or 4·560 candles, gives the gain in light per cubic foot of gas due to the regenerative arrangement, the gas burning within a highly-heated atmosphere.

Date.	Particulars of Burners.	Pressure of Gas.	Consumption in cubic ft. per hour.	Candle-power.	Candle-power per cubic ft. of gas.	Corrected for loss by mirror.
May 6, 1885.	Gas jets taken out of lamp	Ten-tenths	20·0	57·5	2·875	...
,,	Same jets raised 18 inches to reflect light on mirror[1]	,,	20·0	55·0	2·750	...
,,	Same jets burning in cold lamp	,,	20·5	62·5	3·048	3·180
,,	Same jets burning in hot lamp	,,	15·5	115·0	7·420	7·740

Of course light may be diffused or transmitted indirectly by other means than those described, though not perhaps in a more simple or economical way. The electric light has been to a certain extent already treated in a similar way by suspending arc lights at great altitudes, and by means of reflectors concentrating the light down upon certain areas. The intention has been, by this means, to illuminate whole towns or districts of towns from single sources of light. This can, in the author's opinion, be done if the concentration of the light is effected in a different way from what has been hitherto attempted—viz., by the employment of very much larger reflectors. In this way the loss of light sideways and the deep shadows that have been produced will be avoided. It matters very little at what height the light is placed, the chief question being what area has to be illuminated; and then the form of reflector suitable for the purpose can be easily determined upon.

In conclusion, it must be remembered that illumination from above downwards is in nearly all cases the preferable mode of distributing light, as Nature herself proves in having one light only, the sky being the diffusing agent by which the most perfect distribution of light is effected. Nature possesses, indeed, a gigantic reflector in the atmosphere and clouds; and the author has endeavoured to imitate Nature's reflector in a way suitable to our imperfect means and conditions, and to the circumstances of each individual case.

THE VOYAGE OF THE "CHALLENGER."[2]

II.

THE plan adopted in the narrative of the cruise gives the reader a good idea of the course of the voyage, the nature of the researches carried on, and the manner in which these researches have been followed up by the more detailed studies of the experts into whose hands the collections were afterwards placed. But it is necessarily desultory. We are led from station to station, from chemical to biological work, from physics to ethnology, from deep-sea temperatures to the anatomy of sea-slugs, with a rapidity and suddenness that are a little bewildering. Still, the general impression of the far-reaching aims of the expedition, of the skill and completeness with which the work was done, and of the enormous mass of new material obtained, is no doubt deepened by the difficulty or impossibility which the narrators have obviously experienced in giving within the brief compass of their chapters anything like a comprehensive digest of what the *Challenger* voyage accomplished in regard to the problems of the great deep. The reader must resign himself to be carried along as the naturalists of the expedition themselves were, and to listen to their story of what they saw and found.

In our notice of last week we left the *Challenger* at the Cape of Good Hope. From that station she strikes out boldly into the Southern Ocean, giving us glimpses of the Prince Edward and Marion Islands, with their proofs of recent volcanic action, the Crozet Islands and Kerguelen. In this part of the voyage the trawlings are extraordinarily rich, between one and two hundred animals coming up at each haul, representing nearly all the marine groups, and, with few exceptions, belonging to genera and species discovered now for the first time. Among the more interesting forms of life are various crinoids, the mention of which leads to a summary from Dr. P. A. Carpenter and Prof. L. von Graff of their Reports upon the additions to our knowledge of the recent crinoids made by the expedition Fig. 4). The figures of the living *Pentacrinus* remind the

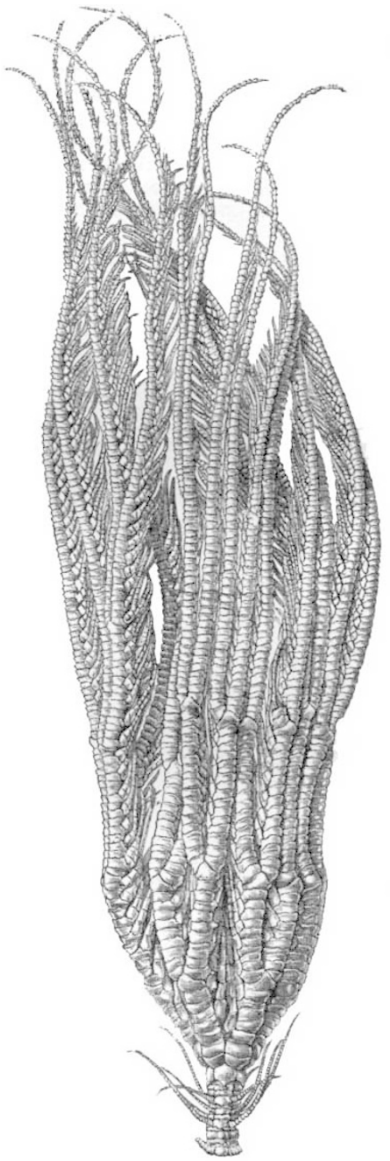

FIG. 4.—*Metacrinus Wyvillii*, P. H. Carpenter.

[1] This shows a loss of 4·35 per cent. owing to absorption by mirror.

[2] "Report on the Scientific Results of the Voyage of H.M.S. *Challenger* during the years 1873-76." Prepared under the direction of the late Sir C. Wyville Thomson, and now of John Murray. "Narrative," vol. I., 1885. Continued from p. 207.

geologist of the familiar Liassic *Extracrinus*, and give a singularly antique aspect to the fauna. Not less interesting is the living *Rhizocrinus*, which is a dwarfed and degraded descendant of the well-known chalk fossil *Bourgeticrinus*, as this in turn appears to have been a dwarfed representative of the Pear-encrinites of the Jurassic rocks. The genus *Bathycrinus*, previously known only from a single immature specimen, is now shown to have a wide extension in the Atlantic, but is not known in the fossil state. While the stalked crinoids have been dying out, the Comatulæ, or Feather-Stars, are probably more abundant now than at any former geological period, no fewer than four hundred species being now known, and three of the six genera into which they are referable having been discovered by the *Challenger*. In connection with the subject of recent crinoids some interesting observations are given regarding the Myzostomid parasites that infest these creatures and produce singular mal-formations. The resemblance of these distortions to those found upon many fossil Palæozoic crinoids no doubt indicates the presence of similar parasites even in the waters of the Palæozoic oceans. From the rich trawlings below water we are led by the narrative to the abundant bird-life of the Southern Ocean and to the conclusions regarding the structure and affinities of the Petrels reached by that able and lamented naturalist, the late Mr. W. A. Forbes.

From the pages of the narrative a good notion of Kerguelen with its snowfields and lavas, and Heard Island with its ice-cliffs and glaciers can be obtained. The profusion of life in these southern waters is not a little remarkable—sponges, alcyonarians, holothurians, ophiurids, asterids, echinids, annelids, amphipods, polyzoa, gasteropods, cephalopods, and many other invertebrates. But the *Challenger* now pushes southward to the Antarctic ice-cliffs, and as these seas are but little known, full details of this part of the navigation are given, with the soundings, dredgings, trawlings, and temperature observations taken along the route. Numerous woodcuts, phototypes, and chromolithographs of icebergs observed in the Antarctic Ocean are inserted, and a special chapter is devoted to the history of exploration in these seas, and to an account of observations made by the scientific staff of

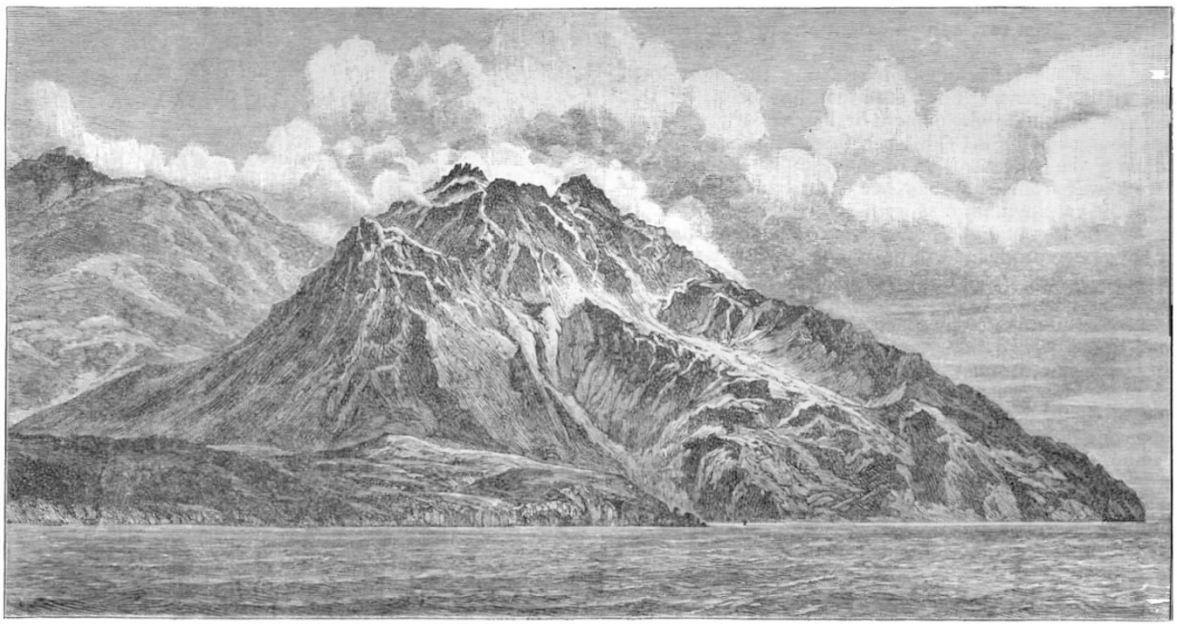

FIG. 5.—New Volcano, Camiguin Island.

the *Challenger* on Antarctic temperatures, the density of sea-water, the true composition of sea-water ice, Antarctic icebergs, the deposits formed on the sea-bottom in the icy tracts of the Southern Ocean, the surface organisms of these seas, and a detailed summary regarding the hexactinellid and tetractinellid sponges collected.

Escaping from the perils of the ice-fields and Antarctic gales the vessel bears away to Australia, touching at Melbourne and Sydney and then, passing between the North and South Islands of New Zealand and northwards to the Fiji Islands, turns westwards again, through the Coral, Celebes and China Seas to Hong Kong. The account of this portion of the voyage is enriched with descriptions of numerous groups of animals collected during the expedition, particularly macrurous and brachyurous crustaceans, butterflies and moths, medusæ, starfishes, amphipods, lamellibranchs, annelides, calcareous and horny sponges. The next track, from Hong Kong by Manila, Zebu, and the Admiralty Islands to Japan, takes up nearly 100 pages of the narrative. Among the more interesting observations recorded are those relating to the volcano of Camiguin Island, which burst forth upon a low plain in the summer of the year 1871 and in four years and a half rose to 1,950 feet in height, with abundant discharge of steam and with glowing lava at its summit (Fig. 5). The mountain is a dome-shaped mass rising from the seashore. It consists of various andesitic lavas but seems to possess no crater, resembling in this respect some of the trachytic domes of Auvergne. The lava is described as having apparently "issued from a central cavity and boiled over, as it were, till it set into the form of the dome." Probably the volcano is an example of the extravasation of viscous lava in successive shells, of which the outer are pushed outwards and upwards by the arrival of fresh material from below, as illustrated experimentally by Reyer. Mr. Busk supplies a *résumé* of his Report on the Polyzoa of the expedition. Professor E. Perceval Wright gives one on the Alcyonaria; Dr. Rudolph Bergh, one on the Nudibranchs; Professor Turner, one on the crania of the Admiralty and other Pacific Islanders; Professor G. O. Sars, one on the Schizopods and other crustaceans.

From Japan we are transported to the centre of the Pacific Ocean, and learn much by the way regarding the

distribution of temperature in this vast expanse of water. A series of soundings taken from lat. 40° N. to lat. 40° S. affords a section of the very centre of the ocean through the volcanic peaks of Hawai and Tahiti. Perhaps no single part of the sounding work of the expedition offers a more impressive example than this of the boldness and success with which the problems of the deep sea can now be attacked. Down the middle of the widest and deepest ocean on the face of the globe a line of temperature soundings is taken with as much precision as if it had been an inland lake, and information is obtained that furnishes a clear picture of the depth of the water, the form of the bottom, and the manner in which the layers of different temperatures are superposed upon each other from the surface downwards. A careful survey of the coral-reef of Tahiti by Lieutenant Swire and Mr. Murray suggested to the latter observer the view which he has already published—that this reef and coral-reefs in general may be formed by the outward growth of the living coral upon a *talus* of coral-rock broken off by the waves, and do not prove subsidence as was believed by Darwin. Among the corals, briefly described by Mr. Moseley, probably the most beautiful of the madrepores is the delicately fragile *Leptopenus* trawled from a depth of 2,160 fathoms between Juan Fernandez and Valparaiso (Fig. 6). Prof. Hubrecht of Utrecht supplies some notes on the *Nemertea* in anticipation of his detailed Report on this subject. A summary is given of Mr. H. B. Brady's studies of the *Foraminifera*, which are so abundant in the surface waters and play so important a part in the formation of deep-sea deposits; and a digest of the Report of Dr. G. S. Brady on the copepod and ostracod crustaceans. But perhaps the most generally interesting section of this part of the narrative is that which treats of the nature of the organic deposits now forming on the floor of the deeper parts of the ocean. The important results obtained by the *Challenger* expedition in this novel department of enquiry have already been made familiar

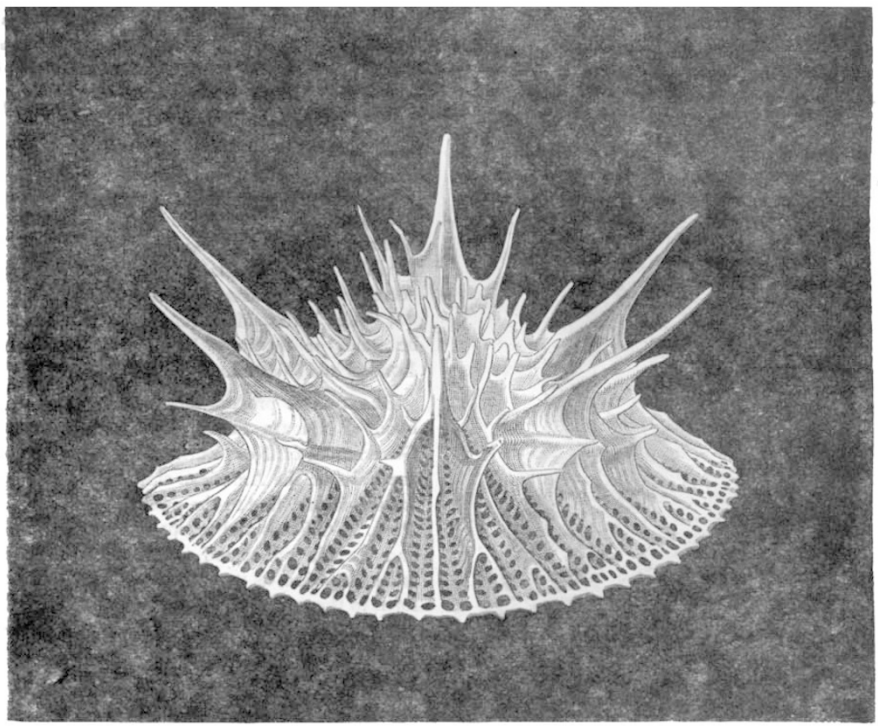

FIG. 6.—*Leptopenus hypocœlus*, Moseley.

by the writings of Messrs. Murray and Renard. But the reader will be glad to have them re-stated in the official account of the voyage, and to find them so admirably illustrated with woodcuts and a lithographic plate, which enable him to realise exactly the nature of the evidence for the extreme slowness of deposition at these great depths and so far from land. From no fewer than 116 sharks' teeth brought up with over two bushels of manganese nodules in a single haul from a depth of 2,385 fathoms, Fig. 7 has been selected for illustration. It differs in no essential particular from the tooth of *Carcharodon megalodon*, so common in Tertiary strata, except that it shows no large base.

Quitting Valparaiso, the *Challenger* pursues a southerly track to Port Otway, and then winding through the long line of sounds between the islands and the mainland passes through Magellan Strait to the Falkland Islands, and thence to Monte Video. During this part of the narrative we learn from Dr. Hoek what he has found out regarding the Cirripedes and Pycnogonids obtained during the cruise; from Mr. F. E. Beddard regarding the Isopods; from Mr. R. B. Watson about the Scaphopods and Gasteropods; from Mr. J. R. Henderson about the Anomurous Crustaceans; from Dr. Günther respecting the deep-sea fishes; and from Prof. E. Selenka regarding the *Gephyrea*. The course is then shaped eastward from Monte Video, across the South Atlantic to Ascension, and during the account of this *traverse* we are shown how the foraminiferal deposits of the deep sea were collected and investigated, and are supplied with a useful summary of the results arrived at by Messrs. Murray and Renard regarding deep-sea deposits in general, illustrated with an excellent coloured plate, which, in default of the actual objects themselves, brings their characters very clearly before the eye. As the narrative proceeds with the account of the homeward voyage from Ascension, we are told about pelagic diatoms, marine infusoria, coccospheres, rhabdospheres, bathybius, and the land-plants

collected during the whole of the cruise, till at last the voyage ends at Spithead, on May 24, 1876. From the start on December 7th, 1872, till that date the vessel had traversed 68,890 nautical miles, and at intervals as nearly uniform as possible had established 362 observing stations.

The final chapter gives a summary of the results obtained by the officers of the Expedition, and by experts subsequently employed in the investigation of the density of sea-water, the composition of the salts of the ocean, the geographical and bathymetrical distribution of specific gravity, the carbonic acid, nitrogen, and oxygen present in sea-water, and a discussion of meteorological observations in their bearing upon oceanic circulation.

In this notice we have endeavoured merely to convey to the general reader some notion of the contents of the two portly volumes which contain the official narrative of the most important scientific expedition which has ever been despatched by any Government for the investigation of the depths of the ocean. The materials are not yet ready for a complete digest of the whole work achieved. But it would have been an important addition to the value of the Narrative had the authors endeavoured to give such a digest as far as the materials are now in their hands, marking those portions regarding which the final reports had not been received. Such a summary, carefully arranged in subjects and with precise references to the detailed Reports for fuller information, would have been of great service to those who cannot follow all the technical details of the Reports, as well as to the specialists who wish to learn to what source they have to turn for their own requirements. Let us hope that in a future edition of the narrative this want will be supplied. Meanwhile no one can rise from the perusal of these volumes without an admiration for the solid, painstaking, and conscientious way in which their compilation has been accomplished. They are not light reading, but they abound in material of general interest and form a fitting record of the great Expedition which they chronicle.

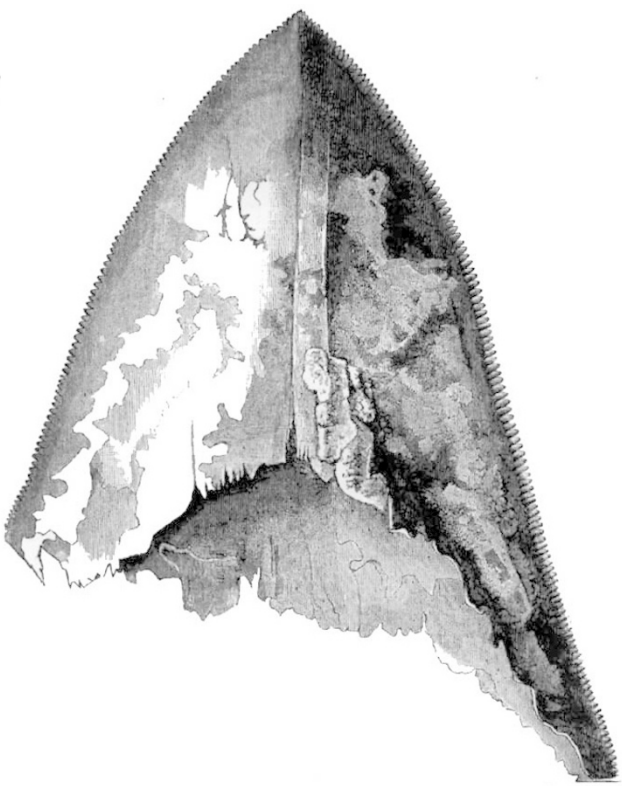

FIG. 7.—Tooth of a Shark (*Carcharodon megalodon*) from a depth of 2385 fms.

NOTES.

THE fourteenth meeting of the French Association will take place on August 12 at Grenoble. M. Verneuil, Member of the Academy of Medicine, will be President. The public lectures will be "On the New Gallery of Palæontology of the Paris Museum," by M. Cotteau, ex-chairman of the Geological Society of France, and by M. Rochard, General Inspector of the Marine, on "The Victualling of France." A large number of medical questions will be dealt with in the several sections of the congress. The Ferran cholera experiments are sure to be discussed at full length. Numerous excursions will take place in the Alps under competent guidance as far as Chambery.

IN the course of the present summer the *Geological Magazine* will be twenty-one years old. During that period Dr. H. Woodward has been one of its editors, and for almost the whole time the principal editor, on whom the burden of the work has fallen. Further, the arrangement made with the publishers, in order to secure the continuance of the *Magazine*, would have actually resulted in pecuniary loss, but for illustrations presented by authors. Of the ability with which the *Magazine* has been conducted, and of its value to geologists, there can be no question. A committee has been formed, with Prof. Bonney as chairman, to give expression to their sense of the services which he has rendered to geology by presenting him with a testimonial, of which a piece of plate will, at any rate, form a part. The secretary and treasurer of the committee is Mr. G. J. Hinde, 11, Glebe Villas, Mitcham, Surrey, to whom subscriptions may be paid, or to the "Woodward Testimonial Fund," at the London and Westminster Bank, Limited.

ELABORATE preparations have been made in the neighbourhood of Niagara Falls for the formal transfer to-day to the Government of New York State of the strip of land adjoining the Falls on the American side. This strip will be thrown open for the future, free to the public, as "The Niagara International Park." Officials and troops representing both New York State and Canada will attend the ceremonies. This transfer attracts much attention, as it renders America's great cataract free henceforth to the world. We have already alluded at some length to the acquisition of the Falls and immediate neighbourhood by the State

THE annual meeting of the Royal Archæological Institute will be held at Derby from Tuesday, July 28, to Wednesday, August 5, inclusive. The presidents of the three sections will be:—Antiquarian, the Rev. J. C. Cox, LL.D.; Historical, the Dean of Lichfield; Architectural, the Right Hon. A. J. Beresford-Hope.

THE observations made at the Ben Nevis Observatory have been received to the end of June. During the twelve months ending with June the rainfall, snow, and hail have been measured with all possible care every hour. During the year the whole of the rainfall, inclusive of melted snow and hail, amounts to 152·15 inches. Averaging the monthly falls from June, 1881, the mean annual rainfall on the top of Ben Nevis is 145·73 inches, which is thus the largest mean annual rainfall of any place at which rain has been observed in Scotland. The largest rainfall in any single month was 25·30 inches in December, 1884, and the smallest 4·85 inches in April, 1885. Falls of an inch a day, or upwards, are of comparatively frequent occurrence, having been recorded during one day in seven out of the 365 days. On two of the days upwards of four inches of rain was measured at the Observatory.