefully, without being able to find any circumstance connected with them, tending even to raise suspicion of their accuracy as examples of communicated disease.

Among several points of collateral interest connected with these cases, he adverted only to one, viz. the manner in which the disease may have been communicated,—thereon expressing his opinion or conjecture, that in one of the four, it owed its origin to actual contact, and in the other three, to touching substances, which had shortly before been touched by the plague patients, such as glass, metals, or earthenware; and he assigned the reasons which led him to this conclusion.

3. Analysis of Two New Minerals of the Zeolite Family. By Thomas Anderson, M.D. Communicated by Dr Christison.

The minerals in question are the Phakolite of the Bohemian Mittelgebirge, and Caporcianite, a newly discovered mineral, first observed by Dr Savi, in a copper-mine at Caporciani, in the valley of Cæcino. The author found, that in point of composition, Caporcianite belongs to that division of the zeolites, which comprehend Analcine, Ledererite, Potash-harmotome, Chabasie, and Levyn, and whose constitution is represented by the mineralogical formula $r\,S^2 + 3\,A\,S^2 + z\,A\,q$,—$z$ being a variable quantity, r representing the variable monatomic bases, and A & S alumina and silica. The formula for Caporcianite proved to be $r\,S^2 + 3\,A\,S^2 + 3\,A\,q$, and the monatomic base consists chiefly of lime. Phakolite belongs to that groupe of zeolites comprising Gigantolite, Harringtonite, Mesotype, Lehuntite, Mezolite, Scolezite, Pyrargillite, and Antrimolite, whose composition is represented by the mineralogical formula $r\,S^3 + x\,A\,S + z\,A\,q$,—the equivalents of alumina and silica being variable, as well as water; and the formula for Phakolite is $r\,S^3 + 2\,A\,S + 3\,A\,q$, the monatomic basis being lime, potash, and soda. The numerical proportions of the constituents of the two minerals were as follows:—

	Caporcianite.		Phakolite.
Silica acid,	52.8	...	45.628
Alumina,	21.7	...	19.480
Peroxide of iron,	0.1	...	0.431
Lime,	11.3	...	13.304
Magnesia,	0.4	...	0.143
Potassa,	1.1	...	1.314
Soda,	0.2	...	1.684
Water,	13.1	...	17.976
	100.7	...	99.960

4. Dr Christison exhibited specimens from the Government Superintendent of Tea Culture in Assam, illustrating

the several ages at which the leaves of the Assam and China Tea-plants are used for making the different commercial varieties of black and green tea.

An examination of these specimens seemed to prove, that the leaves of the China tea-plant, cultivated at the same plantation with the tea-plant of Assam, are considerably less, and somewhat thicker, but otherwise so exactly similar, that the two plants may well be mere varieties of the same species,—an opinion now generally adopted by botanists in India. The specimens further illustrated the doctrine deduced from recent investigations in India, that the different kinds of green and black tea are made from the leaves of one species of plant, collected at different periods of their development. The specimens were collected in April 1841. The unexpanded shoots and very young leaves are marked as yielding Pekoe, a black tea, and Young Hyson, a green tea, by different modes of preparation. The fully-expanded, but still young leaves, are stated to produce Pouchong, Souchong, and Campoi, among the black teas, and Imperial, Gunpowder, and Hyson, among the green teas. Older and firmer leaves produce Congo, a black tea, and Twangkay and Hyson-skins, two of the green teas ; and the oldest and coarsest of the leaves produce Bohea, the lowest in quality of the black teas.

The following Donations were presented to the Society since the last Meeting :—

Proceedings of the Royal Society. No. 52.—*By the Society.*

Theoretical Investigations on the Motions of Glaciers. By W. Hopkins, F.R.S.—*By the Author.*

Comptes Rendus Hebdomadaires des Séances de l' Académie des Sciences. Tome xiv. Nos. 8–12 —*By the Academy.*

Journal of the Asiatic Society of Bengal. 1841. No. 116.—*By the Society.*

Elements of Agricultural Chemistry and Geology. By James F. W. Johnston, F.R.S.—*By the Author.*

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1842–43. No. 21.

Monday, 5th December 1842.

Sir T. MAKDOUGALL BRISBANE, Bart., President, in the Chair.

The following communications were read:—

1. On the Construction of a New Music Hall. By Sir George S. Mackenzie, Bart.

The author noticed a variety of facts which were in direct opposition to the common notions entertained on the subject; and which led to the conclusion, that the chief object to be kept in view, was to destroy all sound that did not go directly from the source of sound to the ears of the audience, by preventing reflection. He described the plan of the Hall now building at the Assembly Rooms, the form of which is crucial, owing to the space on which it stands having been limited, and the necessity for connecting it with the pre-existing apartments; and he stated that he would have preferred a square, with the orchestra somewhat retired on one side. The new Hall was to be regarded as an experiment; and if one mode for destroying superfluous sound did not succeed, others would be tried.

2. On the Geology of Roxburghshire. Part 1. By David Milne, Esq. *See Proceedings on 9th January* 1843.

The following Donations of Books to the Society's Library were announced as having been received since the closing Meeting of last Session.

Report of the Eleventh Meeting of the British Association for the Advancement of Science, held at Plymouth in July 1841.—*By the Association.*

Nieuwe Verhandelingen van het Bataafsch Genootschap der proefondervindelijke Wijsbegeerte te Rotterdam. Vol. viii. St. 2.—*By the Society.*

Archives du Museum d'Histoire Naturelle Publiées par les Professeurs-Administrateurs de cet Etablissement. Tome i. Livr[ns] 2, 3, 4, et Tome ii. Livr[ns] 1, 2.—*By the Editors.*

A new Analogy for determining the distances of the Planets from the Sun, and of the Satellites from their Primaries.—*By the Author.*

The American Journal of Science and Arts, conducted by Professor Silliman, for April, July, and October.—*By the Editor.*

Scheikundige Onderzoekingen, gedaan in het Laboratorium der Utretchtsche Hoogeschool. Stuks 1, 2, 3.—*By the Editors.*

Proceedings of the London Electrical Society. Session 1841–42. Parts 3, 4, 5.—*By the Society.*

Voyage dans la Russie Méridionale et la Crimée. Planches, Livr[n] viii. Par M. Anatole Demidoff.—*By the Author.*

Astronomische Nachrichten. Nos. 433–446.—*By Professor Schumacher.*

Observations Météorologiques faites a Nijne-Taguilsk (Monts Oural), Governement de Perm. 1841.—*By the Author.*

Novorum Actorum Academiæ Caesareæ Leopoldino-Carolinæ Naturæ Curiosorum Voluminis Undevicesimi Supplementum Alterum. —*By the Academy.*

The Quarterly Journal of Agriculture, and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. June, September, and December.—*By the Society.*

Journal of the Statistical Society of London. Vol. V. Parts 1, 2, 3. —*By the Society.*

An Exposition of the Nature, Force, Action, and other properties of Gravitation on the Planets.—*By the Author.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Vander Hoeven, M.D., en W. H. Vriese, M.D. Deel viii. St. 4; and Deel ix. St. 1.—*By the Editors.*

The Transactions of the Linnean Society of London. Vol. XIX. Part 1.

The Proceedings of the Linnean Society of London. Nos. 13, 14. —*By the Society.*

Ordnance Survey of the County of Kilkenny in Ireland. 49 sheets. —*By His Excellency the Lord Lieutenant.*

Bulletin de la Société Impériale des Naturalistes de Moscow. 1842. Nos. 1, 2.—*By the Society.*

Memoirs of the Literary and Philosophical Society of Manchester. (Second Series), Vol. VI.—*By the Society.*

Journal of the Asiatic Society of Bengal. Nos. 115, 118, 119, 120, and 121.—*By the Society.*

Six Lectures on Arithmetic, containing a familiar explanation of the principles and rationale of the General Rules of Arithmetic.—*By the Author.*

Transactions of the American Philosophical Society held at Philadelphia, for promoting useful knowledge. Vol. VIII. Part 1.

Proceedings of the American Philosophical Society. Nos. 20, 21, and 22.—*By the Society.*

The Ninth Annual Report of the Royal Cornwall Polytechnic Society. 1841.—*By the Society.*

Ueber das Magnetische Observatorium der Koniglich-Sternwarte bei Munchen, von Dr J. Lamont.—*By the Author.*

Die Galvanographie, eine methode, gemalte Tuschbilder durch galvanische Kupferplatten im Drucke zu Vervielfältigen, von Franz von Kobell.—*By the Author.*

Proceedings of the Royal Society. No. 53.

Philosophical Transactions of the Royal Society of London for the year 1842. Part 1.—*By the Royal Society.*

Astronomical, Magnetical, and Meteorological Observations made at the Royal Observatory, Greenwich, in the year 1840, under the direction of George Biddell Airy, Esq., Astronomer Royal. —*By the Royal Society.*

Proceedings of the Geological Society of London. Nos. 77 to 87. —*By the Society.*

Teoremi sulle Sezioni Coniche dimonstrati da Nicola Trudi. Nos. 5, 6, 7.—*By the Author.*

Seconde Mémoire sur les Kaolins ou Argiles a porcelaine. Par MM. Alexandre Brongniart et Malaguti.—*By the Authors.*

Forty-ninth Report of the Literary and Philosophical Society of Newcastle-upon-Tyne.—*By the Society.*

Flora Batava. Nos. 123 and 124.—*By the King of Holland.*

Notice respecting the Fossils of the Mountain Limestone of Ireland, as compared with those of Great Britain, and also with the Devonian System. By Richard Griffith, F.R.S.E., &c. &c.—*By the Author.*

Mémoires de l'Académie des Sciences de l'Institut de France. Tome xviii.

Mémoires Présentés par divers Savants à l'Académie Royale des Sciences de l'Institut de France. Tome vii.—*By the Royal Academy.*

Ueber die Abhaengigkeit der Physischen Populationskraefte von den einfachsten Grundstoffen der Natur mit specieller Anwendung auf die Bevolkerungs-Statistik von Belgien, von Dr Ferdinand Gobbi.—*By the Author.*

Mémoires de la Société de Physique et d'Histoire Naturelle de Génève. Tome ix. p^{tie} 2.—*By the Society.*

Journal of the Royal Asiatic Society of Great Britain and Ireland. No. 13.—*By the Society.*

Magnetische und Meteorologische Beobachtungen zu Prag, von Karl Kriel. (Zwieter Jahrgang.)—*By the Author.*

1st and 2d Bulletins of the Proceedings of the National Institution for the promotion of Science at Washington.—*By the Institution.*

Researches in Physical Geology. By W. Hopkins, Esq. Parts 1, 2, 3. —*By the Author.*

On the Errors of Chronometers, and Explanation of a new construction of the Compensation Balance. By E. J. Dent, Esq.—*By the Author.*

Twenty-second Report of the Council of the Leeds Philosophical and Literary Society, 1841–42.—*By the Society.*

Transactions of the Royal Cornwall Polytechnic Society, 1842. No. 1.—*By the Society.*

System der Krystalle, ein Versuch von M. L. Frankenheim, Professor an der Universitat von Breslau.—*By the Author.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin, 1840.

Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Kongl. Preuss. Akademie der Wissenschaften zu Berlin. Juli 1841 bis Juni 1842.—*By the Academy.*

Liber Cartarum Prioratus Sancti Andree in Scotia e Registro ipso in Archivis Baronum de Panmure hodie asservato. (Printed for the Bannatyne Club.)—*By O. Tyndall Bruce, Esq.*

The Grasses of Scotland. By Richard Parnell, M.D., F.R.S.E.—*By the Author.*

The Second Supplement, completing the Seventh Edition of Dr Turner's Chemistry. By Justus Liebig, M.D., and William Gregory, M.D.—*By the Editors.*

Transactions of the Society instituted at London for the Encouragement of Arts, Manufactures, and Commerce. Vol. LII. Pt. 2. —*By the Society.*

Journal of the Royal Geographical Society of London. Vol. XI. Pt. 2.—*By the Society.*

Abhandlungen der Mathematisch-Physikalischen Classe der Koeniglich Bayerischen Akademie der Wissenschaften. Band iii. Abth. ii.—*By the Academy.*

Prodromus zu einer neuen verbesserten Darstellungsweise der Hohern Analytichen Dynamik, vom Grafen Georg von Buquoy. 1 Lieferung.—*By the Author.*

Proceedings of the Zoological Society of London. Nos. 93 to 108. *By the Society.*

Transactions of the Royal Institute of British Architects. Vol. I. Pt. 2.—*By the Institute.*

Historical Transactions of the Royal Society of Copenhagen. 6 vols. —*By the Society.*

Pilote Français comprenant les Côtes Septentrionales de France depuis Barfleur jusqu'a Dunkerque. Publié par ordre du Roi. Partie 5^{me}.—*Par le Department de la Marine.*

Ueber das farbige Licht der Doppelsterne und eineger anderer Gestirne des Himmels, von Christian Doppler.—*By the Author.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome xiv. Nos. 13–26, et Tome xv. Nos. 1–8.—*By the Academy.*

Donations of extensive collections of valuable specimens in Mineralogy and Conchology to the Society's Museum, by Lord Greenock and Mr Stark, were also announced ; and the thanks of the Society were returned to the Donors by the President, viz. :—

1. A number of Mineral and Fossil Organic Specimens, from various localities.—*Presented by Lord Greenock.*
2. Specimens of Land and Fresh-water Shells, chiefly from the neighbourhood of Edinburgh.
3. Specimens of Marine Shells, chiefly from the Firth of Forth. And,
4. Specimens of Zoophytes, chiefly from the Firth of Forth.—*Presented by John Stark, Esq.*

John Goodsir, Esq., Conservator of the Museum of the Royal College of Surgeons of Edinburgh, proposed by Professor Syme, was duly elected an Ordinary Fellow.

Monday, 19*th December* 1842.

The Right Honourable Lord GREENOCK, Vice-President, in the Chair.

The following communications were read:—

1. Letter on Terrestrial Magnetism, addressed to the Secretary. By Professor Hansteen of Christiania.

CHRISTIANIA, *the 22nd April* 1842.

* * * * I HAVE the pleasure to send you two papers: the first on the changes, which the moment of a magnetical needle or bar undergoes as a function of the elapsed time, and of the variations of the temperature; the second, in the German language, is an extract of a letter to Professor Kupffer of St Petersburg, exhibiting the changes of the time of 300 horizontal vibrations, in Christiania, of my invariable magnetical cylinder, made by Dollond in 1819, from 1820 to 1839. In the Latin Programma, page 17, seven later observations, to this year, are annexed. In the first paper it is demonstrated by experiments, with nine different magnetical cylinders, that the moment M is a function of the time t, elapsed after its being magnetized, of the following form:—

$$M = C + B e^{-qt},$$

where $C = M_{\infty}$ is the value of M, when $t = \infty$, e the basis of the natural logarithms, q a constant depending of the quality and hardness of the steel, $B = M_0 - M_{\infty}$ is the whole variation of M between $t = 0$, and $t = \infty$. The moment of every magnetical needle has accordingly a limit C, which it cannot transgress; and every variable needle may be used to determine the intensity in a voyage, when only the three constants, B, C, q, are determined by three observations, including the whole time of the voyage. In page 13, you will find under No. 4, the history of the cylinder belonging to the "Hansteen Apparatus" of the Royal Society of Edinburgh, from November 5. 1821, to October 29. 1826. After its arrival at Edinburgh, it seems to have lost some more of its power, perhaps from coming into a higher temperature. For, according to my calculations, it should already have been almost invariable after 664 days. I shall only remark, that to such delicate researches as the variation of the moment of a magnetical needle, which is nearly constant, a single observation is not sufficient, as the daily regular and irregular variations may make 2″ to 3″, upon a time of 800″.

The variation of the time T of 300 vibrations, page 17, seems to point out a variation of the horizontal intensity, either periodical (of short period), or undulatory; for, as the time T has been without variation, or even decreased from 1820, 71, to 1823, 54, in the first period, where, according to the formula $M = C + B e^{-qt}$, the decrease of M should have been greatest, the change of T may have its origin from a variation in the horizontal intensity of the terrestrial magnetism. It had a maximum in 1823, a minimum in 1828, or 1829, and another maximum in 1839. I have found the same difference between 1823 and 1827, by different other cylinders, and in different places, as Copenhagen, Altona, and Paris; also, the same difference between 1832 and 1839 in Göttingen, with the same cylinder. In the letter to Mr Kupffer, I sought to express this variation as a function of the longitude of the moon's ascending node; and, accordingly, the period should be 18⅗ years: the time to come will decide.

I have for four years observed the meteorological instruments here in Christiania, at five fixed hours, 7 — 9 forenoon, and 2 — 4 — 10 afternoon; in the last year are added 0^h and 7^h afternoon. From these observations I have calculated the constants a_1, a_2, α_1, α_2, μ in the formula,

$$\beta = \mu + \alpha_1 \sin (a_1 + t) + \alpha_2 \sin (a_2 + 2t),$$

where β is the variable height of the barometer, t the horary angle of the sun, μ the mean value of β in 24 hours for the whole month. These constants are calculated, and curves constructed, for every month in the year. By these constants I have found, that here, in Christiania, lat. 59° 54′ 42″.5, the barometer has two maxima and two minima in the nine months; but that in the three months, May, June, and July, when the sun is not six hours below the horizon, the nocturnal minimum vanishes, and the morning and evening maximum coincide in the night. In the winter months, November, December, January, when the day is only six hours, the oscillation in the afternoon is very little, so that it is evident, that, in greater latitudes, near the polar circle, the minimum in the afternoon will vanish, and the two maxima, morning and evening, will coincide in the afternoon. This apparent anomaly is, of course, a necessary consequence of the general rule, modified by the short day. I have in the same manner calculated ten years' observations in Dresden, by Inspector Lohrmann, six times per day, 0^h, 3^h, 6^h, 9^h, 18^h, 21^h. In Dresden, the two minima are visible through all the twelve months. I have sent the calculations and the curves to Mr Schumacher, in Altona, and hope he will publish them in his "Astron. Nachrichten." The whole oscillation, between the greatest maximum and lowest minimum in Christiania, is greater than that deduced from the observations of Mr Sommer at Königsberg. The mean temperature at Christiania is less than that stated by L. von Buch, that is, scarce more than 4¼° Reaumur.

In 1839 I made a voyage through Denmark and the northern parts of Germany, and observed the following horizontal intensities, expressed in absolute unities after the method of Gauss (unities of longitude = 1 millim., of weight 1 milligramme, of time = 1 second mean time). The observations are made with my standard cylinder D (*De mutationibus momenti*, page 16, 17) and are reduced to absolute quantity by the method, *ibid.*, page 40, by the constant logarithm, log. A, which, in the calculations, is assumed = 6,00811, instead of 6,00843.

Christiania,	1839, April,	1.5470	Altona, Schumacher's garden,	1839, Sept.	1.7085
...	... June,	1.5485	Bremen,	1839, July,	1.7172
...	... Oct.	1.5422	Hanover,	1839, Sept.	1.7490
...	1841, April,	1.5464	Magdeburg,	1839, Aug.	1.7662
Götheborg,	1839, Sept.	1.5723	Leipzig,	1839, Aug.	1.8092
Copenhagen,	... July,	1.6503	Dresden,	1839, Aug.	1.8252
...	1840, ...	1.6517	Gotha,	1839, Aug.	1.8057
Kiel,	1839, Sept.	1.6819	Eisenach,	1839, Aug.	1.7973
Bramstedt,	... ...	1.6857	Cassel,	1839, Aug.	1.7834
Altona, Kessel's garden,	... July,	1.7120	Göttingen,	1839, Aug.	1.7751*

Taking the horizontal intensity H, in absolute unities for Göttingen = 1.7751, and according to your observations, Göttingen = 0.9783, Dresden = 1.0007, Edinburgh = 0.838 (Paris = 1.000), I find for Edinburgh in absolute unities, from the observations—

In Göttingen H = 1.5205,

In Dresden H = 1.5284. Mean 1.5244.5,

a little less than in Christiania. When T is the corrected time of 100 vibs. of the Edinburgh cylinder, No. 1, and HT° = A, I find, supposing in Edinburgh T = 270″578.

log. A = 5.04769.

As the horizontal intensity has so many variations, hourly, daily, monthly, regular and irregular, and undulatory, or perhaps periodical variations in 18–19 years, I find the comparison with Paris, especially when it is founded upon a single observation, made in different hours of the day, and after an interval of a month or more, not perfectly sure.† I will illustrate this by the following corrected observations of 300 vibrations of my cylinder D here in Christiania, in the garden of the Observatory.

			h ′	″				h ′	″
1841, April	16,	4 31, P. M.	811.93		1841, Sept.	1,	6 6, ...	810.65
... ...	22,	0 56, ...	812.74		... ...	...	7 38, ...	811.61
... ...	30,	8 5, ...	810.68		... ...	15,	10 12, A. M.	811.63
... May	9,	7 8, ...	810.44		... ...	...	10 35, ...	811.80
... ...	23,	2 22, ...	811.02		... Oct.	8,	9 57, ...	812.62
... June	17,	6 43, ...	810.07					

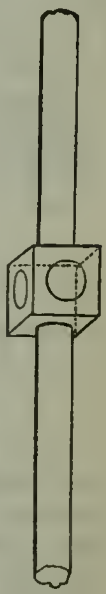
The greatest difference between 1841, June 17, 6^h 43′ P. M., and 1842, Feb. 26, 10^h 32′ A. M., is 3″; and between 1841, June 17, and 1842, April 10, 5^h 29′ P. M. = 5″.17, under influence of aurora borealis.

* The 30th July 1834, Hofrath Gauss observed the same cylinder in the same place in the garden of the Observatory, and found reduced time, T, of 300 vibrations = 759″.29, which gives intensity = 1.7672.

† [The value of the horizontal intensity at Edinburgh compared with Paris (.840) was not deduced, as Professor Hansteen supposes, from a single comparison. It was repeated by me in two different years with almost perfect agreement, and confirmed by observations at Brussels, a station independently compared with Paris. Professor Bache of Philadelphia has since found the same relative intensity for Edinburgh agreeing to the 3d decimal place.—J. D. F.]

		h	′		″	
1842, Feb.	17,	0	5,	P. M.	812.14	
... ...	20,	5	21,	...	811.40	
... ...	22,	11	31,	A. M.	812.27	
... ...	...	4	31,	P. M.	811.85	
... ...	26,	8	36,	A. M.	812.27	The minimum of intensity here occurred at $10^h\ 32'$; the maximum later in the afternoon, after the last observation at $1^h\ 41'$ P. M. This day was a magnetical term, and the results of the vibration of the needle were in good harmony with the corresponding observations on the bifilar magnetometer.
... ...	...	8	56,	...	812.18	
... ...	...	9	15,	...	812.36	
... ...	...	10	14,	...	812.60	
... ...	...	10	32,	...	813.06	
... ...	...	10	51,	...	812.57	
... ...	...	11	10,	...	812.72	
... ...	...	11	30,	...	812.38	
... ...	...	1	3,	P. M.	811.97	
... ...	...	1	22,	...	812.24	
... ...	...	1	41,	...	811.91	
... March	13,	5	44,	...	811.67	
... ...	20,	5	1,	...	811.97	
... ...	21,	5	0,	...	812.25	
... ...	25,	6	6,	...	811.35	
... ...	29,	6	48,	...	811.38	
... April	10,	5	29,	...	815.24	Aurora Borealis.
... ...	...	6	0,	...	813,17	
... ...	11,	10	11,	A. M.	812.69	

In Göttingen I made 96 observations between 8 A. M. and 4½ P. M., from Aug. 27 to Sept. 10. In Dresden only 4, between Aug. 15 and 20; two A. M. and two P. M. When it is possible I generally in every place make at least two observations, one between 10 and 11 A. M., and the other between 4 and 6 P. M., in order to eliminate the daily variation.



Since 1819, I have very often observed the *dip* here in Christiania, with three different instruments, 1*st*, A 5-inch instrument by *Dollond*, divided to 20′, with two needles; the one cylindrical, with conical ends, and in the middle a cube, which is perforated in two directions, so that the axis can be inserted from four different sides, and turned round *ad libitum;* the other flat lancet-formed, in which the axis can be put in from two sides, and turned. 2*d*, A 6-inch instrument by *Ertel*, in Münich, divided to 10′, with a flat needle and three axes, which can be turned round *ad libitum.* 3*d*, An 8-inch instrument by *Gambey*, in Paris, with three needles and fixed axes. By the instrument 1*st* and 2*d*, after every complete observation, the limb east and west, and the needle in the four usual situations, the dip read of four times in every position, after having been lifted from the agate planes (in all thirty-two readings), the axis was turned 90°, and a second observation made. This was continued four times, till the axis arrived in its former position. In all three instruments the needle very often was brought out of equilibrium, by the application of a little tube, with a screw perpendicular to its axis, upon the axis of the needle. This is useful, in order to diminish the influence of the form of the pivots, especially on needles with fixed axis; and the influence of magnetical particles in the circle; shortly, to diminish constant errors. After this proœmium, I shall communicate my observations and their results.

	Year. t.	n.	δ	Observed. i.	Calculated.	Δ
DOLLOND,	1819,857	9	2′.915	72° 39′.00	72° 41′.62	— 2′.62
	1820,397	9	1.410	... 43.63	... 39.67	+ 3.96
	1820,496	9	1.892	... 44.90	... 39.31	+ 5.59
	1820,678	9	1.212	... 42.70	... 38.72	+ 3.98
	1820.823	8	2.059	... 48.05	... 38.15	+ 9.90
	1821,159	7	3.587	... 47.80	... 36.96	+ 10.84
	1821,226	7	2.873	... 37.60	... 36.72	+ 0.88
	1821,303	7	3.517	... 42.90	... 36.45	+ 6.45
	1822,262	7	1.809	... 33.30	... 33.16	+ 0.14
	1822,548	6	3.757	... 33.80	... 32.19	+ 1.61
	1823,373	8	2.503	... 16.80	... 29.47	— 12.67
	1825,144	8	2.828	... 21.80	... 23.87	— 2.07
	1825,155	8	2.741	... 21.60	... 23.83	— 2.23
ERTEL,	1828,325	10	2.325	... 16.20	... 14.69	+ 1.51
	1830,497	5	1.757	... 6.50	... 9.08	— 2.58
GAMBEY,	1830,877	8	0.753	... 7.16	... 8.15	— 0.99
	1831,251	7	0.508	... 8.71	... 7.26	+ 0.45
	1832,521	4	0.414	... 0.56	... 4.33	— 3.77
	1838,405	7	1.042	71 57.58	71 53.14	+ 4.44
	1839,823	14	0.851	... 53.54	... 51.02	+ 2.52
	1841,304	3	2.732	... 45.36	... 49.05	— 3.69
	1841,769	7	0.888	... 51.66	... 48.49	+ 3.17
	1842,179	12	0.806	... 46.60	... 47.63	— 1.03

t is the mean time of the observations in every group ; n the number of complete observations in every mean ; d the probable error of every mean ; i the mean dip of the n observations. As the dip i in a not too long interval of time $t - t_0$ may be expressed by the following formula,—

$$i = a + b\,(t - t_0) + c\,(t - t_0)^2$$

where $a, b,$ and c are constants, I have taken $t_0 = 1820$, and by the method of least squares found

$$a = 72^\circ\ 41'.1 \pm 1'.935$$
$$b = -3'.63978 \pm 0'.21654$$
$$c = +\ 0'.056166 \pm 0'.008749\,;$$

and from these constants calculated the dip in the 5th column. Δ is the difference between observation and formula. The instrument of Dollond was too little, but the great number of observations (102 in 5.3 years), and the great variety of methods which have been employed, I suppose may have destroyed all constant errors. Since better instruments were employed, the quantity of Δ is much less ; and I think that all these differences are not really errors of observation, as it is evident that the dip has its irregular variations as well as all other magnetic phenomena of the earth. The formula—

$$i = 72^\circ\ 41'.1 - 3'.63978\,(t - 1820) + 0'.056166\,(t - 1820)^2$$

with the probable errors of a, b, and c, gives

Minimum in Christiania $= 71^\circ\ 42'.2 \pm 11'.718$
when $t = 1852.4 \pm 5.4$ years.

I have found, that the dip in Paris, observed between 1798 and 1836, may be represented by the following formula:—

$$i = 69° 38'.9 - 4'.465 (t - 1800) + 0'.023395 (t - 1800)^2,$$

which gives the minimum $i = 66° 5'.8$ when $t = 1895$.

That the dip cannot decrease to zero, and, accordingly, should have a minimum, is quite probable; by these two series of observations, this minimum is likely to arrive before the end of this century, perhaps earlier in northern than in southern latitudes.

I am not quite of your opinion, that the observations with a dipping needle should be rejected *only* while it gives a difference of a degree and a half between the different positions. This difference may be derived from two different causes,—the *eccentrical position* of the *centre of gravity*, and the *deviation* of the *form* of the *pivots* from a *true cylinder*. In the first case the mean will approximate very nearly to the true dip, if the moment of the needle before and after the reversion of the poles is not too different; and when the needle is magnetized with the same four magnets, and the same number of strokes, this will scarcely arrive. In the second case, the needle will give *different errors* by *different dips*. This error can be detected by turning the axis in the needle in different observations in the same place, or by applying an eccentrical weight upon the axis, if it is fixed. When the moment of this weight is varied in the different observations, the needle will repose upon different points of the pivots in different observations, and thereby the error will be diminished, if not quite eliminated. I think this has been the case with your needle A.1, as the difference A.2 — A.1 changes its sign by diminished dip.

	A.1.	A.2.	A.2 — A.1.
	° ′	° ′	′
Edinburgh, ...	71 57.8	71 55.1	— 2.7
Greenwich, ...	69 12.4	69 11.5	— 0.9
Brussels, ...	68 36.4	68 28.5	— 7.9
Berlin, ...	68 1.9	68 5.5	+ 3.6
Bonn, ...	67 49.1	67 51.3	+ 2.2
Göttingen, ...	67 47.0	67 53.5	+ 6.5
Carlsbad, ...	66 36.0	66 47.5	+ 11.5
Wien, ...	64 41.2	64 51.0	+ 9.8

It is also my opinion, that even the best needle may, by a single observation, give an error of three to five minutes (perhaps more), including error of observation, and irregular variation of the direction of magnetical force of the earth. I shall here offer some observations with Gambey's instrument here in Christiania, in 1839.

Time of Observation.	Needle.	n.	Marked end, N. P.		Marked end, S. P.		Dip.	
			a.	b.	c.	d.		
Sept. 30, 5½ P. M.	II.	24	72° 0′.9	73° 11′.6	72° 0′.5	70° 2′.7	71° 48′.9	After these three observations I better equilibrated both needles upon a stone the 2d October.
Oct. 1, 0½ P. M.	III.	32	70 27.3	70 33.2	73 18.6	73 24.0	71 55.8	
... ... 2 P. M.	II.	32	72 8.55	73 8.1	71 58.3	70 23.3	71 54.6	
... 3, 10 A. M.	III.	32	71 56.7	71 46.8	71 54.2	72 0.8	71 58.2	*Aurora Bor.* 8½ P. M.
... ... 10¾ A. M.	II.	32	71 53.1	71 58.6	71 55.45	71 13.9	71 45.26	
... 13, 2 P. M.	III.	32	71 59.9	71 40.8	71 42.1	71 50.6	71 48.3	Strong *A. B.* the 12th, 9¾ P. M. behind the clouds.
... 27, 2 P. M.	III.	31	71 47.3	72 1.4	72 21.7	72 1.1	72 2.9	
Nov. 7, 10 A. M.	I.	34	72 50.65	69 57.05	71 21.0	73 13.5	71 50.55	
... 17, 1¼ P. M.	III.	32	87 51.3	58 22.5	58 11.7	88 6.7	71 54.7	Eccentric *weight* upon the axis.
... 18, 11¾ A. M.	III.	32	58 3.6	87 59.0	87 47.5	58 30.5	71 52.2	Weight turned round the axis 180°.
... 19, 1½ P. M.	II.	32	58 51.8	87 50.2	88 36.5	57 28.5	71 56.9	Weight.
... ... 2½ P. M.	II.	32	88 6.8	58 42.6	58 9.4	87 37.6	71 57.3	Weight turned round 180°.
... 20, 11 A. M.	I.	32	96 58.4	51 51.7	54 6.8	94 7.2	71 49.2	Weight (this needle has a weaker magnet.)
... 21, 2½ P. M.	I.	34	53 55.0	92 47.3	92 24.1	56 9.3	71 54.7	Weight turned.
						Mean,	71 53.54	

n is the number of readings in each series ; a the dip, when the marked side of the needle turned to east, four readings with limb east, and four when west ; b the dip, when the marked side was west, and limb both east and west ; c and d the same, after changing the poles. When the weight was applied, the dip is calculated by the formula—

$$\text{tang}\, i = \frac{\text{cotang}\, a + \text{cotang}\, d - \text{cotang}\, b - \text{cotang}\, c}{\text{cotang}\, a \,.\, \text{cotang}\, d - \text{cotang}\, b \,.\, \text{cotang}\, c}\,;$$

and by this method the different magnetical moment of the needle, before and after the returning of the poles, is quite eliminated. The eight first observations, without weight, give 71° 53′.1, the last six, with weight, 71° 54′.2, and the probable error of the mean of the whole series is 0′.851. Though the probable error of the three determinations 1839, 823 (14 obs.), 1841, 769 (7 obs.), 1842, 179 (12 obs.), are only 0′.851, 0′.868, and 0′.806, their deviations from the formula are respectively + 2′.52, + 3′.17, and — 1′.03, which, I think, may principally be ascribed to irregular variations in the dip.

I beg your pardon for my profusion in this matter, but my long experience with different instruments of this kind has made me somewhat sceptical in the way of observing the dip, and I am not content before I have varied the methods of observation, and multiplied the observations as much as possible.

In observing the intensity by vibrations of a magnetical cylinder, you are almost the only observer who has not neglected one or more of the necessary reductions, as that for temperature, rate of the chronometer, force of torsion, arc, and to observe the cylinder in the same place before and after the voyage. Some have neglected them all, and thereby brought the method in an undeserved miscredit.

If you should desire any other communications which are in my power to procure you, I shall make them with great pleasure. I am, Sir, with the greatest respect, your obedient and humble Servant,

CHR. HANSTEEN.

To Professor FORBES.

2. Notice of the occurrence in Scotland of the *Tetrao medius*, shewing that supposed species to be a hybrid. By James Wilson, Esq.

There exists in several northern continental countries a peculiar kind of grouse, called by foreign naturalists *Tetrao medius*, on account of its exhibiting, as it were, a combination of the characters of the wood-grouse or capercailzie on the one hand, and of the black-cock on the other. It is never found except in countries inhabited by the two species last named; and as it presents a union of their characters, several naturalists have inferred that it is not itself a distinct kind, but a hybrid, resulting from the casual intercourse of the other two. But most naturalists have maintained that it is a distinct species, chiefly upon the principle, that, in the wild state, birds of different species do not intermingle sexually with each other. Mr Wilson, however, having discovered that, in certain districts of Scotland into which Lord Breadalbane has lately introduced the capercailzie, and in which the black-cock previously existed in abundance, this so-called intermediate grouse has also now made its appearance, he draws the conclusion, that it is not a distinct species, but a hybrid or mule. "It had not been previously known in Scotland, at least in our times,—it has not been introduced by any one from abroad,—and yet here we now find it in the very districts inhabited by the other two." Mr Wilson exhibited a specimen recently killed on the estate of Dunira, and shewed its entire agreement with the foreign *T. medius*, by comparing it with a specimen from Norway.

3. On the Coloration of the Blood. By the late Daniel Ellis, Esq., F.R.S.E. Communicated by Dr Christison.

[*Note.*—During the latter part of his life, Mr Ellis had been engaged in drawing up a statement of his views with regard to the function of respiration in animals generally; and having, for some years previous to his death, had it in contemplation to lay before the Royal Society an account of that part of his researches which relates to the cause of the change of colour of the blood in its passage through the lungs, he had prepared and nearly completed the paper on this subject, of which the following is a short abstract. It may be proper to state that no reference is made in the paper to the recent experiments of Magnus, which are now generally held to afford incontrovertible proof of the existence of free carbonic acid in greater, and of oxygen in less quantity, in venous than in arterial blood. These experiments came to be known in this country only a short time before Mr Ellis's death, and, had he been acquainted with them, might have tended to modify his views.]

In the first part of the paper, the author states that he still maintains the opinion expressed in his published work on respiration, viz., that the quantity of carbonic acid formed in respiration is exactly equal to that of the oxygen consumed; and he enters into a detailed critical analysis of the different experiments recorded by authors on this subject, placing, however, his chief reliance upon those of Berthollet, and of Allen and Pepys, in order to justify his opinion. He also holds the view that the exhalation of carbonic acid and consumption of oxygen are not independent processes, but are the immediate result of the direct union of carbonic and oxygen within the air-cells of the lungs, and he expresses doubts as to the accuracy of the experiments of Edwards, which have by many been held to establish the opposite view.

Proceeding upon this basis, the author next examines the effects of air and other re-agents upon blood out of the body, and deduces the conclusion, that, although oxygen gas appears to have the direct effect of changing the colour of the blood from dark to bright red, that change may be induced without the presence of any oxygen gas, and that within the living body, it is not necessary to attribute the change to the agency of that gas. In proof of this, the author refers particularly to the experiments of Stevens and of Gregory, and he also details experiments made by himself, which shew that, while a strong saline fluid has of itself the power of changing the colour of the blood, weaker saline solutions, or such as contain no more salt than is naturally dissolved in the serum of the blood, do not effect any change unless oxygen gas be also present; and that water, which contains dissolved in it less than $\frac{1}{160}$ part of its weight of salt, does not brighten blood even in air.

The author forms the conclusion, that we must seek some other cause of the coloration of the blood than the direct action of oxygen. That cause he conceives to be of the nature of electricity. He refers to various experiments which shew that electricity produces the effect of reddening the blood, and he explains the development of electricity in respiration, by supposing that the heat evolved by the combination of carbon with oxygen in the lungs, becoming latent, is converted into electricity, and there produces its effect on the colouring matter of the blood. That effect the author holds to consist in the decomposition of the saline ingredients of the serum, the consequent separation of a quantity of free alkali, which, acting on the hematosine, changes its colour from dark to bright red.

The following Donations of Books to the Society's Library were announced.

Astronomical Observations made with Ramsden's Zenith Sector, together with a Catalogue of the Stars which have been observed, and the amplitudes of the Celestial Arcs, deduced from the observations at the different stations. Published by order of the Board of Ordnance.—*By the Master-General, &c.*

Proceedings of the London Electrical Society. Part 6. Session 1842-43.—*By the Society.*

Bulletin de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. 1842. Nos. 3-9.

Nouveaux Mémoires de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xv.

Annales de l'Observatoire Royal de Bruxelles. Publiées par le Directeur, A. Quetelet. Tome ii.—*By the Royal Academy.*

Annuaire Magnétique et Météorologique du Corps des Ingénieurs des Mines de Russie ou Recueil d'Observations Magnétiques et Météorologiques faites dans l'étendue de l'Empire de Russie. Par A. T. Kupffer. Annee 1840.—*Par l'Administration Imperiale des Mines.*

Astronomische Nachrichten. Nos. 447-461.—*By Professor Schumacher.*

Transactions of the Philosophical Society of Cambridge. Vol. VII. Part 3.—*By the Society.*

Scheikundige Onderzoekingen, gedaan in het Laboratorium der Utrechtsche Hoogeschool. Stuk. 4.—*By the Editors.*

Donations to Museum—

Specimens illustrative of Mr Stark's paper on the Food of the Herring and Salmon.—*Presented by John Stark, Esq.*

Specimens of the Woods of Ceylon (fifty different kinds.)—*Presented by J. Anstruther, Esq.*

Specimens of Minerals and Fossil Organic Remains from Malta, the Ionian Islands, and Ceylon.—*Presented by Dr John Davy.*

Geological Specimens from the Velay and Vivarais (Haute Loire and Ardêche.)—*Presented by Professor Forbes.*

Monday, 9th January 1843.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following communications were read:—

1. On the Growth of the Salmon. By Mr Andrew Young, Invershin, Sutherlandshire. Communicated by James Wilson, Esq.

Mr Young has here taken up the subject of the salmon's growth where it was necessarily left off by Mr Shaw. So far as the earliest or fresh-water state of the fish is concerned, he entirely agrees with the observer just named. He then states the various opinions which prevail regarding the more or less rapid growth of smolts and grilse, and shews by tabular lists (the result of frequently repeated experiments), that the increase in their dimensions is extraordinary so soon as they descend into the salt water. So far back as the months of April and May 1837, he marked a number of descending smolts, by making a peculiar perforation in the caudal fin, by means of small nipping irons constructed for the purpose. He re-captured a considerable number of them ascending the rivers as grilse, in the course of the ensuing months of June and July, and weighing several pounds each, more or less according to the difference in the length of their sojourn in the sea. Again, in April and May of 1842, he marked a number of descending smolts, by clipping off the little adipose fin upon the back. In June and July he caught several of them returning up the river, and bearing his peculiar mark,—the adipose fin being absent. Two of these specimens were exhibited to the Society. One marked in April, and re-captured on the 25th of July, weighed 7 lbs.; the other, marked in May and recaptured on the 30th July, weighed $3\frac{1}{2}$ lbs. As the season advances grilse increase in size, those being the largest which abide the longest in the sea. They spawn in the rivers after their first ascent, and before they have become adult salmon.

Mr Young also described various experiments instituted with the view of shewing the transition of grilse into salmon. He marked many small grilse after they had spawned in winter, and were about to re-descend into the sea. He re-captured them in the course of the ensuing summer as finely-formed salmon, ranging in weight from 9 to 14 lbs., the difference still depending on the length of their sojourn in the sea. He has tried these experiments for many seasons, but never twice with the same mark. A specimen marked as a grilse of 4 lbs. in January 1842, and re-captured as a salmon of 9 lbs. in July, was exhibited to the Society. It bore a peculiarly twisted piece of *copper* wire in the upper lobe of the caudal fin. Those marked and retaken in 1841 were marked with *brass* wire in the dorsal fin. With these and other precautions Mr Young avoided the possibility of any mistake as to the lapse of time. Both grilse and salmon return uniformly to their native streams; at least it very rarely happens that a fish bearing a particular mark is found except in the river where it was so marked. Salmon in the perfect state as to form and aspect, also increase rapidly in their dimensions on again reaching the sea. A spawned salmon weighing 12 lbs. was marked on the 4th of March, and was re-captured on its return from the sea on the 10th of July, weighing 18 lbs. Mr Young is of opinion that salmon rather diminish than increase in size during their sojourn in rivers; and he illustrates this and other points of his subject by numerous experiments and observations.

2. On the Geology of Roxburghshire. Part 2. By David Milne, Esq.

Mr Milne divided his paper into two parts, the first comprehending a description of the leading geological features of the district; the second containing the inferences of a cosmological character, which the facts related in the first part seemed to warrant.

In describing the geology of Roxburghshire, Mr Milne referred, *first*, to the stratified rocks; *secondly*, to the igneous rocks; and, *thirdly*, to the superficial, or (as they have been sometimes termed) the diluvial deposits.

The stratified rocks were stated to consist of the following series, beginning with the oldest, viz.—greywacke, old red sandstone, and the coal measures. As to the long disputed question regarding the existence of the new-red-sandstone formation in this county, Mr Milne, whilst not wishing to affirm absolutely the non-existence of any strata whatever belonging to this epoch, referred to the older formation the great mass of the red sandstones abounding in the district, adding that he had himself seen none which necessarily belonged to a later epoch.

It was stated that no fossils had been found in the greywacke strata, but that in the old red sandstone formation, scales and bones of the *Holoptichius* had been found embedded both in the red and the white coloured strata.

The igneous rocks consist of all the varieties of felspars, basalts and greenstones, known in other parts of Scotland, the first mentioned of these being the oldest. All these rocks occur in the form of dykes, as well as hills, of which the Eildons and Cheviots are the highest and most extensive.

The superficial deposits consist, beginning with the oldest, of the boulder clay, well known in the Lothians,—of sand and gravels,—and of great blocks or rounded fragments of rocks, all strewed over the surface. It was mentioned, that, whilst the boulder clay was deposited in tumultuous waters (presenting no signs of stratification), the sands and gravels being for the most part stratified, have been deposited by waters not in violent action. The greater number of boulders in Liddesdale consist of grey granite, very similar to that of Criffel, situated between thirty and forty miles to the westward.

In part 2d, the author observed, that the greywacke formation, presenting as they do enormous foldings, in consequence of which the formation is traversed by ridges and valleys, all running east and west by compass, must have been acted on here, as throughout the rest of this part of the island, by a force or system of forces, which acted in a particular direction ; and that as hardly any igneous rocks whatever occur, within the limits of this formation, it seemed that the greywacke strata had not been elevated and folded together by igneous action, but more probably in consequence of changes in the form of the Earth's nucleus, as suggested by Elie de Beaumont.

The elevation of the greywacke ranges was followed by eruptions of felspathic and a few greenstone rocks, which took place chiefly on the outskirts of that formation ; and from the sediment afforded by the wearing down of these rocks, still at the bottom of a sea, the stratified rocks surrounding and partly covering these older rocks were formed. As the heaviest sediment would be deposited first, the sandstones filled with oxide of iron, and now constituting the principal beds of the old red sandstone formation, would girdle the hills of greywacke and older felspathic rocks, whilst the strata of white sandstone, shales, and limestones, being composed of lighter sediment, would be carried farther, and become members of the coal measures situated in Liddesdale, Northumberland, and Berwickshire.

The formation of the whinstone dykes, one of which was described as running in a NW. direction, for about twenty-four miles, was ascribed by the author to the irruption of igneous matter into fissures previously formed in the earth's crust.

The beds of gravel and sand, as well as the boulders, the author thought might all be explained on the supposition, that the district had been covered by the waters of the ocean, when they were deposited. He adduced facts and arguments for the purpose of shewing that certainly none of these deposits could have been formed by glacial action, and that probably submarine currents, or great waves, such as are known to have been produced by submarine eruptions, would be sufficient to account for all the phenomena.

3. On the Property of Transmitting Light, possessed by Charcoal and Plumbago, in fine plates and particles. By John Davy, M.D., &c.

The charcoal of the pith of the elder consists of plates of extraordinary thinness. It was in examining this charcoal, that the author first observed the property which is the subject of his paper. He detected it by means of the microscope, using a high magnifying power. By analogy, he was led to infer that the power of transmitting light must belong to charcoal in general, in all its varieties, when reduced to the state of fine powder or filaments,—an influence which he found confirmed by experiment in a number of different instances, as the charcoal of the pith of the sycamore, of the pith of the rush, the fibre of cotton, flax, &c. He also found it to belong to lamp-black, to cork in very fine powder, to anthracite, and plumbago.

The light transmitted he found to vary in its hues, from almost white, as in the instance of the thinnest plates of the charcoal of the pith of the elder, to brown and red of various shades, in the instances of lamp-black, anthracite, and plumbago.

He considers the property of translucency belonging to charcoal and plumbago, in their finely divided state, as favourable to the opinion now commonly received, that these substances and diamond owe their marked peculiarities not to difference of chemical mixture, but of mechanical structure. Incidentally, he notices the specific gravities of these substances,—stating, as the result of his own experiments, that the specific gravity of charcoal, cork, and anthracite, is about 1.5; and that of plumbago about the same, making allowance for the ferruginous and earthy matter with which the carbon in this mineral is mixed.

In conclusion, he offers the conjecture, that the coloured tints of vapour and fluids in which carbon is suspended, may be connected with the translucency of this substance, and that other bodies, hitherto considered opaque, may be found capable of transmitting light, when examined in a manner similar to that which he has employed.

The following Donations of Books to the Society's Library were announced.

Maps of the Ordnance Survey of England and Wales. Nos. 80, 81, and 90.—*By the Master-General of the Ordnance.*

Maps of the Irish Ordnance Survey, containing the County of Clare. 77 sheets.—*By His Excellency the Lord-Lieutenant.*

Report made at the Annual Visitation of the Armagh Observatory. By the Rev. T. R. Robinson, D.D.—*By the Governors of the Observatory.*

Proceedings of the American Philosophical Society. Vol. II. No. 23.—*By the Society.*

Journal of the Asiatic Society of Bengal. Nos. 122 and 123.—*By the Society.*

Donations to Museum—

Specimens of Fossil Organic Remains from East Kilbride and neighbourhood, Lanarkshire. Collected by the late Rev. David Ure, A.M.; and a number of them figured in his "History of Rutherglen and East Kilbride."—*Presented by John Stark, Esq.*

Tail of a Wild Elephant from Ceylon.—*Presented by Rob. Bryson, Esq.*

Specimens of Fossil Fishes from Syria.—*Presented by Dr John Davy.*

Monday, 23d January.

The Very Reverend Principal LEE, Vice-President, in the Chair.

The following communications were read:—

1. Chemical Observations on the Flowers of the Camellia Japonica, Magnolia grandiflora, and Chrysanthemum

Leucanthemum; and on three proximate principles which they contain. Part I. By Dr Hope.

The Abstract of this Paper has been postponed till the remaining part of it shall be communicated.

2. On the Law of Visible Position in Single and Binocular Vision, and on the Representation of Solid Figures by the union of two dissimilar plane figures on the Retinæ. By Sir David Brewster, K.H. Part I.

The Abstract of this Paper also has been postponed till the whole shall have been read before the Society.

The following Donations of Books to the Society's Library were announced.

Proceedings of the London Electrical Society. Part 7.—*By the Society.*

De Fido Uranometriæ Bayeri Dissertatio Academica. Scripsit D. F. G. A. Argelander.—*By the Author.*

Memoirs of the Royal Astronomical Society. Vol. XII.—*By the Society.*

Philosophical Transactions of the Royal Society of London. 1842. Part ii.—*By the Society.*

Kongl. Vetenskaps-Academiens Handlingar, för Aren 1839-40.

Arsberättelse om framstegen i Fysik och Kemi Afgiven den 31 Mars 1839 and 31 Mars 1840. Af Jac. Berzelius.

Ärsberättelse om Technologiens Framsteg, Afgiven den 31 Mars 1839 and 31 Mars 1840. Af G. E. Pasch.

Arsberattelser om nyare Zoologiska Arbeten och Upptackter. Afgifne för Aren 1837-40. Af C. J. Sundewall.—*By the Royal Swedish Academy.*

Donation to Museum—

Three Specimens of Salmon, shewing the rapid growth (on descending to the sea) of the Smolt to the state of Grilse, and of the latter to the adult condition.—*By Mr Andrew Young, Sutherlandshire.*

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1843. No. 22.

Monday, 6*th February* 1843.

Sir T. MAKDOUGALL BRISBANE, Bart., President, in the Chair.

The following communications were read :—

1. On the Law of Visible Position in Single and Binocular Vision, and on the representation of Solid Figures by the Union of dissimilar Plane Pictures on the Retina. By Sir David Brewster, K.H.,—*concluded.*

This subject is treated under eight different heads :—1. On the law of visible direction in *Monocular* vision. 2. On the law of visible direction in *Binocular* vision. 3. On vision of objects of three dimensions, by monocular vision ; by binocular vision. 4. On the binocular vision of figures of different magnitudes. 5. On the cause of the perception of objects in relief by the coalescence of dissimilar pictures. 6. On the doctrine of corresponding points. 7. On the vision of cameos and intaglios. 8. On the change in the apparent position of the drawings of solid bodies.

The general object of this paper is to establish the law of visible direction, (position in monocular vision,) and to shew that it is equally applicable to binocular vision, and affords a complete explanation of various phenomena which had been considered incompatible with it, but for which no theory had been proposed. In the last two sections, the author treats of the collateral subject of the vision of cameos, and of the drawings of solid bodies.

2. Papers on Glaciers. No. 1, Account of a Geometrical Survey of the Mer de Glace of Chamouni. By Professor Forbes.

This paper does not admit of abridgment. The author gave an account of a survey which he executed of the whole extent of the principal glacier of Mont Blanc and its tributaries. A base line of nearly 3000 feet was carefully measured in the valley, and extended by means of a very careful triangulation to a point on the glacier distant 28,600 feet, and elevated 4400 above the base line. From the several points of this triangulation, the positions and heights of the adjoining mountains were taken and laid down on a map on a scale of $\frac{1}{25000}$ of nature, portions having been drawn out to $\frac{1}{10000}$. The map was laid before the Society, and is now being engraved.

The following Donations of Books to the Society's Library were announced.

Elements of Chemistry, including the Applications of the Science to the Arts. By Professor Graham, University College, London. Part 6.—*By the Author.*

Maps of the Irish Ordnance Survey, containing the County of Waterford, in 42 sheets.—*By his Excellency the Lord Lieutenant.*

The following Donations to the Museum were presented—

Specimens of Volcanic Rocks from Vesuvius, and Minerals from Derbyshire.—*Presented by Sir T. M. Brisbane, Bart.*

Specimens of Fossil Shells from Grignon, collected by Dr Stark in Oct. 1833.—*Presented by John Stark, Esq.*

The following gentlemen were duly elected Ordinary Fellows of the Society :—

Dr John Rose Cormack, Fellow of the College of Physicians of Edinburgh.

Dr Allen Thomson, Professor of the Institutes of Medicine in the University of Edinburgh.

Monday, 20*th February* 1843.

The Right Honourable Lord GREENOCK, Vice-President, in the Chair.

The following communications were read :—

1. On the Anatomy of the Human Placenta. By John Goodsir, Esq., Conservator of the Museum of the Royal College of Surgeons of Edinburgh.

In the first section of the paper, the author described the parts which enter into the structure of the villi of the placenta. The villi are covered by a membrane with which anatomists are already familiar. Within this membrane, and attached to its internal surface, is a layer of cells, which has also been observed, and described as epithelium. The cells composing this layer, Mr Goodsir denominated the external cells of the villus. The next structure is a membrane not hitherto described, and named by the author the internal membrane of the villus. The adhesion of this membrane to the external cells is so slight, that it is generally seen at some distance from them, even in villi which have undergone no violence. Within the internal membrane of the villus, a set of very transparent cells, hitherto undescribed, is situated. These the author denominated the internal cells of the villus. The ultimate loops of the umbilical capillaries are imbedded in this mass of cells, the cells and vessels being closely bound up by the internal membrane of the villus.

The second section of the paper was devoted to the description of the fœtal portion of the organ. Mr Goodsir described the development and structure of the tufts of the chorion. He stated that the development consists in the addition of cells to the extremity of each villus of the tuft, these being supplied by a germinating mass, which resembles the spongiole of the root-fibre of a plant. These tufts and villi are entirely cellular, and are covered by a fine membrane. Before the villi become vascular, the ovum derives nourishment from the decidua, by the absorbing agency of the cells of the spongioles at the extremities of the villi of its chorion. When bloodvessels have formed in the villi, the cells, although less numerous, still remain, and are believed by Mr Goodsir to be the active absorbing agents in the villi of the placenta. In the perfect placenta, the villi of the chorion appear as the internal membrane, and the internal cells described in the first part of the paper. These, along with the umbilical vessels, constitute the fœtal portion of the placenta.

In the third section of the paper, in which Mr Goodsir treated of the maternal portion of the organ, he corroborated the statements of of Professors Weber and Sharpey as to the nature and structure of the decidua ; and he more particularly described an interfollicular tissue, consisting of cells, which conduces, he thinks, as much as the enlargement of the glands, to the thickening of the mucous membrane. Since the discovery made by Professors Weber and Sharpey, too little attention, he believed, has been directed to the secretions of the thickened mucous membrane. This secretion, which forms the greater part of the decidua reflexa, is, according to the author, composed entirely of cells, and is the nourishment destined for the embryo, being taken up after solution by the absorbent cells of the villi. By tracing the cavities of the vessels of the gravid uterus from without inwards, as had formerly been done by Professor Owen, the author verified the statements of certain anatomists, that the vessels pass from the uterus into the decidua, and open on the internal surface of the latter by oblique valvular orifices. He likewise observed, that the meshes enclosed by the uterine veins become smaller and more ribbon-shaped near the cavity of the placenta, and that in that cavity they represent the appearance of hollow threads, which pass in great numbers from the uterine surface of the organ on to the extremities and sides of the villi, and also from villus to villus. Along the cavities of these threads the cellular mass of the decidua becomes continuous with the external cells of the villi.

From these observations, Mr Goodsir concluded that the sac of the placenta is a network of enlarged decidual vessels, the meshes of which have been reduced to hollow threads ; and, secondly, that not only is the external membrane of the villi a part of the mother, being a portion of the membrane of her vascular system, but that the external cells also are maternal, being decidual cells continuous, along the hollow threads, with the general mass of the decidua.

Mr Goodsir stated in conclusion—

1. That the external membrane and the external cells of the villi constitute together the central division of the placental decidua, or the principal maternal portion of the organ, the cells being secreting cells destined to separate from the blood of the mother a matter proper for the nourishment of the fœtus.

2. That the villi present, in addition, an internal membrane and internal cells, which together constituted, at an earlier period, the villi of the non vascular chorion ; that the internal cells are absorb-

ing cells, like the chyle cells of the intestinal tube, taking up for the fœtus the matter secreted by the external cells.

3. That the placenta not only performs the function of a lung, but also that of a gastro-intestinal mucous membrane.

2. On the Mode in which Sound is produced and diffused, and on the Vibrations caused in the quality of Sound by substance and form. By Sir George S. Mackenzie, Bart.

The following Donations of Books to the Society's Library were announced.

Voyage dans la Russie Méridionale et la Crimée, par M. Anatole de Demidoff. Tome 4, avec un Atlas des Planches.—*By the Author.*

Bulletin de la Société Géologique de France, from 15th March to 9th September 1841.—*By the Society.*

Proceedings of the Glasgow Philosophical Society, 1841-42.—*By the Society.*

The following Gentlemen were duly elected Ordinary Fellows of the Society:—Joseph Mitchell, Esq., civil engineer; Duncan Davidson, Esq. of Tulloch.

Monday, 27th February 1843.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following communication was read.

Papers on Glaciers. No. 2, describing the Rate of Motion of the Ice of the Mer de Glace, deduced from observation. By Professor Forbes.

The author detailed in this paper the methods of observation by which he was enabled to ascertain the *daily* and even *hourly* motion of different parts of the glacier.

The following are some of the principal results:—

I. In the particular case of the Mer de Glace, the motion of the higher parts of the glacier are on the whole slower than those of its lower portion, but the motion of the middle region is slower than either.

The following table, the result of observations at a series of ascending stations, will authorize this conclusion.

	Velocity.
Lower part,	1.000 0.770
Middle do.,	0.479
Higher do.,	0.674

II. The Glacier du Géant moves faster that the Glacier de Lechaud in the proportion of 7 to 6.

III. The centre of the glacier moves faster than the sides. When two glaciers unite, they act as a single one in this respect, just as two united rivers would do.

The author measured the velocities at different places in the breadth of the glacier, and it was found to increase towards the centre. The following are the numerical results, assuming the motion of the ice near the edge as the standard or the unit of reference.

Side.			Centre.
1.000	1.332	1.356	1.367

IV. The difference of motion of the centre and sides of the glacier varies (1) with the season of the year, and (2) at different parts of the length of the glacier.

1. From the observations made, the author concludes, that "the variation of velocity diminished as the season advanced; and that it was proportional to the absolute velocity of the glacier at the same time."

2. The variation of the velocity with the breadth of the glacier is least considerable in the higher parts of the glacier, or near its origin.

V. The motion of the glacier generally varies with the season of the year and the state of the thermometer.

Perhaps the most critical consideration of any for the various theories of glacier motion is the influence of external temperature upon the velocity. It is shewn in this paper, by a direct numerical comparison, and by projected curves, that in nearly every instance the velocity of the glacier, during any period of days, has a reference to the temperature of the same period. If the thermometer fell, the glacier advanced slower, and *vice versa*. It is not, however, to be inferred that at the same external temperature the velocity will always be the same; only at any season, the change will always be in the same *direction*, and governed by the thermometer, though not always the same in amount.

The author also deduced from various indirect considerations, that it is very improbable that the glacier *stands still* in winter. On the contrary, he supposes that though its velocity is less than in summer, it still bears a considerable proportion to it.

Monday, 6th March, 1843.

The Right Honourable Lord GREENOCK, Vice-President, in the Chair.

The following communications were read :—

1. On the Nature, Locality, and Optical Phenomena of Muscæ Volitantes. By Sir D. Brewster, K.H.

2. On the Structure of the Lymphatic Glands. By John Goodsir, Esq., Conservator of the Museum of the Royal College of Surgeons of Edinburgh.

The author stated that the different lymphatics, as they enter the gland, become deprived of their external tunic, which passes on to the surface of the organ, to assist in forming its capsule. The middle tunic also becomes weaker, and presents the appearance of fibres arranged in the form of arches, which enclose rounded or oval spaces, particularly towards the surface of the gland, and at the angles formed by the anastomosis of one lymphatic with another. Mr Goodsir then observed that it was to the changes which the internal tunic of the lymphatics undergoes in the interior of the gland, that these organs owe their peculiar structure. This tunic, when traced from the afferent or efferent vessels into the gland, is found to become thicker and more opaque, till at length it no longer transmits light. It consists of two parts—a fine external membrane, and a granular substance attached to the inner surface of that membrane. The membrane belongs, according to the author, to the class of germinal membranes, with the germinal spots placed at regular distances. This germinal or primitive membrane of the internal tunic of the intra-glandular lymphatics is extremely delicate, and has germinal spots of an oval form, with compound nuclei. These spots are the sources of the nucleated particles which come from the granular substance. These particles are about the 4000th to the 5000th of an inch in diameter, and form a considerable proportion of the corpuscles, which have been long recognised in the fluid which may be squeezed out of lymphatic glands. The layer which these nucleated particles forms on the internal surface of the germinal membrane is so thick as almost to fill the cavity of the lymphatic. The canal of the vessel is irregularly pierced through the granular substance, the surface and particles of which are freely bathed by the chyle or lymph. This granular layer being continuous in both directions with the scale-like epithelium of the extra-glandular lymphatics, it is therefore merely a developed form of this epithelium.

Mr Goodsir then stated that the opinion of those anatomists who hold that the intra-glandular lymphatics form a net-work, is correct. In the glands in which the meshes of this net-work are elongated, the vessels, even after forcible injection, never assume the cellular appearance. In those glands again, or in those parts of glands in which the meshes are rounded or equilateral, the injection of mercury produces the appearance of globular cells. In other lymphatic glands, a process of absorption, similar to that which occurs in the maternal vascular system of the human placenta, reduces the meshes of the lymphatic net-work to mere threads or bars, and converts one or more short lymphatic branches into one multilocular cavity. All these varieties are modifications of the simple net-work.

The ultimate capillaries of the blood-vessels form very fine net-works on the external surface of the germinal membrane of the intra-glandular lymphatics. The anatomical relations of this capillary net-work, and the germinal membrane and granular substance of these lymphatics, are identical with those of the vessels, membrane and secreting epithelia of true glands.

One of the functions of the granular substance, the author stated to be the secretion of chyle and lymph corpuscles; but, as these are also formed in other parts of the lymphatic system, he reserved his observations on this part of the subject for a future occasion. He concluded by observing, that the structure he had described afforded, in his opinion, satisfactory evidence, 1st, That the lymphatic glands are merely net-works of lymphatic vessels, deprived of all their tunics but the internal, the epithelium of which is highly developed for the performance of particular functions; and, 2d, That these peculiar lymphatics have a fine net-work of capillary blood-vessels in close contiguity with their external surfaces, for the purpose of affording matter for the continued renovation of the epithelium.

3. On the Determination of Heights by the Temperature of Boiling Water. By Professor Forbes.

The investigations in this paper were made in order to reduce certain observations on the boiling point of water, made by the author in the Alps, in 1842.

He considered that it has been too generally assumed that the boiling point corresponds to a barometric pressure which expresses the elasticity of steam taken from the usual tables. He, therefore, attempted to deduce the connection of these data by a direct comparison of cases, in which both the barometer and boiling point were noticed by himself. He finds this result, that the pressures increase *rigorously* in a geometrical ratio, whilst the temperature of the boiling point rises uniformly. This law is not new, for Deluc arrived at the same result; but it appears to have been considered by all late writers as unworthy of adoption, and the scale of the elasticities of vapour by Dalton or Ure has been preferred. Now, these elasticities cannot, it is well known, be accurately represented by a geometrical proportion to the temperature; but Professor Forbes finds that the geometrical ratio represents the barometric heights exactly, whilst the tabular elasticities do not. But, farther, since the common barometric formula shews that the pressure varies geometrically, whilst the height above the sea varies uniformly, we have the same form of relation between the boiling point and the barometric pressure as between the height above the sea and the barometric pressure, namely, that each is as the logarithm of the other. Hence the boiling point falls *exactly* in proportion to the height ascended, and at the rate of 549.5 feet for 1° Fahr.

The following Donations of Books to the Society's Library were announced.

Monthly Notices of the Astronomical Society of London, containing Abstracts of Papers and Reports of the Proceedings of the Society. Vols. 1, 2, 3, 4, and vol. 5. Nos. 1–27.

Memoirs of the Royal Astronomical Society. Vol. XIV.—*By the Society.*

Examination Papers of the several Faculties in the University of London, for 1842.—*By the Council of the University.*

Mémoire sur la Chaleur des Gas Permanens, par Jean Plana, Astronome Royal, et Directeur de l'Observatoire de Turin.—*By the Author.*

Journal of the Asiatic Society of Bengal. Nos. 124 and 125, for 1842.—*By the Society.*

The Quarterly Journal of Agriculture, and the Prize Essays and Transactions of the Highland and Agricultural Society of Scotland. No. 60, for March 1843.

The following Donation to the Museum was presented—

A Specimen of a Vegetable Impression from Burdie House.—*Presented by D. Balfour, Esq. younger of Trenaby.*

The following Gentlemen were duly admitted Ordinary Fellows of the Society:—

Andrew Coventry, Esq., Advocate.
D. Balfour, Esq. younger of Trenaby.

Monday, 20th March 1843.

Sir DAVID BREWSTER, Vice-President, in the Chair.

The following communication was read:—

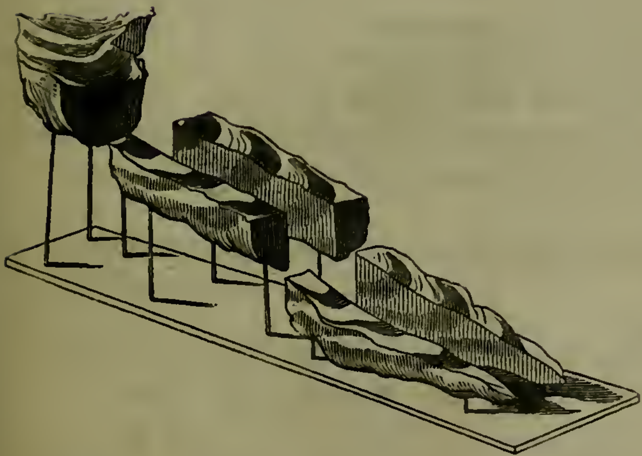
Papers on Glaciers. No. 3, On the Structure of Glaciers, and the cause of their motion. By Professor Forbes.

With reference to his former paper of the 27th February, the author stated, that he had received a most satisfactory confirmation of his opinion respecting the motion of glaciers in winter. From observations made by his direction on the Mer de Glace of Chamouni, and in which he places entire confidence, it appears that the ice moved no less than 76 feet between the 12th December 1842 and 17th February 1843, or at the rate of $13\frac{1}{2}$ inches *per diem*, whilst its mean motion during the summer was $17\frac{1}{2}$ inches.

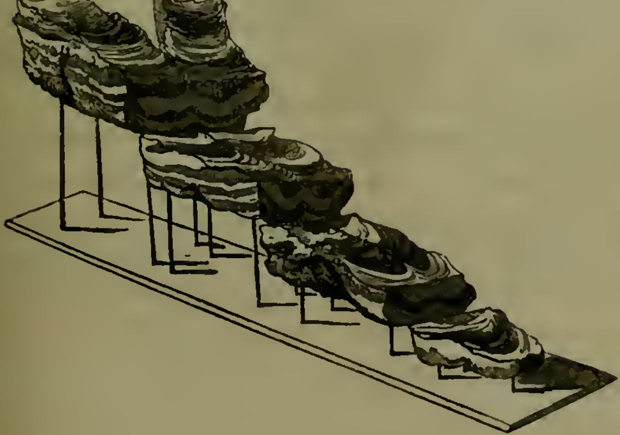
The author then explained the manner in which he conceives the conoidal structure of glaciers to be due to the varying velocity of different points of their section producing discontinuity by minute fissures, which are infiltrated and ultimately frozen. He had before satisfied himself that the forms of these surfaces are such as the motion of the particles of a viscid fluid, obstructed by the sides and bottom of the canal in which it moves, would engender. But to make this more palpable, he has endeavoured to imitate the motion of a glacier, by causing a plastic fluid of different colours to mould itself by the action of gravity in an inclined bed, and he has thus succeeded in reproducing the forms of the structural surfaces of glaciers so precisely that they cannot be distinguished from the curves which he had drawn as representing the actual phenomena.—*See Edinburgh Philosophical Journal*, Oct. 1842, pages 346, 347.

ILLUSTRATIONS
OF THE
VEINED STRUCTURE
OF GLACIERS.

View of a Glacier, shewing its Structure by Ideal Sections.



View of a Model shewing the curves generated (experimentally) by the motion of a viscous fluid.



View of a Model shewing the effect of the union of two streams on the motion of a viscid fluid.

Professor Forbes also mentioned the objection recently taken by M. Agassiz to this theory of the veined structure being due to the different velocity of parallel portions of the ice, namely, that where two glacier streamers unite, their structure remains separate and distinct. Professor Forbes admits that it does so for a certain distance after union, but affirms, that, if the glacier be long enough, the structure always tends to consist of a single series of curves. He shewed, by models formed by the union of two plastic streams, that, in point of fact, such phenomena of united streams may be reproduced, the double structure being very slowly worn out, in consequence of the nearly uniform movement of the middle part of the stream.

Professor Forbes recapitulated the proofs that the glacier moves as a plastic mass, the friction of whose parts is less than their friction upon the surface over which they tend to slide ; and he bases his theory upon three classes of facts, which he considers that he has demonstrated. 1. That the glacier moves like a stream, fastest at the centre. 2. That its velocity is immediately governed by the external temperature and the state of infiltration of the ice by water at the time. 3. That the forms which its veined structure assumes are those due to the movement of a semi-solid mass in the manner supposed.

The following Donations of Books to the Society's Library were announced.

Archives du Museum d'Histoire Naturelle, publiées par les Professeurs-Administrateurs de cet Etablissement. Tome ii. Liv. 3.—*By the Editors.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome xv. Nos. 9-26, et Tome xvi. Nos. 1-7. —*By the Academy.*

Monthly Notices of the Astronomical Society of London. Vol. v. No. 28.—*By the Society.*

Specimen de l'Imprimerie de Bachelier, Rue de Jardinet.—*By M. Bachelier.*

Henry Stephens, Esq was duly elected an Ordinary Fellow of the Society.

Monday, 27th March 1843.

Dr ABERCROMBIE, Vice-President, in the Chair.

The following communications were read:—

1. Observations on the Temperature and Hygrometric state of the Island of Barbadoes. By R. Lawson, Esq., Assistant-Surgeon of H. M. 47th Regiment. Communicated by Henry Marshall, Esq.

This paper contains an account of the Thermometric and Hygrometric observations made at the Barbadoes, from May 1841 to January 1842. The instruments were carefully verified and observed; and, during three months, the temperature was ascertained for 18 hours out of the 24. The author thence deduces the form of the daily curve of temperature for that period.

2. On the Growth and Migration of the Sea-Trout (Salmo Trutta). By Mr John Shaw, Drumlanrig. Communicated by James Wilson, Esq.

The author has here pursued the same course of experimental enquiry regarding the sea-trout, as that formerly followed in relation to the salmon. Having obtained impregnated ova, from a pair of spawning fish, he conveyed these ova to his experimental ponds. This was on 1st November 1839, and the young were excluded from the egg in 75 days. They resembled salmon of the same age, but were somewhat smaller and paler. They took two years to grow about seven inches, and the majority were then converted into smolts. But about one-fourth did not assume the silvery lustre; and this peculiarity, Mr Shaw thinks, distinguishes a like proportion even in the rivers. He then experimented on the smolts in the natural streams, and found, that, after descending to the sea, they returned as *herlings* (*Salmo albus* of Dr Fleming) in July and August, with an addition to their weight of seven or eight ounces. These herlings spawn towards the end of the season of their first ascent; and, after revisiting the sea, they ascend the rivers again in the ensuing months of May and June, with an average weight of 2½ lb. This increase takes place almost entirely in the sea. After spawning for the second time, they descend for the third time to the sea, and make their appearance again in fresh water in the course of the ensuing summer, weighing 4 lbs. They are now in their fifth year, including the two seasons they had passed as fry, anterior to the assumption of the migratory dress and instinct. Descending seawards for the fourth time, they weigh about 6 lbs., when next seen in the rivers, in the course of their sixth summer. These at least were the progressive changes and ratio of increase observed by Mr Shaw, in specimens distinctively marked, and carefully noted, when retaken in the river Nith successively from year to year. The peculiar marks imposed each season are detailed in his paper, and the whole subject is illustrated by an extensive series of specimens, from the day of hatching, to the middle of the sixth year. These specimens are now in the Society's Museum.

3. Experiments with Hydro- and Thermo-Electric Currents; and an Examination of Metals long exposed to Thermo-Electric Currents. By R. Adie, Esq. Communicated by Dr Traill.

The author commences his paper with a description of two forms of Electric Batteries, which he used in his experiments, and which consisted of bars of antimony and bismuth. One of these, which was chiefly intended for currents excited by solar and astral influences, was so delicate as to make the needle of the galvanometer deflect at right angles, when one end of the battery was exposed to the influence of clear summer's sun; and he therefore considers it a very delicate meteorological instrument. The other form of battery was principally used for thermo-electric currents, from a low flame of gas, or a spirit-lamp.

With the former instrument he succeeded in decomposing cyanide of silver, by exposure to the air for three months in winter, even although the voltameter, in connection with the battery, was often exposed to frost.

In using the second form of instrument, he remarked, that water is decomposed by copper poles, but not by poles of platinum,—a fact, which appears to him to account for Professor Daniell not having been able to produce electrolysis by primary thermo-currents. He farther observed, that metallic salts yield readily to a thermo-current, when the poles consist of the metal whose oxide forms the base of the salt.

On examining the effect of long-continued electrolysis on the metals constituting the battery, he found that no appreciable change was caused in the antimony by a current maintained for four months, and strong enough to cause, in 164 days, the deposition of a quantity of copper in the voltameter, equal to the weight of the battery. But the junctures of the bismuth and antimony, which were soldered by pure bismuth, presented an important change, even in thirty or forty days,—the bismuth soldering having undergone a species of disintegration, so that the antimonial bar was easily separated, and the surface of the bismuth lost its crystalline appearance, and might be rubbed off in the form of a fine powder. The author proved, that this change could not be the effect merely of the heat to which the metals were exposed, but is truly an electric phenomenon. Changes were also found to be effected, by long-continued electric currents, in the specific gravity of the metals. Antimony had its density raised, after exposure for twenty-two days to a thermo-electric current, from 6.645 to 6.670; and the density of bismuth was diminished from 9.853 to 9.838.

In pursuing his experiments with hydro-currents, he found, that the elimination of hydrogen from a copper wire soon comes to an end under the influence of pressure caused by the accumulation of gas in a hermetically sealed space around the wire, while the deposition of copper goes on. By hydro-currents, aided by pressure, he obtained leaf-like deposits of metal, in solutions of common salt, with poles of copper, tin, silver, and zinc, and pulverulent deposits with gold, mercury, antimony, cobalt, platinum, and arsenic. But when iron, bismuth, cadmium, and nickel were used, no deposition took place,—the hydrogen continuing to be disengaged, till the voltameter burst.

To these investigations the author added some experiments on the effects of quick and slow cooling, in altering the densities of metals. He found, that antimony loses in density by sudden cooling; that this metal, and also bismuth, do not gain in density by slow cooling; that by this process the density of lead, tin, and zinc is increased; that copper and silver are densest when allowed to cool slowly; that iron undergoes no change by slow cooling, unless first heated very strongly, in which case its density is diminished; and that steel loses in density by the process of hardening, but does not lose by repeated heating.

Lastly, in conformity with the experiments of Bequerel, on the developement of electric currents, by sudden alterations in the density of metals, the author found, that, when the density of gold, platinum, cadmium, silver, and iron, was increased, by passing them through the drawing-plate, a deflection of from one to four degrees was occasioned in the galvanometer: but with lead and tin no perceptible deflection was occasioned.

The following Donations of Books to the Society's Library were announced.

Bulletin des Séances de la Société Vaudoise des Sciences Naturelles. Nos. 1 & 4.—*By the Society.*

Essai Historique sur les Phénomènes et les Doctrines de l'Electro-Chimie. Par Elie Francois Wartmann.—*By the Author.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome XVI. Nos. 8 & 9.—*By the Society.*

On the Transparency of the Atmosphere and the Law of Extinction of the Solar Rays in passing through it. By James D. Forbes, F.R.S. &c.—*By the Author.*

The following Donations to the Museum were presented—

Specimens of the Hyperstene Rocks of the Cullin Hills, and of the Limestone and Dykes traversing the Cullen Hills at Kilbride, Isle of Skye. Collected by G. Bellas Greenough, Esq.—*Presented by Lord Greenock.*

Specimens of the Calcareous Formation of the Bermudas and Bahama Islands. Collected by Lieut.-Colonel Emmett, R.E.—*Presented by Lord Greenock.*

Monday, 3d April 1843.

Sir T. MAKDOUGALL BRISBANE, Bart., President, in the Chair.

The following communications were read:—

1. Chemical Observations on the Flowers of the Camellia Japonica, Magnolia Grandiflora, and Chrysanthemum Leucanthemum, and on three Proximate Principles which they contain.—*Conclusion.* By Dr Hope.

The author first called the attention of the meeting to the principal facts which he had established in the two memoirs read to the Society in the year 1836. 1*st*, Of these the most important are, that when acids cause a red colour, and alkalis a green or yellow, in a blue vegetable infusion, they act on different substances;—the acids on erythrogen, and the alkalis on xanthogen. *2dly*, That the compound of alkalis and xanthogen is of a yellow colour, and that when a blue infusion is changed to green, it is owing to the gradual intermixture of the newly generated yellow with the original blue.

Camellia Japonica.—The blossoms of the beautiful double white Camellia Japonica are remarkable for the peculiar matters which they contain, two of which appear to be distinct vegetable principles. When a parcel of the petals is infused in boiling-hot water, and digested for some time, a nearly colourless infusion is obtained, which is not visibly affected by acids. When solution of potash is added, a light orange colour appears, which gradually deepens, till in a few hours it acquires a very deep orange hue. Solution of ammonia causes a similar effect. When lime-water is employed, it produces turbidity in the infusion, and a pinkish red colour. This colour gradually assumes a richer tint, and in about 24 hours exhibits a deep pinkish red. The author has applied the same alkalescent agents to above 150 flowers, both white and coloured, without observing any similar effect.

To this colourable matter he gives the name of Camelline. The author tried the effects of various reagents, but no interesting facts resulted.

When any portion of the flower-leaf is bruised, whether remaining on the parent plant or removed from it, it immediately begins to assume a rusty or ochry tint, which grows deeper and deeper, till it arrives at the tint of perfect ochre.

By various experiments, it was proved that this change of colour depends upon the action of the oxygen of the air. It takes place in a very remarkable degree in oxygen gas, and does not take place at all when the contact of air is excluded by an immersion in mercury, in hydrogen, or carbonic acid gas. To this brown-growing matter, viewing it as a distinct vegetable principle, Dr Hope gave the name of Magnoline, in consequence of its occurring in a very remarkable degree in the Magnolia grandiflora and Magnolia conspicua. A third remarkable circumstance respecting the Camellia petals, is, that they contain a notable quantity of iron. This was little to be expected, seeing that iron is so common a source of colour, and the blossom is entirely colourless. The author was led to search for this metal in consequence of the strong resemblance which the colour which protoxide and protocarbonate of iron acquire by the absorption of oxygen from the air, and the colour acquired by the bruised petals of the Camellia bear to each other. Dr Hope is satisfied that the ochry tints of the Camellia are in no way dependent on, or connected with, the iron which it contains.

Magnolia Grandiflora. — When the petals of the *Magnolia Grandiflora* are boiled for some time in distilled water, a liquor of a very light yellowish brown is obtained. This colour is banished by sulphuric acid. Solution of potassa immediately causes a deep gall-stone yellow, shewing that this, like other white flowers, contains no erythrogen, but abounds in xanthogen. That matter, which becomes of an ochry hue by the contact of air, is very abundant in the Magnolia, so that, if the cuticle be scraped off, in less than a minute the place of abrasion exhibits the ochry tint. The petals of the snow-white *Magnolia conspicua* exhibit the same phenomena in a still more remarkable degree. If a petal of this beautiful flower be bruised between the fingers and thumb it immediately becomes of a very deep brown, and ere long almost black. Some other white flowers, by being crushed and exposed to the air, also acquire the ochry tint, but in a much inferior degree to those already mentioned. The ochry-growing matter is not confined to white flowers. It exists in different species of the blue flowers of the Aconitum, particularly the napellus.

The third flower of which Dr Hope gave an account, was the *Chrysanthemum leucanthemum*, the ox-eye daisy. A strong decoction of the white petals exhibits a light brown colour, which potash quickly converts into the usual gallstone yellow. When sulphuric acid is dropped into this decoction, the colour becomes a light primrose yellow, and the liquid immediately assumes a gelatinous state. This jelly gradually becomes more consistent, and, in about a quarter of an hour, it is so firm that the capsule containing it may be inverted without the jelly falling out. The matter thus gelatinized by sulphuric acid is peculiar to this plant. The author has applied sulphuric acid to the infusion of at least 150 flowers, without any similar result taking place. The author conceives that the gelatinising matter is a distinct vegetable principle, to which he gave the name of Leucanthemine. To support this view, he drew a comparison between it and the coagulable matters both of the animal and vegetable kingdoms, viz. animal albumen, casein, fibrin, and vegetable albumen. In drawing this comparison, the author described some remarkable properties of these albuminous matters, which have escaped the observation of all the investigators of the chemistry of organic substances, and some of which he had been in the habit of exhibiting in his lectures for nearly half a century. These are, principally, that sulphuric acid dissolves the albuminous matters in the cold, and yields a nearly colourless solution, without altering the nature of the albumen. But if the liquor be heated to 160°, it acquires an extremely beautiful rich crimson hue, during which change the nature of the albumen is totally altered. Muriatic acid acts upon albuminous matter nearly in the same manner; but the colour which the solution acquires by being heated is a very rich purple. The jelly from the Leucanthemum affords no crimson colour with sulphuric acid. After pointing out other circumstances of difference, the author gave his opinion that the Leucanthemine ought to be considered as a distinct substance *sui generis*, another vegetable principle; and concluded with expressing his hope that the Camellia, Magnolia, and Chrysanthemum furnish three to the long list of vegetable proximate principles.

2. On certain Negative Actions of Light. By Professor Moser of Kœnigsberg. In a Letter to Sir David Brewster.

"There are certain actions of light which may be called *negative actions*. By this name I mean to indicate a series of *new actions*, without pretending to enter into any theoretical considerations. In acting upon an iodised plate, common light produces successively different states, which are made manifest by exposing the plate, when taken out of the camera, to the vapours of mercury. If the plate has remained in the camera but a short time, we shall see only the first traces of an image. The parts most strongly affected by the light condense the mercurial vapour only in small quantities. If the light acts during a longer time, the image will appear with more details and more distinctly, the mercurial vapours being condensed more abundantly. By increasing the time of action, the image gains in details, but the parts which have been affected with a strong light condense the mercurial vapours in smaller quantities. The images that exhibit many details have usually at the same time a grey aspect, arising from the mercurial vapours having already begun to blacken the iodised silver. If the plate remains still longer in the camera, it does not present any visible image; but when exposed to the mercurial vapours, there is produced an image wholly *negative*. The parts which have been too long acted upon by an intense light condense little vapour, and hence become completely *black*, while the parts which were in shadow condense much vapour, and appear *white*. Hence arises the peculiar aspect of the image. When this period of action is exceeded, the plate comes out of the camera with a visible image, which the vapours of mercury scarcely affect. This species of images is well known to experimentalists, and they have not hitherto been applied to any useful purpose.

" Now, when any one of the above *states* of the image has taken place, we may always, and easily, cause the image to retrograde on the plate, and arrest it at any anterior state we please. For example, I leave the iodised plate 300 minutes and more in the camera, whereas 10 minutes are sufficient to produce an ordinary Daguerreotype picture. When this plate is withdrawn from the camera, it presents a distinct negative image. I then expose the plate during 22 seconds to the vapours of *iodine*, and then to those of *mercury*, and the result of this is the production of a splendid Daguerreotype picture. The vapour of the iodine has, therefore, caused the action of the light to *retrograde*. I have repeated and varied these experiments in every way, and always with the same success, taking care not to allow the vapours of iodine to act too long, otherwise they would completely destroy the action of the light.

" There are many other bodies which, in their gaseous state, produce the same negative actions, when applied to an iodised plate, such as *chlorine*, *bromine*, the *hydro-fluoric acid*, &c. &c.; but I shal not enlarge on this point, because I have to mention to you a gas much more interesting, viz. *oxygen*, which exercises the same negative action.

" Having left the iodised plate from *four* to *six* times the period necessary for an ordinary picture in the camera, and exposed it to *pure oxygen* during a few seconds, the mercurial vapours produce the ordinary image. The oxygen in atmospheric air acts also upon the plate, and requires only that the action be prolonged. If we expose a plate with an image that would become *negative* by mercurial vapour, during *one* or *two* minutes, to a current of air from a pair of bellows that would raise a column of water *four* or *five* inches high, the image will be presently brought back to its ordinary state; or if the blast is continued longer, to any other anterior state, the primordial state not excepted. Atmospheric air, indeed, quite calm, exercises also these negative actions, provided its action is continued for some hours.

" I may also add, that among the gases which compose atmospheric air, oxygen alone produces these negative effects. Nitrogen, carbonic acid, and the vapour of water, do not produce them; the latter, however, produces the effects which I have described in my Memoir on the Latent State of Light. These negative actions are never produced by any of the rays of solar light.

"It appears to me that these new facts, of which I have communicated to you the most remarkable, lead to important results. It naturally follows from them, that the oxygen of the atmosphere will retard the action of light, and tend to preserve the surfaces of bodies in their primordial condition. I have, without success, endeavoured to make a direct experiment on this subject. I placed a camera-obscura under the receiver of an air-pump, and exhausted the air; the time, however, for producing any particular effect of light did not change; but the air-pump was so imperfect, that it did not produce a rarefaction beyond five or six inches of the barometer. In the mean time, however, I may adduce some of my experiments communicated seven months ago to the Academy of Sciences at Berlin, which prove, at least indirectly, what the air-pump has not yet verified. If we wet an iodised plate of silver with *any fat oil*, we shall find that the time in which light produces any particular effect is greatly diminished. In applying, for example, *oil of olives*, the plate will be four or five times more sensitive; so that, instead of four or five minutes, *one* minute only will be necessary to produce the same effect in the camera. The mercurial vapour readily penetrates the thin film of oil, and produces very perfect images. This singular action of oils arises probably from their obstructing, or, at least, enfeebling, the negative action of oxygen gas. The mercurial vapours produce even a better developed image, that is to say, one which corresponds to a more prolonged action of light, if we apply the oil only at the instant the plate is taken out of the camera.

"I believe that these negative actions, which bring back the surfaces of bodies to their natural state, will throw some light upon the process of vision, because the same effects seem to take place upon the retina. But I greatly regret that I am not able to enter into any details on this interesting subject, as I am wholly occupied with other researches, particularly on a very remarkable and different kind of action exerted by *hydrogen gas*."

3. On the Specific Gravity of certain Substances commonly considered lighter than Water. By Dr Davy.

The author enters on the subject by adverting to the apparent lightness imparted to the common woods, and to certain vesicular minerals, by the entanglement of air in their substance, as is commonly understood, and as is proved by the action of the air-pump.

The specific gravity of oak-wood, after having been kept under the exhausted receiver till it sunk in water, and ceased to give off air, he found to be (inclusive of hygrometric moisture) 1.58 ; that of deal, 1.18, or when crushed about 1.5 ; that of the pith of the elder, 1.45 ; and that of pumice, 1.94, or crushed, 2.41, which is nearly the same as that of obsidian, from which pumice appears to be formed by the action of volcanic fire.

Reasoning analogically, the question naturally occurred, are there not other substances, commonly considered lighter than water, which are so only in appearance, owing, it may be, to air adhering to their surface, or included in them, such as cork, caoutchouc, camphor, wax, spermaceti, cholesterine, stearine ?

Cork, he finds, continues to float on water, after having been kept under the exhausted receiver nearly two months. This he attributes to the elasticity of the plates constituting its cells, confining a very minute quantity of air, that cannot be extracted by the pump. When the cells are broken, it sinks in water. From indirect experiments, he infers its specific gravity to be about 1.6, or nearly the same as that of lignin.

In common caoutchouc, he detected the presence of air by the microscope, which, owing to the peculiar quality of this substance, could not be separated either by the air-pump, or by compression, or by boiling. Dissolved in ether, and precipitated by alcohol, he found it apparently of specific gravity .97 ; allowing for circumstances interfering with accuracy of result, he conjectures that the specific gravity of caoutchouc is about the same as that of water.

The specific gravity of camphor, he concludes from his experiments, to exceed a very little that of water, viz. as 1.005 to 1.000 ; that of bees' wax, and also that of spermaceti and of stearine, to be about the same as that of water at the temperature 50°, though considerably lighter at the boiling temperature of water ; and that of cholesterine to be a little higher, viz. 1.0102.

In conclusion, he expresses the opinion, that attention to the specific gravities of the substances under consideration, may be useful in conducting chemical analyses of compound bodies in which they may be contained ; that a consideration of the cause of their apparent lightness, viz. included or adhering air, may help to explain some rather obscure phenomena,—as the raising of cream, &c. ; and that attention may be deserving of being paid to the same cause, as exemplified in the substances treated of, whenever, in works of art, unusual lightness or buoyancy is a desideratum.

The following Donations to the Society's Library were announced.

Scheikundige Onderzoekingen, gedaan in het Laboratorium der Utrechtsche Hoogeschool. St. 5.—*By the Author.*

Natuurkundige Verhandelingen van de Hollandsche Maatschappij der Wettenschappen te Haarlem. Deel. 2.—*By the Society.*

The following Donations to the Museum were presented—

Series of Specimens of the different Rock Formations. (150 specimens.)—*Presented by Lord Greenock.*

Specimens connected with Mr Shaw's paper on the Development and Growth of the Sea-Trout of the Solway.—*Presented by Mr John Shaw.*

Monday, 17*th April* 1843.

The Right Honourable Lord GREENOCK, Vice-President, in the Chair.

The following Communications were read :—

1. On the presence of Organic Matter in the purest Waters from Terrestrial Sources. By Professor Connell.

It must be well known to chemists, that when solution of acetate of lead is added to the transparent and colourless water of springs, wells, and rivers, a more or less dense white cloud is almost invariably produced. This reaction has been usually attributed to the presence of inorganic salts, such as carbonates, sulphates, and muriates ; but it will be found that, generally speaking, this precipitate is formed even after the water has been boiled ; that it is usually dissolved by the speedy addition of a drop or two either of acetic or of nitric acid, without visible effervescence ; and that the agency of the water with nitrate of silver is commonly too small to admit of its being caused by any muriate. These facts exclude the idea that it is due in the general case to carbonates, sulphates, phosphates, or muriates ; although, of course, in those particular cases where the water has enough of such constituents to affect acetate of lead, the reactions will be modified accordingly. Thus, in some cases, where the first action is as above stated, a deposition takes place after a certain interval of sulphate of lead, no longer soluble in weak acids.

It occurred to the author that the true cause of the reaction was to be found in the presence of organic matter in the water, derived from the decomposition of vegetable matter in the strata or soil through which it had passed. To ascertain whether this view was correct, the precipitate by acetate of lead from several quarts of the town water of St Andrews was decomposed by sulphuretted hydrogen. After filtration, a liquid was obtained, which, besides sulphuric acid derived from precipitated sulphate of lead, was found to contain some organic matter apparently of an azotised nature; but its amount was too small to characterise its properties with accuracy. The salt obtained by saturating the liquid with potash, yielded by distillation empyreumatic vapour, and left a black coaly mass behind. The liquid itself, when neutralized and sufficiently diluted, had still a marked action on lead salts; and it or its potash salt produced more or less precipitate after the interval of a day or two, in acetate of copper and neutralized persulphate of iron.

The author has found this matter in the town waters of Edinburgh and Glasgow, but to a less extent than in that of St Andrews. The Glasgow water shewed the least of the three. He has also found it more or less in every instance he has hitherto tried of transparent and colourless well, spring, or river water. In rain water it does not exist, and probably could not be found in springs above the limits of vegetation, or in snow or glacier water. It would seem that it ought to perform functions of some importance in the economy of nature, as contributing in a certain degree to the nourishment of plants and even of animals.

2. Biographical Sketch of the late Sir Charles Bell. By Sir John MacNeill.

This paper is, from its nature, incapable of being here given in an abridged form.

3. Notice regarding the Bebeeru Tree of British Guiana. By Dr A. Douglas Maclagan.

The plant bearing the above Indian name, and also called Sipeeri by the Dutch colonists, furnishes the hard and heavy timber known by the name of Greenheart. The object of the present paper was to state the result of experiments made by the author on the bark and seeds of the tree, which had been found by Mr Rodie, R. N., to contain a vegetable alkali possessed of the power of checking intermittent fevers. Dr Maclagan stated that the tree was unknown to botanists. Sir William Hooker and Dr Lindley had seen the fruit and declared it to be lauraceous, but the author had been unable to find, in Rees v. Esenbeck's *Systema Laurinarum*, any genus or even suborder of lauraceous plants to which he could refer it. With regard to its chemical qualities, Dr M. stated that he had obtained both from the bark and seeds two distinct alkalis, both uncrystallizable, to one of which he applied Mr Rodie's name, Bebeerine; to the other he gave the name of Sipeerine. They could be separated by anhydrous ether, the bebeerine being soluble in that menstruum, whilst the sipeerine was not. Dr M. had likewise obtained, especially from the seeds, a peculiar crystallizable and deliquescent acid, which he called Bebeeric acid, and which seemed to be distinct from every vegetable acid hitherto described.

The author stated that he had instituted experiments with a view to ascertain if a soluble salt of the alkalis could be procured, which might be used as a substitute for sulphate of quinine when dear. He stated, as the result of his trials, that the produce did not amount to more than one and a-half of sulphate per cent. from the bark, but he still calculated that if the bark could be got at a moderate price, the salt of the alkalis might be prepared at a cost inferior to that of sulphate of quinine. Dr Maclagan stated that the bark appeared to be better suited for the purposes of manufacture than the seeds. The author mentioned that sulphate prepared under his directions had been sent out to Demerara, and had been tried there with marked success in intermittent fever by Dr Watt; he had likewise used it with success in a few cases of ague in Edinburgh, and also in periodic headache, so that he had no doubt of its possessing considerable power as an antiperiodic remedy. Lastly, he mentioned that a secret preparation sold under the name of "Warburg's Fever Drops," reputed a good antiperiodic, appeared to him to be a tincture of bebeeru seeds.

W. H. Norie, Esq., was duly elected an Ordinary Fellow of the Society.

The following Donations for the Society's Library were announced.

The Quarterly Journal of Meteorology and Physical Science. Edited by J. W. G. Gutch, M. R. C. S. No. 6. for April 1843.—*By the Editor.*

Proceedings of the London Electrical Society. Part 8.—*By the Society.*

Annual Report of the Council of the Yorkshire Philosophical Society, for 1842.—*By the Society.*

Elements of Agricultural Chemistry. By Sir Humphrey Davy, Bart. (Sixth Edition.)—*By Dr John Davy.*

Proceedings of the Royal Astronomical Society. Vol. V. No. 29. —*By the Society.*

Proceedings of the Royal Society. Nos. 55 & 56.

Revised Instructions for the use of the Magnetic and Meteorological Observatories, and for the Magnetic Surveys. Prepared by the Committee of Physics and Meteorology of the Royal Society.—*By the Royal Society.*

Monday, 1st May 1843.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following Communications were read :—

1. An attempt to explain the Phenomena of the Freezing Cavern at Orenburg. By Dr Hope.

Dr Hope in the first place read, from the Proceedings of the Geological Society in London, the account of the freezing cavern furnished by the President of the Geological Society of London. This is one of several caves which exist in the southern face of a lengthened low hillock of gypsum. It is entered from the south by a passage rather narrow, and is about fifteen feet high, ten paces long, and seven wide, which seemed to send off irregular fissures into the body of the rock.

The extraordinary feature of this cavern is, that during summer it is so cold that ice is generated in it, and dry icicles hang from its roof; and that, in winter, all appearance of congelation ceases, and the temperature becomes such that the Russians say they could sleep in it without their sheep-skins.

Mr Murchison applied to Sir John Herschel for an explanation, and the theory which he proposed is, that the heat and cold of the surface gradually move, though very slowly, backward into the rock ;

that it requires six months for the wave of cold, as he terms it, to reach the cavern, and consequently, that that frigid wave begins to arrive at the commencement of summer, and continues during that season, occasioning such a degree of cold in the cavern as to produce the congelations described by Mr Murchison.

At the commencement of winter, the first effect of the summer's heat arrives, and continues without interruption, and occasions warmth enough to prevent congelation.

Dr Hope entirely concurred with Sir John Herschel in thinking that alternate waves of heat and cold must exist and have a share in producing the phenomena, and in corroboration quoted the observations of Saussure, that at Geneva the winter's cold requires six months to descend 29½ feet, and that the summer's heat penetrates to the same depth in a similar period of time; the maximum of cold taking place at mid-summer, and of heat at mid-winter.

But he also expressed his conviction that these alternate waves were not sufficient to account for the phenomena, further remarking, that were they the only powers employed, the paradoxical phenomena should occur equally in some of the other caverns of the Orenburg hillock, or in other caverns in different quarters of the globe. He observed, that there must be something peculiar to the Illetykaya Zatchita cavern which renders it the only cave in the world which possesses the singular property, so far as he knew. He then alluded to the caverns in different parts of the globe in which accumulations of snow are found in summer, and concurred with Mr Murchison in thinking that they have no analogy with that of Orenburg. They are merely receptacles of the winter snow and ice, and preserve it during summer, after the manner of an ice-house.

The circumstance peculiar to the Orenburg cave is the occurrence of the rents and fissures which rise from the back part of the cavern.

The author stated, that if it were granted that these fissures reach the surface, even by the smallest ramifications, and that they ascend within the reach of the alternate waves of heat and cold, the whole phenomena may be easily and satisfactorily explained. He ascribed the summer's coldness and congelation to a constant current of cold air through the fissures of the rock into the cavern; and he supposed that the current is occasioned in the following manner: When at the close of spring the temperature of the external air and of that in the rents is the same, no particular occurrence takes place; but as soon as the wave of cold begins to make impression on the rocky parietes of the fissures, then the air in them will be somewhat cooled, contracted, and rendered specifically heavier. This being so, the weight of the column of air in these rents will be greater than that of a column of equal altitude of the external atmospheric air, and the consequence will necessarily be, that the colder air will descend, the warmer atmospheric air from above will supply its place, which, in its turn, will be cooled and descend, and thus a current of cold air through the crevices into and through the cavern will be established. As the temperature of the rocky parietes gradually falls with each successive wave of cold, the air in the fissures will become colder and colder, and in the same proportion will descend more rapidly.

But the rapidity of descent does not only depend upon the increasing coldness of the air in the fissures, but is further augmented by the warmth of the summer expanding the external air, so that the difference of weight between the external and internal columns becomes greater. In the manner now explained, a current of cold air is constantly descending and flowing through the cavern, producing all the surprising frigorific effects displayed within it.

That such a current does exist, Mr Murchison gives a satisfactory proof; he says, "That upon unlocking the frail door of the cavern, a volume of air, so surpassingly keen, struck the legs and the feet, that he was glad to rush into a cold bath in front of him to equalize the effect." This downward current will continue the same till the close of autumn, when its course comes to be changed; by that time the first approaches of May's surface warmth will begin to be experienced, the cold of the sides of the rents begins to diminish, and the temperature of the external air must have fallen to nearly that of the internal current. As soon as an equality between the temperatures and densities of the external and internal columns shall have been established, all current must cease. At this period, namely, the commencement of winter, the wave of the summer's heat begins to reach both the walls of the air-channels and of the cavern, and gradually communicates a warmth which progressively elevates the temperature, and dissipates every mark of the preceding summer's congelation. It might at first be reasonably expected, that at this time the preceding order of things would be reversed, and that a current in the opposite direction would commence, such as, it is known, happens in many mines; for, undoubtedly, the temperature of the atmosphere descending rapidly, the gravity of the external air would soon exceed that of the internal column. A current would immediately commence from below, and, entering from the cavern door and ascending through the rents, escape at the surface. The consequence of such a current would be, that the cold would soon reappear in the cave, and gradually increase during the severity of the winter, and completely overpower the heating influence of the thermal wave, now beginning to operate on the walls of the cavern, and so prevent the warmth of the cave during winter.

An occurrence, however, now takes place which puts a stop to the upward draught, and permits the thermal wave to have its full influence on the temperature of the cavern. The winter commences with repeated falls of snow, which form a thick covering on the surface of the earth, and closes up all the communications between the extremities of the crevices and the external air, and no current can take place. In this manner the influx of the intensely cold air into the cavern, and its ascent through the fissures, is prevented, and then full play is given to the calorific power of the wave of heat which continues to arrive in the cavern through its rocky sides during the whole continuance of winter, and communicates the warmth recorded by Mr Murchison. In the beginning of summer the snows melt, and the terminations and ramifications of the fissures have their communication with the atmosphere restored. The currents, as already described, are re-established, and all the paradoxical phenomena to which they give birth present themselves in due succession.

2. Observations on the Temperature of the Earth in India. By John Caldecott, Esq. Communicated in a Letter to Professor Forbes.

These thermometers, made by Mr Adie of Edinburgh, were sunk in the ground at Trevandrum, in lat. 8° 30′ 35″, to depths of 3, 6, and 12 *French* feet. Mr Caldecott says,—" I send you herewith the readings of my long thermometers, which, from various causes, I was not able to put into the ground until the 1st of last May (1842). These two months' readings, therefore, will not, of course, have the proper temperature at the respective depths, especially as it has been raining more or less nearly ever since. Still, I think they will surprise you, as being (so far as they go) entirely opposed to Kupffer's opinion, that the superficial temperature of the earth within the tropics is *below* that of the air, and to Boussingault's assertion, as to the invariability of the temperature *one foot* below the surface. The soil in which the thermometers are buried, is one which very soon becomes compact again, after having been disturbed, so that I do not think the rain can much affect the thermometers *now* * * * * . The situation is on the top of the Observatory hill; the soil, the stone called Laterite."

A subsequent letter contains the readings for four entire months, and confirms the important conclusions mentioned above. The mean annual temperature of the air at Trevandrum is 79°.24 F.

1842.	12 Feet.	6 Feet.	3 Feet.	Air.
May	84.672	85.157	83.820	80.09
June	...	84.562	82.062	79.32
July	84.805	83.627	81.025	78.73
August	84.240	82.800	80.220	77.90

The surface of the ground was grass-grown, and the thermometer stems quite exposed.

3. Researches in Hydrodynamics. Second Memoir. On Waves. By J. Scott Russell, Esq., M.A., F.R.S.Ed., &c.

The object proposed by the author of this paper, was to present, in a complete form, the results of investigations into the phenomena of Waves, in which he had been engaged for several years. A part of the experiments referred to in the paper, had been carried on by Sir John Robison, conjointly with the author of this paper, as a Committee of the British Association. The others were new, and had been carried on by himself, for the purpose of completing and giving that systematic form to our knowledge of the subject, which was attempted in this paper.

The author finds that there may exist in agitated water waves different in kind, generated by different causes, propagated by different laws, and exhibiting different phenomena. These had not hitherto been sufficiently distinguished, and some of them were scarcely known. The following table exhibits the classification resulting from these investigations :—

Waves are of four Orders.

	ORDER I. The Wave of Translation.	ORDER II. Oscillating Waves.	ORDER III. Capillary Waves.	ORDER IV. Corpuscular Waves.
CHARACTERS.	Solitary.	Gregarious.	Gregarious.	Solitary.
SPECIES.	Positive. Negative.	Stationary. Progressive.	Stationary. Progressive.	
VARIETIES.	Free. Forced.	Free. Forced.	Free. Forced.	
INSTANCES.	The Primary Wave of Resistance. The Tide-Wave.	The Secondary Wave of Resistance. River Ripple. Wind Waves.	Dentate Waves. Zephyral Waves.	Wave of Sound through Water.

The rest of the paper consisted of the examination of the properties, and an explanation of the phenomena, of these four orders of waves.

The following Books, presented to the Library of the Royal Society of Edinburgh, were laid on the table—

Transactions of the Geological Society. (Second Series.) Vol. VI. Part 2.—*By the Society.*

Archives du Muséum d'Histoire Naturelle, publiées par les Professeurs-Administrateurs de cet Etablissement. Tome iii. Livr[ns] 1, 2.—*By the Editors.*

The following Donations to the Museum were announced—

A Head of Boodhoo in Dolomite from Ceylon.—*By Dr Davy.*

Specimens of Coal from Penteraclea, the Ancient Heraclea, on the Black Sea.—*By the Same.*

Specimen of "Burn Trout." *Salmo Fario*, taken from the Compensation Pond, weighing 6 lb.—*By James Miller, Esq.*

A Specimen of Chalcedony, from Iceland.—*By Sir G. S. Mackenzie.*

Six Specimens shewing the Action of Glaciers on Rocks:—

1. Limestone taken from under the Ice of the Glacier of La Brenva in Piedemont, in July 1842.
2. 3. 4. Specimens of Granite from the Grimsel, supposed to shew Glacier Polish.
5. 6. Specimens of Limestone from the Jura, shewing (supposed) Glacier Polish.—*By Professor Forbes.*

Specimens of Fossil Fish, from the Old Red Sandstone of Morayshire, named by M. Agassiz.—*By Prof. Forbes.*

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1844. No. 23.

Monday, 4th December 1843.

Sir THOMAS BRISBANE, President, in the Chair.

The following communication was read :—

On the Influence of various Circumstances in Vegetation upon the activity of Plants. Part II. The Umbelliferous Narcotics. By Dr Christison.

In the First Part of this inquiry, the author gave an account, in 1840, of some observations made by him, as to the influence of season on the activity of the acrid plants of the natural family *Ranunculaceæ*, and of the narcotics belonging to the family *Drupaceæ*.* In the Second Part now laid before the Society, he proceeded to relate a series of experiments instituted by him with the view of determining the influence of season on the activity of the poisonous narcotic plants of the family *Umbelliferæ*.

The plants belonging to this family are for the most part aromatic and stimulant, and destitute of poisonous properties. In four species only have narcotic properties been unequivocally recognised, viz., *Conium maculatum*, *Œnanthe crocata*, *Cicuta virosa*, and *Æthusa Cynapium* ; but these are universally held to be highly energetic.

1. *Conium maculatum*, Common Hemlock.—No accurate information is yet possessed as to the influence of season on the activity of this species ; for all investigations on the subject are vitiated by the uncertain strength of its preparations, and the ignorance which prevailed till very lately as to the conditions required for securing

* See the Society's Proceedings, 1840–41.

their uniformity. The author has found by experiment, as Professor Geiger had already been led to conclude, that every part of the plant is poisonous, both the root, the leaves, and the fruit; and that the root is least active, the leaves much more so, but the fruit the most active of all. The root is commonly held to be most active in midsummer, when the plant is in full vegetation and coming into flower; but this belief is founded only on a single, and not altogether conclusive, experiment made by Professor Orfila. The author found this part of the plant to be so feeble at all times, that its respective energy at different seasons could not be satisfactorily settled. The expressed juice of twelve ounces of roots had no appreciable effect on a small dog in the end of October or towards the close of June; but an alcoholic extract of six ounces in the beginning of May killed a rabbit in thirty-seven minutes, when introduced into the cellular tissue. The leaves are commonly thought to be most energetic when the plant is coming into flower in midsummer, and to be very feeble while it is young. The author finds it to be probable, that the leaves are very active in midsummer; but he has likewise observed, that they are eminently energetic in the young plant, both in the beginning of November, and in the month of March before vegetation starts on the approach of genial weather. Thirty-three grains of a carefully prepared alcoholic extract, representing one ounce and a third of fresh leaves, killed a rabbit in nine minutes, when introduced into the cellular tissue. The fruit is most active when it is full grown, but still green and juicy. It then yields much more of the active principle conia than afterwards when it is ripe and dry. The author added, as a fact contrary to general belief, that he had found the ripe seeds of hemlock, and an alcoholic extract of the leaves, to sustain no diminution in energy by keeping, at all events for eight years.

2. *Œnanthe crocata*, Dead-tongue.—This species is universally considered to be the most deadly of all the narcotic *Umbelliferæ*. Many instances of fatal poisoning with its roots have been published during the last two centuries, in the various periodicals of Europe. It has repeatedly proved fatal in two hours; and a portion no bigger than a walnut has been thought adequate to occasion death. Fatal accidents have occurred from it in England, France, Holland, Spain, and Corsica. The root would seem from these cases to be the most active part; but few observations are on record as to the effects of the leaves, and none as to the fruit. The root appears from these cases to be very active in all seasons, at least in the beginning of

January, the end of March, the middle of April, the middle of June, and the middle of August.

The author proceeded to inquire carefully into the effects of season upon this species as it grows wild in the neighbourhood of Edinburgh, but was surprised to find that every part of the plant in this locality is destitute of narcotic properties at all seasons. The juice of a whole pound of the tubers, the part which has proved so deadly elsewhere, had no effect when secured in the stomach of a small dog, either in the end of October when the tubers are plump and perfect, but the plant not above ground, or in the month of June when it was coming into flower; and an alcoholic extract of the leaves, and that prepared from the ripe fruit, had no effect whatever when introduced into the cellular tissue of a rabbit, under the same conditions in which the Common Hemlock acts so energetically. By a comparative experiment he ascertained that tubers, collected near Liverpool, where one of the accidents alluded to above happened in 1782, act with considerable violence on the dog; and he briefly noticed some experiments, made at his request by Dr Pereira, with the Œnanthe of Woolwich, shewing that there also it is a powerful poison to the lower animals. Climate seemed to the author to furnish the only adequate explanation of these extraordinary differences; yet the plant grows in all parts of Scotland with great luxuriance.

3. *Cicuta virosa*, Water-hemlock.—This species has been also held to be a deadly poison ever since an express treatise on its effects was published by Wepfer in 1716; and repeated instances of its fatal action have been observed since, and some of these very recently, in Germany. The root is the only part which has given occasion to accidents; it has proved fatal in two hours and a half. Nevertheless, this plant too seems innocuous in Scotland, or nearly so, although, like the last species, it grows with great luxuriance. The juice of a pound of the roots collected in the end of July, while the plant was in full flower, produced no narcotic symptoms; and the only effects observed, namely, efforts to vomit, might have arisen from the operation which is necessary to secure the juice in the stomach. An alcoholic extract of the leaves collected at the same time, and a similar preparation made with two ounces of the full-grown seeds, while still green and juicy, had no effect whatever when introduced into the cellular tissue of a rabbit, except that inflammation was excited where the extract was applied.

4. The author has not yet had an opportunity of trying the effects of the fourth species, *Æthusa Cynapium*, or Fool's-parsley.

The following Donations to the Society's Library were announced :—

Journal of the Asiatic Society of Bengal. Nos. 126, 127, 128, 129, 130, and 131.—*By the Society.*

The American Journal of Science and Arts. Conducted by Professor Silliman. Vol. xliv., No. 2; and vol. xlv., Nos. 1 and 2.—*By the Editor.*

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. i., Nos. 20, 21, 22, 23, 24, 25.—*By the Academy.*

Proceedings of the Royal Astronomical Society. Vol. v. Nos. 30, 31, and 32.—*By the Society.*

Het Instituut of Verslagen en Mededeelingen, uitgegeven door de vier classen van het koninklijk Nederlandsche Instituut van Wetenschappen, Letterkunde en Schoone Kunsten, over den Jare 1841. Nos. 1, 2, 3, 4; and 1842, Nos. 1, 2, and 3.—*By the Institute.*

Journal of the Royal Geographical Society of London. Vol. xii. Part 2.—*By the Society.*

Historia e Memorias da Academia Real das Sciencias de Lisboa. Tomo xii. Part 2.—*By the Academy.*

Discurso lido em 22 de Janeiro de 1843 na Sessão publica da Academia Real das Sciencias de Lisboa por Joaquim José da Costa de Macedo.—*By the Academy.*

Astronomische Nachrichten. Nos. 462–477.—*By Professor Schumacher.*

Scheikundige Onderzoekingen gedaan in het Laboratorium der Utrechtsche Hoogeschool. Deel 2. St. 1.—*By the Editors.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. Van Der Hoeven M.D. en W. H. De Vriese M.D. Deel x. St. 1.—*By the Editors.*

Flora Batava. Nos. 127 and 128.—*By the King of Holland.*

Proceedings of the American Philosophical Society. Vol. ii. Nos. 24 and 25.

Transactions of the American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge. Vol. viii. Parts 2 and 3.—*By the Society.*

Address to the Anniversary Meeting of the Royal Geographical Society, 22d May 1843.—*By the Society.*

Reports on the Fishes, Reptiles, and Birds of Massachusetts.—*By the Bowditch Family.*

Annales des Sciences Physiques et Naturelles, d'Agriculture et d'Industrie, publiées par la Société Royale d'Agriculture, &c., de Lyon. Tomes i. ii. iii. et iv.—*By the Society.*

Applications of the Electric Fluid to the Useful Arts, by Mr Alexander Bain; with a Vindication of his claim to be the first Inventor of the Electro-Magnetic Printing Telegraph. By John Finlaison, Esq.—*By the Society.*

The Journal of Agriculture, and the Transactions of the Highland and Agricultural Society of Scotland. July and October 1843. —*By the Society.*

Proceedings of the Zoological Society of London. Nos. 108 to 119. —*By the Society.*

Magnetische und Meteorologische Beobachtungen zu Prag. Dritter Jahrgang. Von Karl Kreil.—*By the Author.*

Journal of the Statistical Society of London. Vol. vi. Part 3.—*By the Society.*

The Transactions of the Microscopical Society of London. Vol. i. Part 1.—*By the Society.*

The Electrical Magazine, conducted by Mr Charles V. Walker. Vol. i., Nos. 1, 2.—*By the Editor.*

Proceedings of the Geological Society of London. Nos. 92–3.—*By the Society.*

Archives du Muséum d'Histoire Naturelle publiées par les Professeurs-Administrateurs de cet Etablissement. Tome ii. Livr. 3.—*By the Editors.*

Astronomical Observations made at the Royal Observatory, Edinburgh. By Thomas Henderson, F.R.S.S.L. & E., Professor of Practical Astronomy in the University of Edinburgh. For the year 1839.—*By the Royal Society, London.*

Memoirs of the Chemical Society of London. Vol. i.—*By the Society.*

Annuaire de l'Observatoire Royal de Bruxelles pour 1843, par A. Quetelet, Directeur de cet Etablissement.—*By the Author.*

Observations des Phénomènes Périodiques. Par Monsieur Quetelet. —*By the Author.*

Annuaire de l'Académie Royale des Sciences et Belles Lettres de Bruxelles pour 1843.

Nouveaux Mémoires de l'Académie Royale des Sciences et Belles Lettres de Bruxelles. Tome xvi.

Mémoires Couronnés et Mémoires des Savants Étrangers, publiés par l'Académie Royales des Sciences et Belles Lettres de Bruxelles. Tome xv., P^tie 2.

Bulletin des Séances de l'Académie Royale de Bruxelles. Tome ix., Nos. 10, 11, 12; and Tome x., Nos. 1, 2, 3, 4, 5, 6, 7.—*By the Academy.*

Journal of the Bombay Branch Royal Asiatic Society. Nos. 3, 4. January and April 1842.—*By the Society.*

Notizie relative a tre specie d'Insetti Nocivi all' Ulivo, dal Dr Passerini.

Osservazioni sulle Larve, Ninfe, e Abitudini della Scolia flavifrons, dal Dr C. Passerini.

Notizie sulla moltiplicazione dell' uccello Americano Paroaria cucullata, dal Dr Passerini.—*By the Author.*

Mémoires de la Société Géologique de France. Tome v. P^ties 1, 2.—*By the Society.*

Carte Géologique du Departement de l'Aisne, exécutée et publiée sous les Auspices de M. Legrand, Sous-Secrétaire d'État des Travaux Publics. Editée par la Société Géologique de France, 1842.—*By the Society.*

Niewe Verhandelingen der Eerste Klasse van het Koninklijk-Nederlandsche Instituut van Wetenschappen, Letterkunde en Schoone Kunsten te Amsterdam. Deel viii. St. 1, 2. Deel ix. St. 1.—*By the Institut.*

Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin 1841.—Thiels 1, 2, 3.

Bericht über die zur Bekanntmachung geeigneten Verdhandlungen der Konigl. Preuss. Akademie der Wissenschaften zu Berlin. Juli 1842, bis Mai 1843.—*By the Academy.*

Memoirs of the Royal Astronomical Society. Vol. xii.—*By the Society.*

Astronomical Observations made at the Royal Observatory, Greenwich, in the year 1841; under the direction of George Biddell Airy, Esq.—*By the Royal Society, London.*

Tenth Annual Report of the Royal Cornwall Polytechnic Society, 1842.—*By the Society.*

The Quarterly Journal of Meteorology and Physical Science. Edited by J. W. G. Gutch, M.R.C.S., for April 1843. No. 6.—*By the Editor.*

An Introductory Lecture on Botany, considered as a Science, and as a Branch of Medical Education. By Edward Forbes, Professor of Botany in King's College, London.—*By the Author.*

Mémoires de l'Académie Impériale des Sciences de Saint-Pétersbourg. (Sciences Politiques, &c.) Tome vi., Livrais. 1–3.
Do. do. do. (Sciences Naturelles). Tome v., Livrais. 1. 2.
Do. do. do. (Sciences Mathematiques). Tome iii., Livrais. 1, 2, 3.
Do. do. do. Mémoires présentés par divèrs Savans. Tome iv., Livrais. 1.
Recueil des Actes des Séances Publiques de l'AcadémieImpérial e des Sciences de Saint-Pétersbourg, tenues le 31 Decembre 1841, et le 30 Decembre 1842.—*By the Academy.*
Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome xvi., No. 9–25, et Tome xvii., Nos. 1–19.—*By the Academy.*
Maps of the Irish Ordnance Survey, containing the county of Tipperary, in 93 sheets.—*By His Excellency the Lord Lieutenant.*
Transactions of the Royal Irish Academy. Vol. xix. Part 2.—*By the Academy.*

Monday, 18*th December* 1843.

Dr ABERCROMBIE, V.P., in the Chair.

The following Communications were read:—

1. A description of Congenital Malformation of the Auricle and External Meatus of both sides in three persons, with Experiments on the state of Hearing in them, and Remarks on the mode of Hearing by Conduction through the hard parts of the Head in general. By Professor Allen Thomson.

Read 18*th December* 1843, *and* 2*d January* 1844.

The three persons referred to came accidentally under the observation of the author during the past year. They were from different parts of the country, and not related to one another. In one of them only was it ascertained that other members of the same family had been similarly affected.

The first part of the paper contained a notice of the history of these persons, and an anatomical description of the malformation with which they were affected. In all the individuals, unsuccessful attempts had been made by different surgeons to uncover a membrana tympani by operation. In one of them, it was supposed that a structure of that nature was brought into view, but, in the other two, nothing of that kind could be seen or felt. By a comparison of the external appearances in the last-mentioned individuals, with observations made in the dissection of similar cases, and more especially from the examination of a specimen preserved in the Anatomical Museum of the University of Edinburgh, the author formed the conclusion, that, in the majority of such cases, the complete closure of the bony part of the meatus opposes an insuperable obstacle to their relief by surgical operation; and that the malformation visible externally, indicates the existence of other defects in the deeper or middle portion of the organ of hearing. These defects consist in the small size and unnatural shape and structure of the cavity of the tympanum; the imperfect condition of the chain of small bones; the impossibility of these bones fulfilling their usual office from the absence of their connection with a membrana tympani; and probably other defects of structure, such as that observed in the specimen preserved in the Edinburgh Museum, which seems important, as consisting in a contracted state of the fenestra rotunda, and the want of direct communication of that orifice with the cavity of the tympanum, such, in fact, as would occasion an interruption of the transmission of vibrations through the air of the tympanum to the fluid of the labyrinth. It does not appear probable, that the Eustachian tube is entirely absent in such cases; but the size of its opening into the tympanum is probably much diminished in most of them. In most of such cases, the labyrinth or internal ear appears to be natural. The defective condition of the bony parts in these cases then appears to consist mainly in the absence of a part of the tympanic bone, that, namely, which intervenes between the fissure of Glaser and the mastoid process, and which forms the tympanic ring and auditory process of the temporal bone.

In the second part of the paper, the author endeavoured to explain the origin of the malformation in question, by a reference to the ascertained history of the development of the external and middle parts of the organ of hearing in the fœtus of man and animals: founding his conclusions more particularly upon the researches of Huschke, Rathke, Reichert, Günther, and his own observations in this point of organo-genesis. From these, it appeared that malformations of the external and middle ear are, in a great measure, unconnected in their origin or progress with those of the labyrinth; and that, while the latter are related to the earliest changes of formation occurring in the brain and cranium, the former may be traced to an arrest or imperfection in the development of part of the walls of the visceral cavity, more particularly of the two anterior branchial arches and the fissure between them. The incomplete condition of the chain of ossicula, and part of the bony wall of the tympanum, is attributable mainly to the defective development of the first branchial arch; the want of the tympanic ring and auditory process, and the consequent absence of bony meatus, to the deficient development of the second branchial arch. The same observations rendered it probable, that the closed condition of the meatus proceeds from a preternatural increase of that deposit in the outer part of the first branchial fissure, which, in the course of natural development, forms the foundation of the septum of the membrana tympani, and thus separates the cavity of the tympanum and Eustachian tube on the inside from the meatus on the outside of this the first branchial fissure. The malformation of the softer part of the meatus externus, and of the auricle, is connected with a defect in the development of the integumental parts of the first and second branchial arches, which constitutes the latest series of changes occurring in the parts under consideration, and, accordingly, is more frequently defective than the others. The very peculiar form of the face, resulting from the undeveloped condition of its maxillary, zygomatic, and malar portions, together with the existence of cleft palate, to a slight degree, in two of the individuals described, appeared to the author to establish still more fully the relation subsisting between the origin of the malformation of the auricle, meatus, and tympanum, and the incomplete development of the anterior part of the transitory branchial apparatus of the fœtus.

The third part of the paper contained an account of a series of experiments performed on the state of hearing in the malformed individuals, and in other persons having the external meatus artificially plugged. In all the three malformed individuals, the hearing was such that they could carry on a conversation with others who spoke slowly and articulately to them, and in one only was there any degree of difficulty in this; and yet, in all of them, sounds must have been communicated to the ear entirely through the bones of the head. In ordinary persons, it is well known, that all sounds which are transmitted directly by contact of the sounding body with the hard parts of the head, are heard with greater intensity when the external ears are closed; but in them the most complete plugging or obliteration of the meatus does not reduce the ear to the condition of that organ in an aquatic animal, nor entirely remove the effect of the chain of bones and column of air within the tympanum. The author shewed, that in two, at least, of the three malformed individuals, the case was different, as circumstances existed which obstructed the secondary action both of the chain of bones and tympanic column of air, so that these two individuals might be regarded as hearing solely through the solid parts of the head. In these two individuals it was ascertained, by accurate and frequently-repeated experiments, that hearing was not, as in other persons, most perfect near the site of the ear, but on the top of the head ; and this was the case whether the sounds proceeded from a body held in contact with the head, or at some distance in the air. So exclusively, indeed, did the hearing seem to take place in these two individuals through the hard parts of the head, that neither, but particularly one of them, seemed ever to have referred sounds to the ear as the seat of the sensation of hearing. As might be supposed in such circumstances, these persons made no distinction between hearing in one ear and in the other; and could obtain, therefore, no knowledge of the direction of sounds in the same manner as other people do, by the comparison of the relative intensity of sounds in the two ears, or in the same ear in different positions. The author made some remarks on the amount of deafness which is calculated to induce dumbness, as well as upon the means of distinguishing different kinds of deafness, and the different means that ought to be employed for their relief. He concluded his paper with some remarks upon the subject of double hearing, considered with reference to the obvious impossibility, in the individuals referred to, of the sensations of one ear being distinguished from those of the other, in consequence of the perfectly equal and simultaneous communication of sonorous vibrations to both ears.

2. On the Luminousness of the Sea. By Dr Traill.

The author stated, that this phenomenon seems scarcely to be noticed in the writings of Aristotle or of Pliny which have reached us, though Pliny was familiar with the light emitted by certain shell-fish, and by the *Sea Lung* or Medusa.

Mr Boyle gives an account, from the journal of a shipmaster, of the luminousness of the sea ; and it is particularly detailed, from personal observation, in the Indian voyage of Father Bourzes, in 1704.

The first philosophers, who ascribed it to light emitted by living animals, would seem to be the Abbé Nollet, Professor Vianelli, and Dr Gressellini of Venice, about the middle of the last century. In Cook's first voyage, the luminous properties of several marine animals are well described by Banks and Solander; and in his second voyage, by Forster. Spallanzani made some good experiments on the phosphorescence of a Medusa in the Straits of Messina.

Since that period, the catalogue of noctilucous animals has been greatly enlarged, especially by Peron and Lessueur, the naturalists to the French Voyages de Découvertes aux Terres Australes. A good paper on the luminousness of the sea, by Mr Macartney, appeared in the London Phil. Trans. for 1810; in which the phenomenon is ascribed entirely to living animals, an opinion now generally embraced by naturalists.

The author then detailed his own experiments and observations made, from early life, in different parts of the European Atlantic, from lat. 62° to 36° N., chiefly around the shores of Britain, all which confirmed this opinion.

He detected, in 1814, several of the same noctilucous animals in the waters of the Bay of Biscay as in our own seas, especially the *Noctiluca miliaris*, *Orythia minima*, and a very minute crustacean, seemingly a Zöe.

Besides these, the *Beröe fulgens* of Macartney, and several other Medusaria, he found two very remarkable animals in the luminous waters of the seas around the Western Isles of Scotland—one an *Æquorea*, most splendidly phosphorescent, which seems to be *Æquorea mesonema* of Eschscheltz; and the other a most elegant *Cydippe*, probably the *Cydippe pomiformis* of Paterson. Both were carefully figured from the life by the author, and magnified drawings of them were exhibited.

The paper was concluded by some strictures on the hypothesis of Lamarck, respecting the absence of muscular power and of voluntary movements in the order of *Radiaires mollasses*. He gave the results of many experiments which he had made on the movements of the Medusæ, and which convinced him that they possessed considerable muscular power, obedient to volition; and he ascribed the erroneous views of Lamarck on this subject to his little familiarity with those animals in their natural haunts; for a Medusa swimming in the sea, and cast on the beach, have very different capabilities of locomotion.

The following Donations to the Society's Library were announced:—

Journal of the Asiatic Society of Bengal. Nos. 132 and 133.—*By the Society.*

Proceedings of the American Philosophical Society. Nos. 26 and 27.—*By the Society.*

Tuesday, 2d January 1844.

Dr ABERCROMBIE, V.P., in the Chair.

The following Communications were read:—

1. On the Fossil Vegetables of the Sandstone of Ayrshire, illustrative of a series of them, as a Donation for the Society's Museum. By J. Shedden Patrick, F.R.S.E., F.R.S.A., &c.

The author, after mentioning that they were collected by himself from a quarry on the estate of Mr Warner of Ardeer, in the parish of Stevenston and district of Cuninghame, shortly described the quarry, as belonging in its geological position to the carboniferous group; and stated that it is considered the most valuable for white freestone in the west of Scotland. He mentioned the different strata in the order of their occurrence; and stated that coal had been wrought out from beneath it, within the remembrance of the present generation. He said that the fossils are not confined to any one stratum of the sandstone, but are found in them all, wherever the stone is faulty. He had counted about five strata at the deepest part of the quarry, separated from each other by thin layers of shale; and fossils are found in all these strata, chiefly, however, where the sandstone is rendered impure by a mixture of greenstone and ironstone. There have been above thirty different kinds of fossils found in this quarry (and in the schist connected with the coal); among them many beautiful impressions of *Stigmariæ*, *Sigillariæ*, *Lepidodendra*, and other plants unknown in the present day. Among the ferns will be found *Sphenopteris*, *Neuropteris*, *Pecopteris*, &c. The fossils which occur in greatest profusion are the *Calamites*. Of these, the two kinds met with most commonly are *Calamites nodosus* and *C. approximatus*. The following species are also found, but not so frequently, *C. cannæformis*, *C. Mougeotii*, *C. arenæceus*, and *C. verticillatus*.

The *Sternbergia approximata*, designated by Lindley "a most singular coal-measure plant occurring in most coal-fields in Great Britain, but not abundant anywhere," is likewise found here; the specimens obtained are in general small, but one or two fine large ones have been got. They are usually found in the sandstone, and are covered with a fine coal, which adheres either in the form of an even, thick, glossy integument, or in a powdery state, to the surface of the stem. Some very fine examples of *Sternbergia nodosa* have likewise been procured.

A curious fossil, which he has every reason to believe is original, was discovered by the author among the debris of the quarry. It somewhat resembles a piece of tartan, being divided into regular parallelograms, by double lines intersecting each other at right angles. He submitted it to the inspection of the Rev. D. Landsborough, and to other gentlemen in the neighbourhood, who all declared that it was new to them. He also shewed it to the manager of the works, and to some of the most intelligent of the overseers and colliers, and they all said that they had not before met with it; he therefore ventures to think it unique. Mr Landsborough, after minute examination, bestowed upon it the name of *Dictyodendron Patricii*, deriving the generic name from δικτυον, a net, from its close resemblance to network, and δενδρον, a tree; and dedicating it, by the specific name, to the author, as its discoverer.

The Stigmariæ, which may be said to be peculiar to, and the distinguishing feature of, the coal-measures, occur plentifully. Among these will be found *Stigmaria ficoides*, *S. radiata*, and *Stigmaria*. Brongniart comes to the conclusion that the *Stigmaria* and *Sigillaria* constitute a peculiar and extinct family (belonging probably to the gymnospermous division of the Dicotyledons), but of which neither the fruit nor the leaves are as yet known, and adds, that probably *Stigmaria* is only the root of *Sigillaria*.

The *Trigonocarpum olivæformæ* (or fruit of the palm) is very scarce, being found only in one portion of the quarry, of very small extent, in the lowest stratum, next to the shale.

Another fossil met with, but rare, in that district at least, is *Halonia tuberculata*. A very fine specimen was obtained some time ago, adhering to the surface of the upper stratum of sandstone.

Of the *Lepidodendra* there are several species; among them *Lepidodendron Sternbergii* and *L. Harcourtii*, and a peculiar and rare variety, with whose specific name the author is unacquainted.

Endogenites striata is also met with.

A very remarkable fossil was discovered in 1842, by the Rev. D. Landsborough, which there is every reason to consider as unique. He says, that only a very few specimens exist, and that, to the best of his belief, it has not been found elsewhere. He submitted it to the Philosophical Society of Glasgow, who report, that "the exposed surface presents a most singular appearance, and is unlike any fossil plant which we have ever seen figured. Its peculiar appearance is its resemblance to part of a common osier-basket. Hence, Mr L. used humorously to designate it 'Noah's creel,' for want of a better name. To supply this desideratum in nomenclature, and as no such fossil appears to have been described or figured, we have named it '*Lyginodendron Landsburgii;*' forming the generic name from λυγινος, wicker-work, and δενδρον, a tree; and dedicating it by its specific name to its discoverer, Mr Landsborough." The fragments of the fossil were spread over a space of about two yards, and have not been observed, except in that place. The finest specimen obtained was about 18 inches in length, by 3 in breadth. It was discovered in the middle stratum.

Of the genus *Sigillaria* there are two or three varieties, as *Sigillaria oculata*, *Sigillaria reniformis*, &c. &c.

The most magnificent fossil found in the quarry is the *Bothrodendron punctatum.* A splendid specimen of this fossil is in the possession of Mr Landsborough, which he describes to be of a size and weight which he can scarcely lift from the ground. It is extremely rare, however; only two, or at most three, examples of it have been procured.

Another very curious and remarkable fossil also, is the *Stylolithen*, of which there appears to be two distinct varieties—one with very broad stripes, the other with the lines more closely approximating, and, likewise, more deeply indented.

Specimens of all the before-mentioned fossils were contained in the collection presented to the Society. The author presented at the same time some masses of impure ironstone, from a coal-pit on the same estate, containing very beautiful specimens of the *Unio Urii.*

2. On a new Self-Registering Barometer. By Robert Bryson, F.R.S.

From the nature of the instrument, it is impossible to give an intelligible abstract of the paper. The paper, with a description of the instrument, and a statement of its indications for some months, is published in the Society's Transactions.

Monday, 15th January 1844.

Dr ABERCROMBIE, V.P., in the Chair.

The following Communications were read:—

1. On the Vibrations of an Interrupted Medium. By Professor Kelland.

The object of this paper was the approximate determination of the change of phase, and intensity of a ray reflected at the surface of a medium, which admits of no refraction.

2. On certain Laws of the Resistance of Fluids. By John Scott Russell, Esq.

3. Chemical Examination of the Tagua-Nut, or Vegetable Ivory. By Professor Connell.

This remarkable nut is now well known as being extensively carved into ornaments, having the high polish and general appearance of the finest ivory.

It is a seed or nut of a palm called *Phytelephas macrocarpa*, which is found on the banks of the Magdalena river, in the republic of Columbia.

For analysis the fine turnings of the vegetable ivory were employed. These were well rubbed in a mortar successively with cold and hot water, and were then heated with hot alcohol. The constituents were found to be—

Gum, ...	6.73
Legumin or Vegetable Casein, . . .	3.8
Vegetable Albumen, ...	0.41
Fixed Oil, ...	0.73
Ashes, ...	0.61
Water, ...	9.37
Lignin or Woody Matter, ...	81.34
	100.

In the ashes were found phosphate of lime, sulphate of potash, chloride of potassium, carbonate of lime, and a little siliceous matter.

The following Donations to the Society's Museum were announced:—

14 Specimens of British Land and Fresh-water Shells. Presented by the Honourable Mrs Macadam Cathcart.

Block of Sandstone, with organic remains imbedded in it, found in one of the dry docks at Leith, when enlarging it; originally from Rosyth Quarry, Fifeshire. Presented by Captain Patrick Dall, R.N.

Portrait of James Mitchell, at the age of 46 years, well known, and described in the Transactions of this Society, by the late Professor Dugald Stewart and others, as the blind, deaf, and dumb boy. This portrait was given by his sister, Jane G. Mitchell, to, and was presented by, Sir Thomas Dick Lauder, Bart.

The following Donations to the Society's Library were announced:—

Proceedings of the Geological Society of London. Nos. 94, 95, and 96.—*By the Society.*

Journal of the Statistical Society of London. Vol. vi. pt. 4.—*By the Society.*

Journal of the Asiatic Society of Bengal. Nos. 50, 51, and 52.—*By the Society.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences de Paris. Tome xvii., Nos. 20, 21, 22, 23, and 24.—*By the Academy.*

The Journal of Agriculture, and the Transactions of the Highland and Agricultural Society of Scotland. Jan. 1844.—*By the Society.*

Elements of Agricultural Chemistry and Geology. By James F. W. Johnston, M.A., F.R.SS.L. & E., &c.—*By the Author.*

Transactions of the Institution of Civil Engineers. Vol. iii., pts. 2, 3, 4, and 5.

Minutes of Proceedings of the Institution of Civil Engineers for Sessions 1840–41–42–43.—*By the Institution.*

Flora Batava. Nos. 129 and 130.—*By the King of Holland.*

Descriptive Catalogue of the Anatomical and Pathological Museum of the School of Medicine, Park Street, Dublin. By John Houston, M.D.—*By the Author.*

Transactions of the Society instituted at London for the Encouragement of Arts, Manufactures, and Commerce. Vol. liv.—*By the Society.*

The Journal of the Royal Asiatic Society of Great Britain and Ireland. No. xiv.—*By the Society.*

Tijdschrift voor Natuurlijke Geschiedenis en Physiologie. Uitgegeven door J. van der Hoeven, M.D., en W. H. De Vriese, M.D. Deel x., Stuk iv.—*By the Editors.*

Abhandlungen der Königlichen Gesellschaft der Wissenschaften zu Göttingen. Band 1.—*By the Society.*

Nova Acta Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum. Vol. xviii., Suppl. ii., et Vol. xix., Pars ii.—*By the Academy.*

Almanach der Königlichen bayerischen Akademie der Wissenschaften. 1843.—*By the Academy.*

Twenty-third Report of the Council of the Leeds Philosophical and Literary Society. 1842–43.—*By the Society.*

Bulletin de la Société Impériale des Naturalistes de Moscou. 1842, No. 4, et 1843, Nos. 1, 2, 3.—*By the Society.*

PROCEEDINGS

OF THE

ROYAL SOCIETY OF EDINBURGH.

1844. No. 24.

Elections omitted in No. 23.

18*th February* 1843.

Arthur Forbes, Esq. of Culloden.
J. Burn Murdoch, Esq.

Monday, 2*d January* 1844.

The Hon. Lord Murray.

Monday, 5*th February* 1844.

Sir T. M. BRISBANE, Bart., President, in the Chair.

The following communications were read :—

1. On the Tides of the Firth of Forth, and the East Coast of Scotland. By J. S. Russell, Esq. (Abstract of this paper not obtained from the author.)

2. Additional Observations as to the Poisonous Properties of Œnanthe crocata. By Dr Christison.

In this paper the Author added a few supplementary observations to those made on the alleged poisonous properties of the *Œnanthe crocata*, in his paper on the poisonous *Umbelliferæ*, read on the 4th December last.

He stated that he had met with other cases of poisoning with this plant, recorded by Continental authors, shewing that death may take place in an hour,—that so small a quantity as a single tuber, no bigger than the finger, has proved fatal,—that the roots are poisonous in some countries, from the beginning of January till the middle of October at all events, and probably throughout the whole year ; and that Spain may be added to the countries formerly mentioned, where fatal effects have been produced by the plant.

He next added, that he had recently tried on a dog the effects of the juice of a pound of tubers, collected by Dr Pereira on the 16th December from the locality at Woolwich ; and that no effect, or an exceeding slight one only, was produced.

It was farther observed, that, according to an analysis executed in 1830 by MM. Pihan-Dufeilay and Cormerais, the activity of the roots in French plants depends upon a resin. On proceeding to try upon a rabbit the effects of the resin, obtained by their process from the Woolwich plants, the author found that, when the resin from eight ounces avoirdupois, amounting to 24 grains, was introduced in the state of emulsion into the cellular tissue, the animal died in 78 minutes, after being affected with a remarkable combination of tetanic spasm and convulsions : but that no effect whatever was produced by the resinous extract from the same quantity of roots obtained about the same season of the year (midwinter) from the Dalmeny œnanthe, near Edinburgh,

He concluded this notice with an account of some experiments on the chemical analysis of œnanthe, observing that he had failed to obtain any principle from the Dalmeny seeds or root, by a process analogous to that by which conia is obtained from hemlock ; and that the alcoholic extract of the Woolwich plants, distilled with solution of potash, yielded, like hemlock, a little oleaginous-like fluid, which was too minute in quantity for him to ascertain its properties accurately, but which on the whole seemed a volatile oil, and not an alkaloid.

Lieut.-Colonel Lowe was duly elected an Ordinary Fellow.

Monday, 19*th February* 1844.

Dr ABERCROMBIE, V. P., in the Chair.

The following communications were read :—

1. On the Cellular Fibre and the Incrusting Matters of Plants. By Mr P. F. H. Fromberg. Communicated by Professor Johnston.

The results obtained by the author, on analysing the cellular fibre of different kinds of plants, after a sufficient purification, are, on the whole, in conformity with those of Payen. But he considers the formula, which Payen has derived from his results, an inconvenient one; and that the composition of cellular fibre is in conformity with that of inuline, rather than with that of starch, as that chemist has supposed.

The author observes that he obtained, by treating different kinds of wood in different ways, a great many substances, of different properties and composition. As to the composition, however, it could almost always be represented by a formula, differing, more or less, from that of ulmic acid, only by the number of equivalents of hydrogen, that of the carbon and oxygen remaining the same. The composition of the ulmic acid is, according to numerous and accurate experiments of Professor Mulder, $C^{40}\ H^{14}\ O^{12} +$, a greater or less number of equivalents of water, according to the temperature at which the substances are dried, and the manner in which they are obtained.

Now, according to the analysis of several kinds of wood, and especially of the more constant, hard perisperm of the stone fruits analysed by M. von Baumhauer, the following formula is determined:—

	Found.	Atoms.	Calculated.
Carbon,	52.5	64	52.38
Hydrogen,	5.9	44	5.88
Oxygen,	41.6	39	41.74
	100		100

If we subtract from this formula . .	$C^{64}\ H^{44}\ O^{39}$
That of the cellular fibre, . . .	$C^{24}\ H^{21}\ O^{21}$
There remains, ...	$C^{40}\ H^{23}\ O^{18}$

As the average formula of all kinds of incrusting matters, which may be easily reduced to this:—

$$C^{40}\ H^{17}\ O^{12} + 6\ H\ O,$$

A combination which differs from ulmic acid only by three equivalents of hydrogen.

All the matters obtained and analysed by the author, could be represented by formulæ from $C^{40}\ H^{22}\ O^{12}$ to $C^{40}\ H^{14}\ O^{12}$, all the others containing 20, 21, 19, *etc.* of hydrogen. The last formula, $C^{40}\ H^{14}\ O^{12}$ + water, which is at the same time that of ulmic acid, represented a substance obtained after the action of strong reagents.

In all these experiments, an augmentation of carbon was accompanied by a diminution of hydrogen; but the proportion of the change varied.

According to the author's experiments, so far as they have gone, cellular fibre is not only soluble in alkalies, but also gradually changed by them into matters which approach, more and more, to the composition and properties of the ulmic acid. The difference between the action of alkalies and of acids consists in this : that the states of transition, namely dextrine and sugar, are not produced by the action of the alkalies. Cellular fibre and the incrusting matters, when united in the substance of the plant, resist more powerfully the influence of chemical reagents, than when they are separated from each other. Payen's idea, that the incrusting matters should be considered as consisting of three substances, two of which are electro-negative, seems much too limited and artificial.

The quantity of nitrogen found in these substances was much too small to exercise any influence on the composition. It is the younger parts of growing plants to which nitrogen is indispensable, and in which it can always be found and demonstrated.

Finally, it is not improbable that there exists a whole series of incrusting matters, always present in their substance, for the use of the different fluids and organs of plants : a purpose for which they are eminently calculated, by their great facility of transformation, and by their strong tendency to attract water.

Were we to assume the transitory existence of ulmic acid in the cells, we should probably obtain wider ideas with regard to the growth and decay of plants. It is well known, with respect to the decay of vegetable matter, that a large quantity of hydrogen must be set free during its decomposition, by means of which the formation of ammonia in the soil is eminently favoured.

In the converse process, that of growth, precisely the opposite process—that is, combination with hydrogen—must occur. Growth is thus a reduction, decay an oxidation. The ulmic acid would thus be, after the formation of the primary cell fibres, the common source of all the matters deposited in the cells, in all plants which are rooted in the ground.

If we agree to this proposition, then we do not require the decomposition of water to explain the growth of plants. The large quantity of pectine, $C^{12}\ H^{8}\ O^{10}$, which is present in some parts of so many plants, and which may be considered as the incrusting matter of the cells of carrots, turnips, different kinds of fruits, &c.

together with other organic matters which contain much oxygen—for instance, oxalic acid—may be the cause of the relative and various abundance of hydrogen in the products of ulmic acid—namely, the incrusting matters of plants.

2. On a remarkable Oscillation of the Sea observed at various places on the coasts of Great Britain, in the first week of July 1843. By David Milne, Esq.

This phenomenon was observed on the 5th July and three following days. It did not occur on all parts of the coasts of Great Britain. In England, it was observed only on the south shores of Cornwall and Devonshire. In Scotland, it was observed on the east coast; and there it was seen at a great many places, between Eyemouth in Berwickshire and the Shetland Islands.

It was only on the 5th July that the oscillation occurred on the Cornish and Devonshire coasts. It prevailed on the Scottish coast, however, from the 5th to the 7th July inclusive.

The phenomenon consisted of a flux and reflux of the sea, beyond what could be accounted for by ordinary tides, or any wind prevailing at the time. The water suddenly rose up and sunk down from 2 to 5 feet in perpendicular height, producing effects more or less striking, according to the shelving character of the shore.

In regard to the cause of the phenomenon, various had been the surmises; though the general impression seemed to be, that it was produced by distant submarine earthquakes.

The author stated that he could not acquiesce in this view, and gave his reasons for saying so.

In order to obtain a wider field of induction, he referred to former instances of oceanic oscillations, and shewed that they were almost always accompanied with considerable atmospheric disturbances.

He then proceeded to give an account of a remarkable storm of wind, accompanied by thunder, lightning, and hail, which had traversed the British Islands on the 5th July, appearing first in the SW. of England, and passing through the midland counties, traversing the south-east parts of Scotland, and going off about the Aberdeenshire coast.

By the lightning and large hail-stones accompanying this storm, much damage to property, as well as loss of life, had occurred. At Sheffield, the barometer was, during the passage of the storm, observed to sink suddenly about an inch.

The storm appeared to have rotated, and in the usual way,—viz. in a direction contrary to that of the hands of a watch,—of which proofs were given.

The author then suggested, that the oscillations in question were probably produced by this storm. The parts of the coast where they were observed, coincided with the direction in which the storm moved. The fact that the oscillations on the Cornish and Devonshire coasts commenced before the storm arrived there, so far from being hostile to, supported this view; for if waves were created by the storm, as it approached Great Britain, these waves would advance more rapidly than the storm, which appeared to move northwards at the rate of from 70 to 80 miles per hour,—whereas the similar waves produced by the two Lisbon earthquakes had moved forward at a rate of from 120 to 130 miles per hour.

As to the way in which waves could be produced on the surface of the ocean, sufficient to produce the fluxes and refluxes in question, it was observed—

(1.) That the wind, by its mere mechanical pressure, was capable of heaping up, over a large expanse, a considerable body of water. By the force of the south or south-west blasts in the storm, the sea would be elevated, and waves would thereby be formed, which would move forward before the storm towards the south coast of England.

(2.) That the level of the ocean rises in proportion to the fall of the barometer; so that if, as there was every reason to suppose, this storm was accompanied in its track by a diminution of atmospherical weight, waves almost commensurate in extent with the diameter of the storm would be formed.

In either or in both of these ways, the sea may have been, and probably was, so affected on the 5th, 6th, and 7th July 1843, as to produce the ebbing and flowing which was observed on certain parts of the coasts of Great Britain.

The following Gentlemen were duly elected Ordinary Fellows:

Archibald Swinton, Esq., Professor of Civil Law in the University of Edinburgh.

Dr Begbie, Fel. Roy. Col. Surg. Edin.

The following Donations of Books to the Society's Library were announced:—

The London University Calendar for 1844.

The Examination Papers of the London University for the year 1844.—*By the Council of the University.*

The Transactions of the Linnæan Society of London. Vol. xix. Part 2.

Proceedings of the Linnæan Society of London. Nos. 15, 16, 17, 18.—*By the Society.*

Astronomical Observations made at the Radcliffe Observatory, Oxford, in 1840 and 1841. 2 vols. By Manuel J. Johnson, —*By the Radcliffe Trustees.*

Maps of the Irish Ordnance Survey, containing the county of Dublin, in 30 sheets.—*By the Lord Lieutenant.*

Nouveaux Mémoires de la Société Impériale des Naturalistes de Moscow. Tome vii.—*By the Society.*

Monday, 4th March 1844.

Sir T. M. BRISBANE, President, Bart., in the Chair.

The following communication was read :—

On the Human Races in Britain, enumerated by Tacitus. By Dr Hibbert Ware.

This memoir had been undertaken as preliminary to an ethnological inquiry which the author had proposed to institute into the aborigines of the British Islands. It was premised, that, in this endeavour to seek for ancient races in those which were modern, great caution is required.

It has been asked, if, at the present day, we can as readily distinguish an Iberian type from one that is Gaulish or Caledonian, as was done more than seventeen hundred years ago in the time of Tacitus? It is answered, that, by a conservative principle in our nature, directed to the persistency of types, the influences of Time, Climate, and Civilization, are rendered of little avail. And, even in a mixture or crossing of races, there is an interposition of preserving laws made in favour of mutually approximating types, such as those of Europe. For instance, when two or more races are mingled together in different proportions, it is expected that the type of the minority will eventually become merged in that of the majority. But whether, in accelerating or postponing such a result, it will be found that, among all animals, nature exercises a sort of discretionary power under three varied circumstances: 1*st*, When races widely differ from each other; 2*d*, When races are in a less degree remote; and, 3*d*, When races, like those of Britain, or Europe in general, approximate closely to each other. These three circumstances the author discussed in succession.

1*st*, When races widely differ from each other, as in the crossing of the horse and the ass. In this case, nature has ever declared, that a debased or intermediate breed shall not be perpetuated.

2*d*, When races are in a less degree remote. In this example nature acts with uniformity, as in the crossing of the spaniel with the greyhound, &c.; and, among the human species, in the mixture of European and black races. In any one of these instances, there is no incapacity in the progeny to perpetuate its breed; but it will be found that the principle directed to the persistence of races gradually restores, in the course of a few generations, the purity of any one of the types which may have been contaminated by mixture, while the other type, in the meantime, is doomed to extinction.

3*d*, When races approximate closely to each other, as when spaniels (of which there are divers breeds), are crossed among themselves, and the same of white and grey mice, the result shews that, in the progeny, the types of a paternal or maternal stock are less liable to occur in an intermediate, than in a perfectly distinct form; or, in other words, that there is a less tendency to a fusion than to a separation of types. For instance, in the Western Highlands of Scotland, which were peopled in succession by the dark-haired Gael, and the flaxen-haired Scandinavian, there is, in the descendants, less a mixture than a separation of the types; the progeny of many families of the peasantry illustrating the distinctness with which Gaelic and Scandinavian characters are reproduced in cases where the paternal and maternal types differ from each other.

In bringing forward these illustrations, it was far from being argued that a progeny did not often exhibit an intermediate character, derived from the two races of a paternal and maternal stock; it was simply urged that a separation of types is equally, if not more common; and that, when a sort of intermediate character is actually derived from two European races, it is not necessarily perpetuated to a future progeny. On the contrary, a pure and distinct type, even though rendered, for a generation or two, intermediate and obscure, is often revived, with all its primitive decision of character.

The author, lastly, availed himself of the occasion to state, that the laws which appertained to the characters of races, hold good also with *individual* distinctions; and that nature seemed far more intent upon perpetuating through successive generations, what might be named the type of the *individual*, or *person*, than upon producing intermediate likenesses, referred (often fancifully) to two types, paternal and maternal.

From all these observations, it was concluded, that, although in every society of mixed races the type of the minority had a tendency to become merged, or to disappear in that of the majority, yet that, by the interposition of relaxed laws, made in favour of the mixture of two or more approximating races, such a result (in the absence of exterminating wars, famine, or pestilence) may be postponed to an incalculable period of time; and, as an ultimate consequence, that the discovery of ancient European races in those which are modern is a reasonable expectation not likely to be frustrated.

After these observations, the author proceeded to the chief object of the Memoir, which was to explain, on ethnological principles, the ancient British races enumerated by Tacitus. These were, 1*st*, the Caledonians—"the red hair of those who inhabit Caledonia, and their large limbs, bespeak a German origin;" 2*d*, the Gauls—"those who are nearest to the Gauls are also similar to them;" and, 3*d*, the Iberians, indicated by their swarthy features and their curled hair.

The following exhibits a classification of the modern British races with which the author compared those enumerated by Tacitus; but the description of them does not admit of abridgment.

(A.) Races referrible to the Light-haired German Stock.

Under the common title *German*, it was supposed that three races, and possibly a fourth, might be included.

(*a*) *The Teutonic race.*—To this race the description given of the Germans by Tacitus was supposed to apply exclusively. This type the author stated to be found in Scotland and the north of England.

(*b*) *The Scandinavian race.*—This type was described by the author as it occurs in Orkney and Shetland, in the North and West Highlands of Scotland, and in Ireland.

(*c*) *The Anglo-Frisian race.*—The type prevails in the south and midland districts of England, but diminishes in the northern counties and in Scotland.

(*d.*) *The Pictish race.*—The author has not yet had leisure to verify his suspicion, that there exists, in certain Scottish districts, another German race, to which, possibly, the description given of the Picts by Adamnan and various early writers, may apply.

(B.) The Dark-haired Races of Europe.

Between the light-haired and dark-haired races of Europe constitutional differences exist; the former shewing the sanguine, and the latter the melancholic temperament. In the female constitution the diversity is still more apparent. Under the dark-haired races are included (*a*) the Cymric; (*b*) the Gaulish; (*c*) the Iberian. Tacitus merely distinguishes the two latter; but under the term Galli of the ancients, two distinct races are included; and when the Romans alluded to the gigantic stature of the Gauls, the description could only apply to the Cymric race, variously named Cimmerii, Cimbri, and Ombri, who were contemporary with the Gauls.

(*a*) *The Cymric race.*—This was the type of the ancient Britons in the time of Tacitus, as well as of the Belgæ and Armorici in Gaul. It was also that of the Fir-bolgs (Viri Bolgæ) of Ireland.

(*b*) *The Gaulish or Gallic race;* also named Celtic,—a name which M. Thierry has proved to be merely a local one applied to an armed confederation of Gauls. The type was that of a third part of Gaul; and, in the time of Tacitus, it distinguished the population of Ireland, part of Wales, and perhaps a few limited districts of Caledonia.

(*c*) *The Iberian race.*—This type is still to be studied in the ancient Silurian district of Tacitus, particularly in the counties of Monmouth and Brecon. Hitherto the characters of this race have not been defined; which blank in ethnology it was one of the leading objects of the present memoir to supply;—while another, yet an ultimate one, was to shew, that the Iberian tribes are to be considered as the aborigines of the British Islands, as well as of Spain, Ireland, Gaul, and Italy.

The following Donations of Books to the Society's Library were announced:—

Annuaire Magnétique et Météorologique du Corps des Ingénieurs des Mines de Russie, Par A. T. Kupffner. Année 1841.—*Par le Ministre des Finances.*

Journal of Agriculture, and Transactions of the Highland and Agricultural Society of Scotland, March 1844.—*By the Society.*

Observations on Days of unusual Magnetic Disturbance made at the

British Colonial Observatories, under the Departments of the Ordnance and Admiralty. Printed by the British Government, under the superintendence of Lieutenant-Colonel Sabine, of the Royal Artillery. Part 1. 1840–1841.—*By the Master-General of the Ordnance.*

Monday, 18*th March* 1844.

Dr ABERCROMBIE, V.P., in the Chair.

The following communications were read :—

1. On the Existence of an Osseous Structure in the Vertebral Column of Cartilaginous Fishes. By James Stark, M.D., F.R.S.E.

The author, after quoting from the works of writers on Ichthyology and Comparative Anatomy their descriptions of the vertebral columns of cartilaginous fishes, proceeded to point out the existence of an osseous structure in the vertebræ of the Plagiastomi, or Rays and Sharks. In these animals the essential portion of each vertebra consists of a double cup or saucer-shaped osseous piece, resembling in form and structure the double cup-shaped vertebræ of osseous fishes, being, like them, composed of concentric rings of osseous matter. It was shewn that the whole of the encrusting cartilaginous matter, with its calcareous granules, could be removed from this osseous structure, without affecting the integrity of the spinal column, or interfering with the intervertebral ligamentary apparatus which was alone attached to this osseous structure. These double cup or saucer-shaped vertebræ were in the Rays shewn to be perforated by an extremely minute central aperture, which was, however, of a considerably larger size in a few genera of Sharks, as in the Dog-fish ; while in others, as in the Saw-fish, no such aperture could be distinguished.

These double cup or saucer-shaped vertebræ receive various strengthening columns, pillars, or plates of osseous matter, which differ in structure and disposition in the several genera and species of cartilaginous fishes. In some, these plates were shewn to have a concentric arrangement, and to be separated from each other by plates of cartilage. In others, the plates were broad and flat, and extended only from the margin of the one cup to that of the other cup of the same vertebra. In others, the supports were compound and broad and had a somewhat radiated arrangement from the centre to the circumference. While in others, two of these modes were united in strengthening the osseous cups.

The peculiarities of these double osseous cups, and their supporting columns, were pointed out in the vertebræ of the Common Skate (Raia batis), Thornback Ray (R. clavata), Sharp-nosed Ray (R. oxyrhynchus), Starry Ray (R. radiata), Common Dog-fish (Scyllium Catulus), Spotted Dog-fish (S. canicula), Picked Dog-fish (Spinax acanthias), Common Tope (Galeus vulgaris), Basking Shark (Selache maximus), White Shark (Carcharias vulgaris), Saw-fish (Pristis antiquorum), and Chimæra (Chimæra monstrosa).

The vertebral column of the Sturiones and Cyclostomi was shewn to be essentially composed of soft transparent cartilage.

It was demonstrated by a chemical analysis of the essential osseous portions of the vertebræ, that they were true bone. This was evidenced by their containing the same amount of earthy and animal matters, as the bones of osseous fishes, as well as by their earthy salts being of the same nature in both classes of bones. The result of the author's analysis gives, as a mean, about 69 per cent. of earthy matters, chiefly consisting of phosphate of lime, and 31 per cent. of cartilage. The chemical composition of the common cartilaginous skeleton, and of the vertebræ, with their encrusting cartilage and calcareous granules, was also noticed, in order to shew the essential difference between them and the truly osseous portion of the vertebræ.

From these peculiarities in the spinal column of the Plagiostomi (Rays and Sharks), taken in connection with the higher degree of development of their nervous, generative, and digestive systems, the author concluded, that these fishes ought to form a new subclass, and, in the descending scale of organization, be placed at the head of the fishes, as they manifestly form the connecting link between the osseous fishes and the reptiles. He also concluded, that the Sturiones and Cyclostomi ought to be arranged together as a distinct subclass, to which the term of *cartilaginous* might still be retained, and be placed after the osseous fishes, in the descending scale of natural classification; as the lower grade of development of their whole systems, taken along with their essentially cartilaginous skeletons, constituted them the connecting link between the higher mollusca and the more imperfectly organized osseous fishes.

The paper was concluded by pointing out the probable importance to the geologist of the discovery of an osseous structure in the vertebral columns of the Plagiostomi, and one or two instances were referred to in illustration of this part of the subject.

2. Farther Observations on Glaciers, by Professor Forbes.

Previous to the reading of the papers, the President announced that the Keith Prize had been awarded by the Council to Professor Forbes for his Papers on Glaciers.

The following Gentlemen were duly elected Ordinary Fellows of the Society :—

Nicholas Grut, Esq.
Rev. Archibald Bennie, one of the Ministers of the City.
David Stevenson, Esq., Civil Engineer.
Dr J. Y. Simpson, Professor of Midwifery, Edin. Univ.

The following Donations of Books to the Society's Library were announced :—

Journal of the Royal Geographical Society of London. Vol. xiii. Part 1.—*By the Society.*

The American Journal of Science and Arts, conducted by Professor Silliman and Benjamin Silliman, Jun. January 1844.—*By the Editors.*

Scheikundige Onderzoekingen, Gedaan in het Laboratorium der Utrechtsche Hoogeschool. 2d Deel. 2d Stuk.—*By the Editors.*

Flora Batava. No. 131.—*By the King of Holland.*

Maps of the Ordnance Survey of England and Wales. Sheets Nos. 88 and 89. *By the Master-General of the Ordnance.*

Kongl. Vetenskaps—Academiens Handlingar för Ar 1841.

Arsberättelse om Framstegen i Kemi och Mineralogi, af Jac. Berzelius, för 1841, 1842, och 1843.

Arsberättelse om Technologiens Framsteg Ar 1841, af G. E. Patsch.

Arsberättelse om Zoologiens Framsteg under Aren 1840, 1842, af C. H. Boheman.

Berättelse om Astronomiens Framsteg för Aren 1837, 1841, af N. H. Selander.—*By the Royal Academy of Sweden.*

Monday, 1st April 1844.

Sir T. M. BRISBANE, President, Bart., in the Chair.

The following communications were read :—

1. On the Development, Structure, and Economy of the Acephalocysts of Authors ; with an Account of the Natural Analogies of the Entozoa in general. By Harry D. S. Goodsir, Conservator of the Museum of the Royal Coll. Surg. Edin. Communicated by John Goodsir, Esq.

The Acephalocyst or Hydatid is composed of a vesicle containing fluid. It propagates by means of internal gemmules, which are developed between the layers of the membrane composing the vesicle, and, after a certain time, are thrown off internally.

The author, after pointing out these distinguishing characters of the Hydatid, referred to the confusion which had arisen, from want of proper observations on this point, and which, with other causes, had been the reason why the animal nature of these creatures had been denied by some writers of great authority.

The author having procured a new form of Acephalocyst, was enabled, from his observations on its structure and economy, to determine several important points relative to the anatomy, physiology, and natural history of the other species of the class.

He characterised this new species of Acephalocyst as a compound animal, inasmuch as one continuous membrane covered a complete group or mass of the Hydatids. This membrane was described as consisting almost entirely of tubuli, ramifying freely through it, and a number of ovoid disks scattered at short intervals over its surface, the edges of which were lined with minute open stomata, which opened into the tubuli. The author looked upon these tubuli and stomata as the organs of nutrition.

Another membrane lay immediately beneath that already described, and covered each Hydatid in particular. The body of the Hydatid itself consisted entirely of a homogeneous mass of gelatine, intersected by a number of very delicate septa.

The author now described the mode of propagation, which he stated was analogous to that of the polyps, in so far, that, 1*st*, there was a number of ova thrown off for the extension of the parent group ; and, 2*d*, another generation for the extension of the species generally. These ovules arose from the internal surface of the external tubular membrane, and consisted of a parent cell, containing young ones within it.

The author here directed attention particularly to the mode of growth in this and the simple Acephalocyst, as compared with that of the next known animal in the class, viz., the Cœnurus. He stated, that, in the first (Hydatid), one cell was thrown off from the internal surface of the vesicle, which increased in size by simple dilatation, without any cellular development whatever. The growth of the new form of Acephalocyst was exactly similar,—with this difference, that originally there was a parent cell which formed a number of young cells within it, each of which afterwards became the separate individual, by simple dilatation also.

The author, after describing the adult Cœnurus, then proceeded to state the observations he had made on its development from the ovule upwards. He stated, that the ovule, when observed within the body of the parent animal, was composed, first, of a germinal spot within a germinal vesicle, and which was enclosed in a yolk of very considerable size. The yolk, again, was surrounded by a very thin layer of albumen, defended by the shell or external covering.* After the ovum escaped from the parent, the germinal spot increased very much in size, and a small clear spot appeared in its centre.

During the third stage, the germinal spot had increased considerably in size, and had become nodulated; the central spot had also increased in size.

During the fourth stage, the nodules had become separate cells, surrounding a central cell, which had also a germinal spot within it. This again underwent similar changes, and was succeeded in turn by other crops of cells in like succession. This formation of cells, from a succession of centres, only extended the growth in a lateral direction, the author therefore named this the discoidal *period* of growth, which again he subdivided into minor *stages*.

After describing all the stages of discoidal development, he proceeded to point out a change that took place in the mode of development of the cells, and which, according to the direction of growth, he named the vertical *period* of growth.

During the discoidal *period* of development, all the cells were produced from one series or succession of centres; but during the vertical *period*, instead of one, there were several, each of which form

* The author looks upon these parts of the ovule as merely analogous to those of the higher animals.

young cells. The excentric cells of this *period* were all productive, and so, able to form new centres. The number of centres, however, were always limited, owing to the liquefaction and absorption of numerous peripheral cells.

The author, in the concluding part of his paper, stated, that during his observations, he was led to perceive the existence of many beautiful analogies between the Entozoa and the species belonging to other classes of the animal kingdom.

The volvox among the infusoria, he considered as the analogue of the Hydatid, and illustrated this by examining their economy comparatively.

The Alcyonidium among the Polyps, is the analogue of the new form of Acephalocyst. Ova in both cases being developed, 1*st*, for the purpose of increasing the bulk of the parent group; and, 2*d*, for the purpose of being distributed generally, to form separate and independent groups. In the function of nutrition the analogy also held true, inasmuch as each of the stomata or disks, it may be, supplied nourishment to the whole group, as well as to its own particular part; in the Alcyonidium, each polype acts as a mouth for the group.

Proceeding upwards in the scale, the author looks upon Diplozoon as the analogue of the Asterias, Tristoma, as that of Scutella and Distoma, that of Echinus; and brought forward an interesting observation, which he thought decisive as to the propriety of the analogies drawn between these Entozoa and Echinodermata, namely, that as the Echinus is merely an Asterias, with the rays folded back, so as to meet at the tips and form a globe, so is the Distoma merely a Diplozoon, with the two bodies folded together.

The Acanthocephala, of which the Echinorynchi are the types, are analogues of the Crustacea, through the Lerneæ. The Cœlelmintha, of which the Lumbricoides are the types, are analogous to the Annelida through the Lumbrici.

2. Account of a Repetition of Dr Samuel Brown's Processes for the Conversion of Carbon into Silicon. By George Wilson, M.D., Lecturer on Chemistry; and John Crombie Brown, Esq. Communicated by the Secretary.

The authors commenced with an account of the trials they made with the Cyanide of lead; which, according to Dr Brown's most recent announcement, is resolved by his process into gaseous nitrogen and silicon. In the first place, however, they could not succeed in obtaining a pure cyanide of that metal. For whether they decomposed the cyanide of potassium, or the hydrocyanate of ammonia containing an excess of hydrocyanic acid, by neutral acetate of lead, by this salt acidulated with acetic acid, or by tribasic acetate, they constantly obtained a compound containing a large quantity of a hydrated basic acetate of lead; and they were not more successful when they substituted other salts of lead for the acetate as a precipitant, such as the nitrate, basic nitrate, nitrite, chloride, or iodide. It was impossible, therefore, to obtain atomic results with the cyanide of lead. But several of the precipitates, obtained in the ways now mentioned, were subjected nevertheless to Dr Brown's process, and there was obtained a brown substance, which they expected to prove to be silicon. When fused, however, with carbonate of potash, instead of yielding more than twice its weight of silica, it gave only a tenth of its weight of a yellowish-white substance, which was not examined with any particular care, but which seemed to correspond with silica in its leading properties.

The Cyanides of copper and zinc were also rejected after adequate trials; and recourse was then had to the Cyanide of silver, which, it is well known, may be readily obtained pure and definite in composition. When similarly treated as in the process with cyanide of lead, it was converted by heat into a brown powder, with the loss of only a 400th of its weight; and when this was fused with carbonate of potash, there was obtained from the product a notable quantity of a substance corresponding in properties with silica, but still much inferior in quantity to what ought to have been obtained, had the whole carbon of the cyanide become silicon.

The authors next mentioned the results they obtained with the Ferrocyanides. The Ferrocyanide of potassium, when heated with carbonate of potash at a white heat, according to Dr Brown's earlier process, yielded them a saline mass, in which, in many trials, they could obtain only traces of a substance corresponding with silica in properties. Ferrocyanide of lead also yielded traces; Prussian blue none; Ferrocyanide of copper rather more than the similar salt of lead.

They then turned to Paracyanogen, which they treated repeatedly by Dr Brown's method of fusion with carbonate of potash. They were foiled, however, in obtaining his results. Paracyanogen obtained from cyanide of mercury, and purified by boiling it first with water, and then with solution of carbonate of potash, gave off, not nitrogen only, as Dr Brown has stated, but also carbonic acid and carbonic oxide; and the residue contained carbon. The authors, however, obtained some silica in the greater number of cases; occasionally none, even from paracyanogen prepared by Dr Brown himself; frequently very little; and never nearly the quantity which ought to have been obtained had the whole carbon become silicon, but fifteen per cent. at the utmost.

They also varied the process with Paracyanogen, by heating it alone for three days over an argand gas-flame in a malleable-iron crucible, luted and coated with stucco. A nut-brown powder, weighing 4.2 grains, was thus obtained from 18.5 grains of Paracyanogen. When 3.9 grains of this were fused with carbonate of potash, and the product treated as if it contained silicate of potash, the authors obtained 8.4 grains of a substance undistinguishable by any characters from silica. Had the brown powder been silicon, the product in this form should have been 8.11 grains. This experiment was twice repeated unsuccessfully.

The authors believe the substance obtained on this and other occasions to have been silica on the following grounds. It was a white, gritty powder, unalterable by ebullition in aqua regia for hours, or by exposure to a white heat, or to the full blow-pipe blast; fusible into a glass bead with carbonate of soda before the blowpipe; soluble with effervescence in fused alkaline carbonates, and recoverable from the product without any change of property; convertible, when heated with potassium, into a substance undistinguishable from silicon; and yielding fluo-silicic acid when heated with fluor-spar and sulphuric acid.

In conclusion, they deny that it is possible to ascribe the appearance of the silicon and silica in these experiments either to impurity of the re-agents employed, or to action upon the vessels constituting the apparatus. They consider, therefore, that silicon was produced in an anomalous manner; but they do not admit that it is proved to have come from the carbon; for it might have been derived as well from the nitrogen, or from both elements together. And they state, that they abandoned the farther trial of Dr Brown's processes, because they became satisfied, that his experiments cannot be repeated at will; and that the conditions essential to success have not been ascertained, nor the details of the processes sufficiently worked out, to afford the means of establishing the transmutability of carbon into silicon on quantitative grounds.

3. On Dr Mathew Stewart's General Theorems. By T. S. Davies, Esq, F.R.S.E.

The following Donations were presented to the Society since the last Meeting:—

Proceedings of the Academy of Natural Sciences of Philadelphia. Vol. i., Nos. 30, 31, 32, and 33.—*By the Academy.*

Proceedings of the Royal Irish Academy for the years 1841-42, and 1842-43.—*By the Academy.*

Sketch of the Civil Engineering of North America. By David Stevenson, Civil Engineer.—*By the Author.*

A Treatise on the Application of Marine Surveying and Hydrometry to the Practice of Civil Engineering, By David Stevenson, Civil Engineer.—*By the Author.*

Monday, 15*th April* 1844.

Very Rev. Principal LEE, V.P., in the Chair.

The following communication was read:—

1. Inquiry into the Aborigines of the British Islands. Part 2. On the claims of the Cymric and Gaelic races to be thus considered. By Dr S. Hibbert Ware.

In the first part of the present memoir, it was shewn that Cæsar divided Gaul into three parts, of which one was inhabited by the Belgæ, another by those who, in their own language, were called Celtæ, but who, by the Romans, were named Gauls, and a third by the Aquitani. These three nations, according to the Roman historian, differed from each other in language, custom, and laws; but it was remarked by the author, that they also differed from each other in physical characters,—the Belgæ possessing what is named a Cymric type, the Gauls proper a Gaulish type, and the Aquitani an Iberian type. All these three races were to be distinguished from the zanthous, light-haired, Germanic tribes of the West of Europe, not only by the dark colour of the hair and eyes, but by other particulars, as the form of the head, &c.

The present memoir was confined to (1*st*), the Cymric race, and (2*dly*), the Gaelic race.

(1*st*), *The Cymric race.*—The physiological distinction of Cymri and Gaelic races was first established by the late Dr W. F. Edwards, in his memoir "Des Caractères Physiologiques des Races d'Humain." The Cymric head is long, and often failing in width. The forehead is large and high ; the nose curved, with the extremity depressed, and the nasal ailes raised or turned up ; the chin strongly marked and prominent, and the stature tall. It was also explained by the author that these physical characters were associated with a distinct moral type.

It was argued, in the present memoir, that the Cymri had no real pretensions whatever to consider themselves (as in the ancient British triads) a primitive race in Britain. In tracing their progress from their oriental sojourning place to the remote west, they appear to have taken possession of no ground in any part of Europe which had not been preoccupied by other races. The author, in the course of arriving at this conclusion, gave the following historical account of the Cymri.

Sogdiana and Bactriana appear to have been the cradle of this race. At the present day, the Cymric type may be identified among the wandering tribes of Beloochistan, of which the author had evidence in some very accurate drawings, executed for him by his late son, during the expedition of Lord Kean.

The course of Cymric migration from east to west, was inferred by the occasional light which history affords of the physical characters of this early race, aided also by philological tests. The Cymric type is to be detected among some of the tribes anciently dwelling between the Caspian and Euxine seas, and in certain Egyptian sculptures, as figured by Rosallini, of the *Feccaro* (named by Wilkinson, *Tokkari*) dwelling, in the time of Rameses the Third, not far from the eastern shores of the Mediterranean. Various kinds of evidence also demonstrate, that the Cymri are to be traced, during their westerly migration, in Persia, along the shores of the Black Sea, in Greece, in Italy, and in the tracts watered by the Danube and the Rhine. They again appear as confederated tribes, known by the appellation of Boii, and Belgæ. Under the name of Firbolgs (Viri Bolgæ), they peopled Ireland, and, in occupying England and Scotland, they were lastly driven, by Saxon inroads, to the mountainous recesses of Wales. Various details of the greater or less prevalence of the Cymric type, as it is to be traced in these different countries, were supplied by the author.

(*2dly*), *The Gaulish, or Gaelic race.*—According to Dr Edwards, the head is round, so as to approach in a manner to a spherical form ; the forehead is moderate, a little swelled out, and retreating towards the temples; the eyes are large and open; the nose, in tracing it from the depression at its origin, is nearly straight, or without any marked curvature, and rounded at the extremity; the chin is also rounded. Lastly, the height is moderate; which, as Thierry, in his Histoire des Gaulois, first shewed, is an important historical distinction: for whenever the Romans spoke of the gigantic height of the Gauls, they meant their Cymric, and not their Gaelic foes. It was also explained that the moral type of the Gauls differed much from that of the Cymric race.

In considering the claims of the Gaelic race to be ranked as aboriginal in Britain, the author entered upon two questions, (*a*) their original sojourning place, and (*b*) their course of migration.

(*a*) The *Asiatic* cradle of the Gaelic race.—The author, after noticing the suspicion of Baron Larrey, that Arabia was to be thus considered, as well as the various opinions on this subject, advanced by Vallancey, Dr O'Conor, Sir William Betham, and others, was inclined to believe that the primitive Gauls were a polished and civilized people, originally dwelling on the eastern coast of the Mediterranean, who, as maritime adventurers, visited the west of Europe on objects of traffic, particularly for the sake of the precious metals. He did not consider it as necessary to this opinion, that they should be identified with the Phœnicians, or any other nation equally maritime; but left this question to be determined by more satisfactory evidence than has hitherto been adduced, resulting from a comparison of physical characters. It was also observed, that the leading physical characters of the Gael, namely, the form of the head and features, appear in the figures of certain sculptured monuments of the very early period of Rameses the Third, which, from a discordancy in other respects, have greatly puzzled both Champollion, and Rosallini. These figures of a civilized people, richly attired, are referred to inhabitants of Canaan or its confines.

(*b*) The course of Gaelic migration to the West.—The author was disposed to consider, that evidence of the westerly course of Gaelic migration might probably be found in the commercial settlements which early maritime tribes may have formed on the Mediterranean coasts and islands. He, accordingly, adverted to the remark of Baron Larrey, relative to the identity of the western Arabs with Gaulish races,—to the assertion of Gesenius, that the Numidian language was a pure, or very nearly pure, Hebrew, such as was spoken by the ancient Canaanites or Phœnicians,—and to various Cyclopean structures in Malta, on the African coast, and elsewhere, similar to those which characterise the westerly countries of the Gael. But the author dwelt most upon the account of the Turditani of Spain, as given by Pliny, to whom an early introduction of letters was ascribed, together with the use of valuable works of art wrought in the precious metals, resembling such as are constantly discovered in Ireland, which indicate the very early state of civilization in this country. The author then entered into a detailed description, from personal observation, of the greater or less frequency of the Gaelic type in France, Ireland, Scotland, and Wales; and of the causes to which its disappearance in many extensive districts might have been attributable.

After these explanations, the general question was considered,—What race ought to be regarded as aboriginal in the British islands? Llwyd had long since shewn, from the language of topography, that the Gauls had preceded the Cymri in the occupation of Britain. But it was asked,—if there might not have been a still earlier race existing in this country than the maritime and commercial Gauls?

To this question an answer was given in the affirmative. Tacitus, in his enumeration of British races, has suggested, that an ancient Iberian stock, remarkable for a swarthy complexion and curled hair, might have passed over and occupied the seat of the Silures (in South Wales);—a British tribe, with whom he was disposed to identify this primitive race of Spain.

It was then stated, that the author had collected abundant evidence which leads to the conclusion, that an Iberian, or Aquitanian race, was an older one in Britain than either of the two whose pretensions he had discussed; but that it would be in vain to establish their aboriginal claims, unless the history of the Cymri and the Gael, in reference not only to their Asiatic sojourning place, but also to their westerly course of migration, was well understood. He, lastly, expressed his hope, that, if the aboriginal claims of the Iberian race meet with confirmation, some light would be thrown upon the fossil bones of the human species which are found in caves, or buried deep in strata of peat, occasionally associated with the remains of animals now extinct, which have had an existence prior even to the records of history.

2. On the Knowledge of Distance given by Binocular Visions. By Sir David Brewster, K.H.

The following Gentleman was duly elected an Ordinary Fellow of the Society :—

Dr Thomas R. Colledge, Fel. Roy. Coll. Phys. Edin.

The following Donations of Books to the Society's Library were announced,

The Electrical Magazine. Conducted by Mr Charles V. Walker. Vol I., No. 2.—*By the Editor.*

Literarische Sympathien oder industrielle Buchmacherei : Ein Beitrag zur Geschichte der neueren Englischen Lexicographie, von Dr J. G. Flugel.—*By the Author.*

Fifty-Fifth Annual Report of the Regents of the University of the State of New York.—*By Dr Christison.*

Journal of the Asiatic Society of Bengal. Nos. 136, 137, 138, and 139.—*By the Society.*

Travels through the Alps of Savoy, and the other parts of the Parisime Chain, with observations on the phenomena of Glaciers. By James D. Forbes, F.R.S.S.L. and E., &c. &c.—*By the Author.*

Monday 6th May 1844.

Dr ABERCROMBY, V.P., in the Chair.

The following communications were read :—

1. On the Conversion of Relief by Inverted Vision. By Sir David Brewster, K.H.

2. On the Geology of Cockburn-Law and its Neighbourhood. By William Stevenson, Dunse. Communicated by David Milne, Esq.

The author, in the first part of his paper, described the nature of the formations, and in the last part offered his views in explanation of the appearances.

In describing the formations, he enumerated, first, those of *aqueous*, and last those of *igneous* origin.

I. The former consist of the greywacke, the old red sandstone, and the coal-measure formations.

(1.) The *greywacke* strata form the summit of Cockburn-Law, having a strike about NE. and SW. nearly vertical. There appears to be no decided evidence of any organic remains in these strata ;—there are curious markings which are most probably only concretionary. At Hoardwheel, situated to the eastward of Cockburn-Law, two varieties of copper ore are found in the greywacke, the green and the grey, the former of which is the most plentiful, and imparts a beautiful hue to the rocks. The oxide of manganese is also widely diffused.

(2.) The *old red sandstone* strata lie over the upturned edges of the greywacke, and have therefore been deposited at a more recent epoch. At a distance from the hills they are generally horizontal, or dip away at a gentle angle ;—but at the sides of the hills they are highly inclined,—a circumstance probably caused by an upheaval of the hills, which took place after the date of this formation. These old red sandstones are extensively developed in Preston Haugh. The lowest bed consists of pebbles or fragments of rocks, both angular and rounded, derived from the wearing down of the greywacke and porphyritic rocks. The colour of this formation is, especially towards its base, of a red colour.

It is in this formation, that the bones, teeth, scales, and spines of the *Holoptichius nobilissimus*, a large ganoid fish, described by Agassiz, were found by the author in 1840. These are remains of the same kind of fish which have been found in Perthshire, England, Russia, and in other parts of the globe, and which abounded at the epoch of the old red sandstone formation ; for wherever it is found, these particular rocks prevail. The nature of the strata in which it is found—a coarse, gritty sandstone—seems to indicate that the *Holoptichius* swam about in waters near the shore ; another proof of which is afforded by the ripple marks on the sandstone slabs near their place of sepulture. These interesting relics are very abundant in the strata opposite to Cockburn Mill, and also about half a mile below it, on the right bank of the Whitadder.

(3.) The *coal-measure* strata lie above the old red sandstone rocks, but are not disconformable to them in dip. They are to be seen in the Whitadder, below Preston Bridge, and consist of the ordinary sandstones, shales, and strata of ironstone. The only fossils prevailing in them are those of terrestrial vegetables, which probably had been drifted by rivers.

II. The *Igneous* rocks were divided by the author into two classes —one of which he described as the Felspathic, the other as the Augitic.

(1.) The *Felspathic* rocks comprehend all those igneous rocks associated with the greywacke strata, consisting of the granites, and syenites, and old porphyries of Cockburn-Law, the Staneshiel, the Knock Hill, Blackerstone Hill, &c. The central parts of these igneous masses present the most crystalline appearance, consisting there of pyramidal and wedge-shaped blocks. In those parts approaching to and in contact with the greywacke strata, a rhomboidal parallelopiped structure prevails,—which also characterises the aqueous rocks when in contact with the igneous. It is interesting to notice the effect produced on the greywacke strata, by the outburst through and among them of these igneous rocks. Where the two kinds of rocks are immediately in contact, all signs of stratification in the greywacke have been obliterated; and, indeed, these strata appear to have been metamorphosed into syenite.

(2.) The *Augitic* trap-rocks exist almost entirely among the more recent aqueous rocks, viz. the old red sandstones and coal-measures. They are seldom or never seen within the range of the greywacke formation, at least in this neighbourhood.

These augitic traps exist both in the form of narrow dykes, and in that of great masses constituting hills. Of the former, the Cumledge trap-dyke is a good example. It is seen in the bed of Oxendean Burn at Cumledge House, and there forms in amygdaloidal greenstone, abounding in veins of zeolite, steatite, and other minerals. The width of the dyke at this place is about ten yards. The average direction of the dyke is NN.W. and SS.E. It has had the effect, as usual, of hardening the strata on each side of it. This dyke has been traced by the author for a considerable distance, running through both the old red sandstone and coal-measure formations. It appears also to reach into the granite of the Staneshiel and Cockburn-Law.

An overflow of amygdaloidal trap is to be seen on the left bank of the Whitadder, below Cockburn Mill, forming a bed of about four feet thick, and lying above the old red sandstone strata. There are large accumulations of greenstone at Borthwick and Castle Mains. Dunse-Law is also composed of basalt.

In the *second* part of his paper, the author shewed that the outburst of the granite and other felspathic rocks had taken place simultaneously with the upsetting of the greywacke formation, and before the deposition of the old red sandstones. He also stated, that when, after the deposition of the coal-measures, a new outburst of igneous rocks took place, the Lammermuir chain probably received an additional upheave,—as the considerable dip of the old red sandstone from that chain could not otherwise be very well accounted for. The colour of the old red sandstones he attributed to the wearing down of the greywacke and porphyritic rocks of a red colour. The reason why the outburst of the porphyritic rocks took place before the augitic traps, he supposed might be the smaller specific gravity of the former.

Mr Stevenson's paper was illustrated by a geological map, as well as by numerous sections.

3. Notice regarding The Indian Grass Oil, or Oil of Andropogon Calamus-aromaticus. By Thomas G. Tilley, Phil. D. Communicated by Dr Christison.

The oil known as Indian Grass Oil, has been referred by Dr Royle to the Andropogon Calamus-aromaticus, a plant which he conceives to be identical with the Καλαμος αρωματικος of the Greeks. It has been used in medicine as a stimulant embrocation in rheumatism, &c.

The oil, which was green, became yellow when heated. It acquired a steady boiling point at 440°, between which temperature and 442°, a transparent colourless oil distil over. This, after rectification by chloride of calcium, was analysed, and found to have the following composition.

	Found.	Atoms.	Calculated.
Carbon	88.10	10	88.46.
Hydrogen	11.29	16	11.54.

from which data, it appears that the oil of grass contains, and chiefly consists of a carbo-hydrogen, in which the proportion of the carbon is to the hydrogen, as 10 to 16, as in the case of oil of turpentine, and other volatile oils of the same class.

The following Donations of Books to the Society's Library were announced :—

Mémoires présentés par divers Savants à l'Académie Royale des Sciences de l'Institut de France. Tome viii.—*By the Royal Academy.*

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Tome x., Part 1.—*By the Society.*

Annales des Sciences Physiques et Naturelles d'Agriculture et d'Industrie de Lyon. Tome v.—*By the Royal Society of Agriculture at Lyons.*

Bulletin de la Société Géologique de France. (Deuxieme Serie.) Tome i. Feuilles 8-10.—*By the Society.*

Memoirs of the Literary and Philosophical Society of Manchester. Vol. vii., Part. 1.—*By the Society.*

Journal of the Statistical Society of London. Vol. vii., Part 1.—*By the Society.*

Scheikundige Onderzoekingen, gedaan in het Laboratorium der Utretchtsche Hoogeschool. Deel ii. Stuk 4.—*By the Editors.*

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. Tome xvii., Nos. 25 and 26; and Tom. xviii., Nos. 1-14.—*By the Academy.*

The KEITH PRIZE having been irregularly announced, this opportunity is taken of laying before the Members of the Royal Society, in a separate form, the several awards, by the Council, of this Prize, from its institution to the present period, viz. :—

On 7th January 1828, to Dr Brewster, for his papers on his Discovery of two new Invisible Fluids in the Cavities of certain Minerals.

On 6th May 1833, to Mr Thomas Graham of Glasgow, for his Discovery of the Law of Diffusion of the Gases.

On 6th January 1834, to Sir David Brewster, for his paper on a New Analysis of Solar Light.

On 18th January 1836, to Professor Forbes, for his paper "On the Refraction and Polarization of Heat."

On 19th March 1838, to John Scott Russell, Esq., for his Researches on Hydrodynamics.

On 2d March 1840, to John Shaw, Esq., for his Experiments on the Development and Growth of the Salmon.

On 18th March 1844, to Professor Forbes, for his papers on Glaciers.

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