collections kept for sale by him, and many colleges and other cabinets in the United States contain series purchased from him, furnished at very reasonable prices.

THE Newcastle-on-Tyne College of Physical Science has issued its prospectus for the Session 1872-73. The first Session closed with 70 day and over 100 evening students, and considerable accessions are hoped for. The teaching of Biology is still conspicuous by its absence; but there is so strong an element of Natural History on the governing board of the College that we may hope the just claims of this branch of science may not be disregarded much longer. Why is the obsolete term "Natural Philosophy" retained among the subjects taught? It is here apparently meant to embrace Mechanics, Hydrostatics, and Optics. An examination will be held on October 7 and 8 for four exhibitions of 15*l.* each, tenable in the College for two years, in Arithmetic, Algebra, and Euclid, and either Geology, Heat, or Chemistry.

IN 1871 the important papers of Dr. Petermann upon the Gulf Stream, with their accompanying maps and charts, were translated into English and published by the United States Hydrographic Office, under the direction of Captain R. H. Wyman. Since then two supplements have been issued by the office, including additional information obtained by Dr. Petermann, the second one accompanied by a map of the northern regions of Europe and Asia east of Greenland. This, which is on quite a large scale, gives us the results of the discoveries made up to the end of 1871, including the work done by Lamont, Mack, Johannesen, Payer and Weyprecht, Rosenthal, &c. The text of this supplement contains reports of the cruises of Smith and Ulve, and of Captain Torkildsen, papers on the sea north of Spitzbergen, and on Gillis's Land and King Charles's Land, &c. Petermann is of the opinion that, as far as the discoveries of land go, the results of Smith and Ulve are more important than those of any cruise between Greenland and Siberia for many years past, as they show that the north-east line of Spitzbergen extends across 10½ degrees of longitude instead of the 7½ previously assigned, this extension including the southern coast as well as the northern. The easternmost point reached by this expedition was a little beyond the 28th degree of east longitude.

AT no previous period (says *Harper's Weekly*) has there been so much activity displayed on the part of the United States Government in the way of thorough explorations of its territories, the liberality of Congress at the last session in authorising such having been very great. The operations of the Coast Survey have been largely extended, including the commencement of a triangulation between the coasts of the Atlantic and Pacific. Arrangements have been made for extended surveys by the Navy Department of the North Pacific, and an appropriation also made for the expense of making the observation of the coming transit of Venus. Under the War Department are progressing the new survey of the northern boundary of the United States, between the Rocky Mountains and the Lake of the Woods, the geological survey of Mr. Clarence King along the fortieth parallel, and the surveys in Utah and Nevada by Lieutenant George M. Wheeler; while Dr. Hayden's work in the Interior Department is advancing satisfactorily in its two main divisions, as also that of Major Powell along the Colorado.

THERE are at this time four chemical laboratories in Japan, where the science is taught, three of them being presided over by Germans and the fourth by an American. The chief one is at Osaka, where there are nearly 100 students. The rest are at Kaga, Shidzoka, and Fukuwi. A fifth will soon be opened at Jeddo. The students are said to be fairly intelligent, but their minds are at present encumbered with astrology and other kinds of spurious philosophy.

THE BRITISH ASSOCIATION

SECTION A—MATHEMATICAL AND PHYSICAL SCIENCE

On the Application of Photography to Copy Diffraction Gratings, by the Hon. J. W. Strutt.

GREAT interest has always attached itself to the beautiful phenomena discovered by Frauenhofer, which present themselves when a beam of light falls on a surface ruled with a great number of parallel and equidistant lines. Their unexpected character, the brilliant show of colour, and the ready explanation of the main point on the principles of the wave theory, recommend them to all; while the working physicist recognises in them the key to the exact measurement of wave-lengths, which has been so splendidly used by Angström and others.

The production, however, of gratings of sufficient fineness and regularity is a matter of no ordinary difficulty. Indeed, the exactness required and obtained is almost incredible. The wave-lengths of the soda lines differ by about the thousandth part. If in two gratings, or two parts of the same grating, the average interval between the divisions differed by this fraction, the less refrangible soda line of one would be superposed on the more refrangible corresponding to the other. In point of fact the gratings ruled by Nobert, to whom the scientific world has been greatly indebted, are capable of distinguishing a difference of wave-length probably of a tenth part of that above mentioned. But in order that the D lines may be resolved at all, there must be no average error (running over a large part of the grating) of $\frac{1}{1000}$ part of the interval between consecutive lines. When it is remembered what the interval is (from $\frac{1}{1000}$ to $\frac{1}{6000}$ of an inch, or even less), the degree of success which has been reached seems very remarkable.

A work requiring so much accuracy is necessarily costly—the reason, probably, why gratings fit to be used with the telescope for the purpose of showing the fixed lines are comparatively rare. The hope of being able to perfect a process for the reproduction of gratings at a comparatively cheap rate has induced me to return at the first opportunity to the experiments described in a preliminary note read before the Royal Society in June last. Although the subject is as yet by no means exhausted, I have thought it worth while to bring before the Section an account of the progress that has been made, with specimens of the results.

The method of procedure is very simple. A dry plate prepared by any photographic process on a *flat* surface of glass or other transparent material not affected by the fluid media employed, is brought into contact with the ruled surfaces of the grating in a printing frame, and exposed to light. In my first experiments I used exclusively as a source of light the image of the sun in a lens of short focus placed in the shutter of a darkened room; but so small a source is not necessary. The light from the clouds or sky, reflected by a mirror through a hole several inches in aperture, will be sufficiently concentrated if the frame be a few feet distant. I have not as yet specially investigated the point, but I believe that if the light were too much diffused the experiment would fail. Much would, no doubt, depend on the perfection of the contact—an element very likely to vary.

The variable intensity of diffused daylight, which it is almost impossible to estimate with precision, has induced me to use exclusively in my later experiments with ordinary photographic plates the light of a moderator lamp. This, with globe removed, is placed at a distance of one or two feet from the printing frame, the distance being carefully measured. Working in this way there is little difficulty in giving consecutive plates any relative exposures that may be required. A collateral advantage is the possibility of operating at any time of the day or night.

With regard to the preparation of the plates, I have latterly been using the tannin process introduced by Major Russell. A preliminary coating with dilute albumen is generally advisable, as any loosening of the film from the glass must be avoided, on account of the distortion that it might introduce. In some states of the collodion, an edging of black varnish put on after the exposure is sufficient to hold the film down. The glasses, after being coated with collodion (I have used Mawson's), are immersed as usual in the silver bath, and then allowed to soak in distilled water, best contained in a dipping-bath. They are then washed under a tap for about half a minute, and put into the tannin solution (about 15 grains to the ounce) held, in my practice, in a small dish. I usually prepare my plates in the evening, standing them up to dry on blotting-paper. In the morning they are in a fit state for use. Artificial heat might no doubt be used if a more rapid drying were desired.

At a distance of one foot from the lamp the exposure required is four or five minutes. The development is the most critical part of the process. The pyrogallic solution should contain plenty of acid (acetic or citric), and its action must not be pushed too far, the mistake which a photographer accustomed to negative work is most likely to make. At this stage the spectra given by a candle flame are not very brilliant, on account of the iodide of silver still covering the parts which are to be transparent. Any trace of fog is especially to be avoided. I have experienced advantages in many cases from a solution of iodine in iodide of potassium applied to the film previously to fixing; but its action must be carefully watched, or too much silver will be converted. The iodide of silver is then cleared away with hyposulphite of soda or cyanide, followed by a careful washing under the tap.

With regard to the gelatine copies, I have not much to add to the account read before the Royal Society. The process is very simple, and some of the results very perfect; but I have not hitherto succeeded in sufficiently mastering the details. Plates apparently treated in precisely the same manner turned out very differently. That difficulties should arise is not very extraordinary, considering the novelty of the method; but it is curious that some of the very first batch prepared are among the best yet produced. The value of the results is so great that I have no intention of abandoning my attempts, and perseverance must at last secure success.

I will now say a few words about the performance and prospects of the new copies. Their defining power on the fixed lines in the solar spectrum is all that could be desired, being, so far as I can see, in no way inferior to the originals. In the third spectrum the 3,000 to the inch gratings show the line between the D's, if the other optical arrangements are suitable. The fourth line of the group, *b*, is distinguished with the utmost ease. I am not sufficiently familiar with spectroscopic work to make an exact comparison, but I presume that two prisms of 60° at least would be required to effect as much. I am here speaking of photographs on worked glass. With ordinary patent plate, although very good results may be obtained, if tested by the naked eye only, it is a great chance whether the magnifying power of a telescope will not reveal the imperfect character of the surface.

With direct sunlight the light is abundantly sufficient, but it is here in all probability that the weak point of gratings lies. It should be distinctly understood that where light is deficient gratings will not compete with prisms. There are cases, however, where the scale might be turned by the opacity of all highly dispersive substances to the rays under examination. Even if glass be retained as the substratum, it may be used in a very thin layer, while prisms are essentially thick. The immense advantage of a diffraction spectrum for the investigation of dark heat need not here be insisted on. Taking all things into consideration, it is probable, I think, that photographed gratings will supersede prisms for some purposes, though certainly not for all.

The specimens in the hands of Mr. Ladd are copies of two gratings by Nobert, each of a square inch in surface, the one containing 3,000 and the other 6,000 lines. The latter cost about twenty pounds.

SECTION C.—GEOLOGY

Monday, Aug. 19.—*On the Occurrence of Erect Bases or Trunks of Psaronius in the Devonian Rocks of New York, U.S.A.*, by Prof. James Hall.

During the year 1870 some excavations were made in beds of fine sandstone, referred at that time to the upper part of Hamilton's group, but which probably belong to beds higher in the series. In these beds several thousand trunks of tree-ferns were found in an upright position, with their bases resting in and upon a bed of clay, in which they appear to have originally grown. In the clay, and in the sandstone above, to the height of two or three feet, great quantities of vegetable substance occurred. Principal Dawson refers these trunks to the genus *Psaronius*, and he has determined two or more species from the locality.

These facts were held to indicate a point of comparatively dry land upon the eastern margin of the Devonian Sea. Receding from this ancient shore we find the sands and slates to become finer, and the latter to change into calcareous muds. For some distance the shells occurring in these beds are all Lamellibranchs, and it is only when we have travelled a considerable distance to the westward that Brachiopods appear. The author then entered into some detail as to the mode of accumulation of these beds, which are admirably exposed along a line of outcrop 300 miles in length.

Sur les Animaux Fossiles du Mont Leberon, Vaucluse, by Prof. A. Gaudry.

The author remarked that the fossils found by him and others in this place bore a striking similarity to those he had before collected in Attica. In comparing the 4,940 bones from the latter place with the 1,200 from the former, he had been much struck with the great variations exhibited by animals that seem to descend from the same parent. The presence of numerous and large herbivores proves the existence of a considerable extent of meadow-land during the Miocene period.

Brief Notice of the Present State of our Knowledge in connection with the Brachiopoda, by Thomas Davidson, F.R.S.

The object of this paper was "not to trouble you with details, but to mention, in general terms, what has been the advance effected in this portion of palæontology since 1853, the period at which I first published my general introduction." Mr. Davidson first alluded to the general question of classification, dissenting from the views of Prof. Morse, who wished to remove the Brachiopoda from the Mollusca, and to place them with the Annelides. The great importance of the Brachiopoda to the palæontologist was then dwelt upon, and the author remarked that "many instances are on record where the sight of a few specimens of Brachiopoda have enabled a palæontologist to determine accurately the age of a rock in some distant land to which he had no access." Mr. Davidson stated that the number of so-called species of recent forms amounted to about 100, but that probably the number would have to be reduced to about 60. "The number of so-termed species of *Lingula* had been greatly exaggerated, and a certain number of the others are known only by a single specimen."

Tuesday, Aug. 20.—Mr. H. Woodward read his *Sixth Report on Fossil Crustacea.* The report was illustrated by a large number of diagrams, and announced the discovery of new crustacean forms in Silurian, Coal Measure, and Permian rocks.

Remarks on the Genera Trimerella, Dinobolus, and Monomerella, by Thos. Davidson and Prof. W. King. The authors proposed to group these three genera into a new family to be called Trimerellidæ. It was shown to be structurally allied to the Linguliдæ, and it was inferred that the two families were genetically related. This is a point of great interest, inasmuch as the Linguliдæ are the earlier forms, occurring in Cambrian rocks, whilst the Trimerellidæ first appear in the Silurian strata. The Cambrian Lingulas have a horny shell, and so too have generally the animals associated them. In later formations the Brachiopods and other animals have much more calcareous shells; and from these facts it was inferred that lime was less abundant in the Cambrian sea than during later periods. As the result of long labour in this field of research, the authors were led to adopt the doctrine of evolution of species "effected mainly through the operation of Divine laws, and not by purposeless or accidental modifications." The paper concluded with detailed descriptions of the structure of the Trimerellids.

The Rev. John Gunn's paper was then read *On the Prospect of Finding Productive Coal Measures in Norfolk and Suffolk, with Suggestions as to the Places best adapted for an Experimental Boring.* The author controverted the views expressed by Sir R. Murchison as to there being no coal beneath these counties, and on the following grounds:—The "Anglo-Belgian Basin," in which the forest bed was deposited, is bounded by the chalk on the west and south, and by older rocks on the east. It was contended that this area has been characterised by vegetable growths at several successive periods; and that as regards the coal-growths, these were accumulated in a basin bounded by the carboniferous limestone, just as the forest-bed was accumulated in a basin bounded by the chalk. Hunstanton was suggested as the best place to bore; because there the cretaceous rocks have been denuded, and there too some of the oolites are absent. Probably the bore would not exceed 1,000 feet in depth.

An interesting paper was then read by the Secretary, forwarded from Bonn by G. vom Rath, *On a remarkable Block of Lava ejected by Vesuvius during the great Eruption of April* 1872, *proving the Formation of Silicates by Sublimation.* This was a block of old lava which it is assumed had been floating in the melted lava of the late eruption, and was subsequently ejected by the volcano. It shows that in its interior there were formed crystals of pyroxene, mica, sodalite, specular iron, and magnetite;

whilst at the exterior the pyroxene was melted and the leucite destroyed.

The author particularly pointed out that sodalite, which was found sublimed in the interior of the block, is the silicate most rich in sodium. This he contended was not an accidental circumstance, but resulted from the percolation of sea-water charged with chloride of sodium. The author remarked that the study of such matters is conducting us to the conclusion that the quantities of water, hydrochloric, and sulphuric acid, &c., exhaled by craters and streams of lava, are not only an accompanying phenomenon in the production of volcanic rocks and mineral aggregates, but that they are essentially co-operating at their origin. If once we succeed in proving and explaining the origin of minerals through vapours, or under the co-operation of vapours, then the key to many problems relating to the plutonic rocks and their minerals will be found.

A few Remarks on Submarine Explorations, with Reference to M. Delesse's work entitled "Lithologie du fond des mers," by J. Gwyn Jeffreys, F.R.S.

The lithology of the sea-bottom is not only a vast subject in its various relations to natural history and physical science, but is especially interesting in a geological point of view, because every part of our globe has been at one period or another covered by the sea. Mr. Jeffreys contended that it is almost impossible to ascertain with any degree of certainty what stratified formations are marine, unless we find in them such remains of marine animals as were capable of being preserved. Exceptions doubtless occur, *e.g.* where the stratum had been subject to the action of carbonic acid, produced by the subsequent passage of rain or fresh water; in which case all cretaceous organisms might have been dissolved before they became silicified or petrified. He then gave a short account of submarine explorations, from the time when O. F. Müller first used a dredge for scientific purposes (about 1772), to the present day; and he summarised the results of the expeditions conducted by his colleagues and himself on board H.M.S. *Porcupine*, under the auspices of the Royal Society in 1869 and 1870. But next to nothing is known of the enormous tracts of sea-bed which underlie the depths of the ocean in both hemispheres. He attributed the diffusion and geographical distribution of the marine invertebrate fauna to the action of currents, and not to voluntary migration.

M. Delesse's work was recently published at Paris, and consists of two octavo volumes, besides an atlas of charts and maps. The precise date of publication does not appear; the dedication is dated December 1, 1871. It forms part of a series called "Publications scientifiques industrielles," and purports to have been published with the sanction of the Ministers of Marine and Minister of Public Works.

While giving M. Delesse full credit for the laborious and conscientious manner in which he has evidently performed his great task, Mr. Jeffreys regretted that he had omitted to notice the reports on deep-sea explorations published by the Royal Society in 1869 and 1870, or the Address of Mr. Prestwich (the late President of the Geological Society), which was published in May 1871, and particularly treated of those reports. M. Delesse is a foreign member of the Geological Society. By consulting what had been published on the subject, M. Delesse would have been able not only to give fuller information, but to correct errors which unavoidably occur in an extensive compilation. For instance, his map of France during the tertiary epoch does not show the communication which has been proved by naturalists and geologists to have then existed between the Bay of Biscay and the Gulf of Lyons. According to M. Delesse, there has been no communication since the Liassic period between the Atlantic and the Mediterranean north of the Pyrenees. His division of the French marine fauna into three provinces (Celtic, Lusitanian, and Mediterranean) does not agree with modern observations. Zoophagous mollusca do not, as stated by him, live on those which are phytophagous; pebbles ("*galets*") are not everywhere unfavourable to mollusca, even on coasts exposed to a stormy sea; and foraminifera never crawl at the bottom of the sea. But it is to be hoped that these omissions and errors will be rectified in another edition of a work so desirable and important to scientific inquirers.

Mr. W. Boyd Dawkins, F.R.S., then read his paper *On the Physical Geography of the Mediterranean during the Pleistocene Age.* The author showed from the researches of M. Gaudry that during the late Miocene period it is probable that there was some communication between Attica and Africa. During the Pliocene period a similar communication must have existed at some part or parts of the Mediterranean area. The object of this paper was to show that a like union existed during the Pleistocene age. The palæontological evidence was first gone over. It was shown that African mammalia are found at Gibraltar, in river gravels near Madrid, in Sicily, Malta, the Morea, and in Candia; particular reference was made to the occurrence of a small species of Hippopotamus (*H. Pentlandi*) in these localities, and it was contended that there must have been communication between them and with Africa.

An examination of the soundings makes this probable. It is found that the Mediterranean consists of two deep basins, separated from each other by comparatively shallow water, one barrier extending from Africa, past the Straits of Gibraltar to Cadiz, and the other reaching from Tunis, past Sicily and Malta, to join Italy. An elevation of 2,000 feet would effect this. It was pointed out that the existence of such a mass of high land in the south of Europe must have had an important effect upon the climate of the period.

Mr. Charles Moore's paper *On the Presence of Naked Echinodermata (Holothuria) in Oolitic and Liassic Beds*, was then read. Soft-bodied animals, such as these, are rarely found in a fossil state; but the author had fortunately discovered some minute wheel-like plates, somewhat resembling those of a recent Greenland species, and which he referred to at least four different species of Holothuria. Some of these plates indicate structures not hitherto seen in recent species.

Mr. J. E. Lee read a *Notice of Veins or Fissures in the Keuper filled with Rhætic Bone-bed, at Goldcliff in Monmouthshire.* There are exposed on a scarf of Keuper marl, bare at low water, a number of rounded masses of irregular form, but of great length, consisting wholly of bone-bed. The author presumed that these projections are the casts of fissures in the marl which were afterwards filled up with bone-bed. Mr. C. Moore afterwards made some remarks on the extraordinary richness of the bone-bed.

Wednesday, August 21.—Mr. J. H. Judd communicated through Mr. Hughes, a note *On the Discovery of Cretaceous Rocks in the Islands of Mull and Inch Kenneth.* In the former they are seen at several places, and the author supposed that they would be found underlying a great part of the volcanic area of this district. The rocks are all of upper cretaceous age and lie unconformably upon the Jurrassic series and older rocks. Like all other rocks of these islands the cretaceous beds are penetrated by intrusive dykes and sheets of trap. Mr. Judd observed, that this discovery gave great confirmation to Prof. Geikie's views as to the Tertiary age of the volcanic rocks of the Hebrides.

Mr. T. A. Readwin's paper, *On the Coal and Iron Mines of the Arigna District of the Connaught Coal Measures, Ireland*, was then read in abstract.

The shales overlying the Upper Limestones of district were surmised by the author to belong to the Yoredale Series. Over these there are grits and shales with three seams of coal which the author referred to the Gannister Series, remarking that a bed of true "gannister" occurred there.

The coal field was divided into three districts, each of which was described by the author. He noticed at some length the clay-ironstone bands and nodules which occur over a much larger area than do the coals. The ironstone is richer and purer than most of our English clay ironstone. The author believed that the time had come for a vigorous and scientific exploration of the district, which he felt convinced would soon become, as Sir Robert Kane had long ago predicted, "an important centre of industry for the interior of the country."

SECTION D.—BIOLOGY

On Deep Sea Dredging round the Island of Anticosti in the Gulf of St. Lawrence, by T. F. Whiteaves, F.G.S.

Depths of from 100 to 250 fathoms were successfully explored during July and August 1871. The temperature of the deep sea mud was found by using a common thermometer to be almost invariably 37° or 38° F. About 100 species of Invertebrata new to the Gulf of St. Lawrence were collected. These included a remarkable foraminifer, *Marginulina*, with spinous processes from the first chamber, *Grantia ciliata*, a new *Pennatula*, &c. Two rare Echinoderms were collected—the well-known *Schizaster fragilis*, and the curious *Calveria hystrix* of Wyville Thomson. Nearly all the marine invertebrates of the northern part of the Gulf of St. Lawrence are purely Arctic species. Three-fourths

of the mollusca of Greenland range as far south as Gasté Bay. The species which belong exclusively to the deep sea in Canada have a decidedly Scandinavian aspect.

Preliminary Notice of Dredgings in Lake Ontario, by H. Alleyne Nicholson, M.D., D.Sc.

In this communication the author gave a short preliminary account of a series of dredgings carried out in June and July in Lake Ontario. With a praiseworthy appreciation of the value of such researches, the Provincial Government of Ontario had placed at the author's disposal a sum of money to be expended in this investigation, and the results had been very satisfactory. The dredgings were carried on partly in a yacht and partly in a small paddle-wheel steamer, and were prosecuted wholly by hand, the apparatus employed being similar to that used in marine dredging, except that a bag of embroidery canvas was attached outside the ordinary net, an addition rendered necessary by the exceedingly fine nature of the mud at great depths.

Upon the whole, the results obtained in Lake Ontario agreed very fairly with those obtained in Lake Superior in 1871, there being a general conformity in the phenomena observed in both areas. The fauna of Lake Superior, however, so far as deep water is concerned, is decidedly richer than that of Lake Ontario, whilst some of the more remarkable species discovered in the former appear to be altogether absent from the latter. As might have been anticipated, the fauna of Lake Ontario is not extensive, though some forms occur in great profusion. The shallow-water fauna is very rich in individuals, and the number of species is quite considerable for fresh water. Beyond eight or ten fathoms, the fauna becomes very scanty; and when depths of from twenty to fifty fathoms are reached, the list becomes reduced to some Annelides and Amphipod Crustacea. The nature of the bottom, also, at great depths is very unfavourable to life, consisting almost everywhere of a fine impalpable mud or clay, the temperature of which is very low.

Out of thirty-one forms in all discovered by the author in Lake Ontario, the most interesting were the Annelides and Crustaceans. The Annelides were very abundant, and consist of species of *Nephelis*, *Clepsine*, *Saenuris*, and *Chirodrillus*, some of the Leeches presenting phenomena of special interest. Of the *Crustacea*, the most important is a little Amphipod, which occurred plentifully in from thirty to forty-five fathoms, and which the author identified with the *Pontoporeia affinis* of the Swedish lakes. This species, and the Stomapod, *Mysis relicta* of Löven, are found in Lakes Wetter and Wener in Sweden, and it is well known that they have been supposed upon good grounds to support the view that these lakes had been at one time connected with the sea. It is, therefore, a very interesting fact that these crustaceans should both have been found in Lakes Michigan and Superior. The *Pontoporeia* the author had now detected in Lake Ontario; but it was a curious fact that the *Mysis*, which is of common occurrence in Lake Superior, should not have been found to occur at all in the dredgings carried on in Lake Ontario.

On the Flora of Moab, by A. W. Hayne, M.A.

The 250 plants found in Moab from the beginning of February to the middle of March, belong to 58 natural orders, of which by far the best represented are Leguminosæ with 35 species, Compositæ and Cruciferæ each with 26, and Graminaceæ 23. The remainder belonged to Liliaceæ, Scrophulariaceæ, Labiatæ, Boraginaceæ, Umbelliferæ, etc. From the greater abundance of springs the Eastern shore of the Dead Sea is comparatively fertile. The most conspicuous difference which results is the abundance of the date palm, of which on the West only a single clump survives near Jericho.

On the Structure and Development of Mitraria, by Prof. Allman, F.R.S.

Several specimens of the remarkable larval form, to which John Müller gave the name of *Mitraria*, were obtained by Prof. Allman in the Gulf of Spezzia, and were made the subject of careful study of structure and development. Mecznikoff had recently examined another species of the same form, and the author was enabled to confirm the main result arrived at by him, that *Mitraria* was the larval form of an annelide. In some fundamental points, however, regarding the process of development, his observations did not agree with those of the Russian zoologist; while in structure there are some important features which have not been described by either Müller or Mecznikoff, differences which may, in some cases at least, depend on actual differences between the species examined.

The nervous system is well developed, and consists in the principal central portion of a large quadilateral ganglion, formed by the union of two lateral ones, and situated on the summit of the transparent dome-like body of which the larva mainly consists. From this two very distinct chords are sent downwards, so as to form a pair of commissures with two small ganglia, which are situated at the opposite side of the alimentary canal. Besides these, two other small ganglia exist in the walls of the dome, at the oral side of the great apical ganglion, and two similar ones at the ab-oral side. These send off numerous filaments, which dive at once into the walls of the dome, while each sends off a long filament to the region where the alimentary canal begins to bend downwards towards its ab-oral termination. The great apical ganglion supports two sessile ocelli, with pigment and lens, and two small spherical vesicles, each containing a clear spherical corpuscle. These last the author regards as auditory capsules.

A system of vessels was also described. This consists mainly of a sinus which surrounds the great apical ganglion, and sends off three branches, which run in a radial direction in the walls of the dome, two lateral and one ab-oral, and appear to open into a sinus which surrounds its base.

In the progress of development the ab-oral end of the alimentary canal becomes elongated in the direction of the axis of the dome, carrying with it the walls of the base of the dome, which are to form the proper body walls of the future worm, and in this way a long cylindrical appendage becomes developed, and hangs from the central point of the base. At first there is no trace of segmentation, and this is subsequently induced on the cylindrical body of the worm by the formation of consecutive annular constructions.

The process of development as observed by the author in the species of *Mitraria* examined by him thus differs in several points from that observed by Mecznikoff. Among these the most important is that the ventral side of the worm is formed simultaneously with the dorsal instead of subsequently to it and independently of it, as in the case described by Mecznikoff. The development of the worm was not traced to the ultimate disappearance of the dome-like body of the larva.

On the Whales of the Antwerp Crag, by Prof. Van Beneden.

A brief account was given of the great accumulation of bones of fossil cetacea, or rather of whales, which are found in the Antwerp Crag, and of which the greater part belong to species new to science. These primitive whales were all small in size, and in that respect have no existing representative except the Neobalæna of New Zealand. It is only in the Upper Crag that we find representatives of larger species which actually exist such as those of the genera of Balæna, Megaptera, and Balænoptera.

Prof. Flower said that the excavations at Antwerp had revealed a perfect cetacean burial ground. Under the superintendence of a *savant* who had a most intimate acquaintance with the osteology of recent whales, the skeletons of the extinct species had been almost reconstructed in the Brussels Museum. It was a remarkable thing that these ancient whales were all small. It was the reverse of what happened in most other cases where the ancient representatives of any type were generally far larger than those at present existing.

Mr. Sclater inquired what was the relation between the cetacea of the Antwerp and Suffolk Crag.

Prof. Van Beneden replied that they were identical. The English material was not in itself sufficient for independent determination; but with the knowledge he had acquired from the more perfect remains, he was able to identify those from the Suffolk Crag.

Prof. Allman said that there was a parallel to the case of the whales in the dwarf fossil elephant of Malta. This was of the more interest, as the affinities of the elephant and of the whale are by no means remote.

On some points in the Development of Vorticellidæ, by Pr Allman.

The author described, in a beautiful branched and clustered vorticellidan, a process different from any which had been recorded by those observers who had described the so-called encysting process, and the behaviour of the "nucleus" in the Vorticellidæ.

In almost every cluster some of the zooids composing it had become greatly altered in form. They had increased in size, and instead of the bell-shaped form of the others had assumed a globular shape, and had lost both oral orifice and ciliary apparatus, while their supporting peduncle had ceased to be contractile.

In the younger ones the contractile space of the unchanged zooid was still very evident, but was fixed, showing no tendency to alteration of size, and the so-called nucleus was very distinct and larger than in the ordinary zooids. The whole was enveloped in a transparent gelatinous-looking investment.

In a slightly more advanced stage another envelope, in the form of a brown horny capsule, begins to be secreted between the proper wall of the zooid and the external gelatinous investment. It is at first thin and smooth, but it gradually acquires considerable thickness, and becomes raised on its outer surface into ridges enclosing hexagonal spaces.

In this stage the capsule has become too opaque to admit of a satisfactory view into its interior; but if the capsule be carefully opened its contents may be liberated so as to render apparent their real nature. It will be then seen that these consist of a minutely granular semi-fluid plasma surrounding the "nucleus," which has much increased in size and occupies a large portion of the cavity of the capsule. The condition of the contractile space could not be determined; it has probably altogether disappeared.

In a further stage the "nucleus" has undergone an important change; for, instead of the long cylindrical form it had hitherto presented, it has become irregularly branched, has acquired a softer consistence, and has moreover broken itself up into two or more pieces. This change in the "nucleus" is invariably accompanied by the appearance of nucleated cell-like bodies, which are scattered through the corpuscular plasma which had filled the rest of the capsule. They are of considerable size, of a spherical form, and with their nucleus occupying the greater part of their cavity, and having its nucleolus represented by a cluster of granules.

In other capsules, apparently the more advanced, no trace of the so-called nucleus of the vorticella body could be detected, and it seems to be entirely replaced by the spherical nucleated cells, which had now still further increased in number. It is impossible not to regard these cells as the result of the disintegration of the nucleus, and the conclusion is a legitimate one that they are finally liberated by the natural dehiscence of the capsule, and become developed into new vorticellidans.

On the Structure of Noctiluca, by Prof. Allman.

The author gave an account of some researches he had made on *Noctiluca molicus*. They were mostly confirmatory of the results arrived at by other observers, more especially by Krohn, Quatrefages, Busch, Huxley, and Webb, while they further served to supplement the observations of these zoologists.

At one end of the meridional depression is the vibratile flagellum with the mouth at its base, and here the depression becomes quite superficial, while the opposite end is much deeper and is here abruptly closed. Just outside of this deep end of the depression there commences, by a funnel-shaped enlargement, a very slightly elevated ridge of a firmer consistence than the rest of the body; it terminates abruptly after running down, in a meridional direction, over about one-third of the circumference of the body. The author had reason to believe that this ridge is traversed in its length by a canal which opens close to the ab-oral extremity of the meridional depression by a funnel-shaped orifice, thus giving support to the opinion of Huxley, who believes that *Noctiluca* is provided with an anal orifice. The mouth leads into a short cylindrical gullet, and the author confirmed the existence of the vibratile cilium contained within the gullet, as originally described by Krohn; and of the ridge, with its projecting tooth, described by Huxley as existing in the gullet walls. The floor of the gullet is formed by the central mass of protoplasm, here naked and in direct contact with the surrounding medium. The vibratile cilium springs from this floor, and near the root of the cilium is a depression in the floor which can be followed for a little distance into the protoplasm.

Besides the well-known branching processes which radiate from the central mass of protoplasm to the walls of the body, there is also sent off from the central mass a broad, irregularly quadrangular, plate-like process, which extends to the outer walls, where it becomes attached along the line of the superficial meridional ridge. The lower free edge of this broad process is thickened in the manner of a hem.

In contact with the central protoplasm is the nucleus, a clear spherical body about $\frac{3}{2000}$ of an inch in diameter.

The body walls are composed of two layers—an external thin, transparent, and structureless membrane, and an internal thin granular layer of protoplasm, which lines the structureless membrane throughout its whole extent, and which receives the extremities of the radiating processes from the central mass. Under the action of iodine solution and other reagents, the protoplasmic layer may be seen to detach itself from the outer structureless membrane, and, along with the radiating bands, contract towards the centre. It admits of an obvious comparison with the primordial utricle of the vegetable cell.

The flagellum, which is given off close to the margin of the mouth, is a flattened band-like organ, gradually narrowing towards its free extremity, and with its axis transversely striated like a voluntary muscular fibre throughout its whole length. It seems to have the power of elevating its edges, so as to render one of its surfaces concave, and thus becomes converted into a semi-tube, which may assist in the conveyance of nutriment towards the mouth.

The nucleus is a spherical vesicle, with clear colourless contents, among which minute transparent oval corpuscles may usually be detected. When acted on by acetic acid, the difference between the contents of the vesicle and its wall becomes very apparent, and the contents may now be seen accumulated towards the centre as a minutely granular mass, with some of the oval corpuscles entangled in it.

The radiating offsets, which extend from the central protoplasm to the peripheral layer, contain well-defined clear corpuscles which slowly change their relative places, as if under the influence of very feeble currents. These offsets, indeed, closely resemble the radiating protoplasm filaments which extend from the protoplasm, surrounding the nucleus, to the walls of the primordial utricle in the vegetable cell. The peripheral layer contains scattered through it numerous minute cell-like bodies. These are spherical and of various sizes; in the larger ones a distinct central nucleus may be detected.

It is scarcely correct to regard the central mass of protoplasm as a true stomach. The author had failed to find any evidence of a permanent gastric or somatic cavity, and he regarded the protoplasm mass to which the gullet leads as representing the "parenchyma" of the Infusoria, and, like this, allowing of the solid food being forced down into it from the gullet and there encysted in extemporaneously formed vacuolæ. The food also frequently forces its way from the central mass into the radiating processes, and diatoms and other microscopic organisms may be seen in these processes enclosed in cyst-like dilatations of them, extemporaneously formed for their reception at various distances from the central protoplasm.

It was considered probable that the canal which seems to exist in the superficial ridge affords exit for certain effete matters, which may be conveyed to it through the process, by which it is kept in connection with the central protoplasm.

Our knowledge of the phenomena of reproduction and development in *Noctiluca* is still very imperfect, and the author saw little which seemed capable of throwing additional light on this subject. He agreed, however, with Huxley in regarding it as probable that the nucleated cell-like bodies which are present in the peripheral layer of protoplasm have a reproductive function, and are destined after liberation to become developed into new individuals.

From the account now given it will be apparent that *Noctiluca* consists essentially of an enormously vacuolated protoplasm, involving a nucleus and enclosed in a structureless sac, the vacuolation taking place to such an extent as to separate the contents into a peripheral layer of protoplasm which remains adherent to the outer sac, and into a central mass which is kept in communication with the peripheral layer by processes of protoplasm which pass from one to the other. The author believed that the nucleus of *Noctiluca* had a significance different from that of the so-called nucleus of the ordinary Infusoria, and that it admitted of a closer comparison with the true cell-nucleus. He was of opinion that the nearest ally of *Noctiluca* would be found in the somewhat anomalous infusorial genus *Peridinia*.

In conclusion the author detailed some observations he had made on the luminosity of *Noctiluca*; and he gave reasons for maintaining that the seat of the phosphorescence is entirely confined to the peripheral layer of protoplasm which lines the external structureless membrane.

On the Structure of Edwardsia, by Prof. Allman.

The structure of this beautiful little actinozoon differs in many important points from that of both the zoantharian and alcyonarian polypes. It was shown that just within the mouth the walls of the stomach sac project into the cavity of the sac in such a way as to form eight complicated frill-like lobes; that the eight vertical, radiating lamellæ which project into the body cavity

from the outer walls, and are composed of parallel longitudinal fibres enclosed between two membranous layers, do not reach the stomach sac in any part of their course, and that eight strong muscular bundles pass symmetrically through the whole length of the body cavity, being attached at one end to the disc which carries the tentacles, and at the other to the floor of the body cavity, while they are free in their intervening course.

Attached along the length of about the posterior half of each muscular bundle is the long sinuous generative band, with its chord-like craspedum loaded with thread cells. Just before terminating at the lower opening of the stomach sac each of the eight generative bands enters a most remarkable pectinated organ, which appears to be quite unrepresented in any other group of the Cœlenterata. It was difficult to suggest the true significance of these organs; their relation to the generative bands might lead to the belief that they are testes, or they may be analogous to the so-called cement glands which exist near the outlet of the oviducts in some of the lower animals. In this case they might supply some additional investment to the ova at the time of extrusion.

The author regarded *Edwardsia* as presenting a very distinct type of actinozoan structure, which occupies an intermediate position between that of the zoantharian and that of the alcyonarian polypes. He also compared it with the extinct rugose corals of the palæozoic rocks to which it corresponds in the numerical law of its body segments, and of which it might in some respects be regarded as a living non-coraligenous representation.

On the Structure of Cyphonautes, by Prof. Allman.

This remarkable little organism, whose structure and ultimate destination have been variously described by different observers, was obtained by the author in considerable abundance in Moray Firth. The animal is enveloped in a mantle, and the whole enclosed in a delicate, transparent, structureless test formed by two valve-like triangular plates which are in contact along two edges, and separated from one another by a narrow interval along the third. Its form is thus that of a very much compressed cone or pyramid. The author distinguishes by the term base the broader edge where the two plates of the test are separated from one another; while the other two edges are distinguished as the anal and ab-anal edges. The apex is the angle opposite to the base, and here a narrow passage exists through which the fleshy walls of the mantle are brought into immediate contact with the surrounding water.

In the base are two large oval openings, one, the larger, situated towards the anal edge, and the other towards the ab-anal. The former leads directly into the cavity of the mantle. Its edges are prolonged by a membranous lobe ciliated on its margin, and uninterruptedly continued round the anal side of the opening, but deficient on the opposite side. The interior of the lobe is occupied by a cavity.

A large part of the mantle cavity is occupied by the pharynx, a spacious thin-walled sac which opens into the mantle cavity by a long curved somewhat S-shaped slit with thickened and ciliated margins, which, at one side, are continued beyond the large opening situated near the anal side of the base in the form of two short ciliated tentacles. Towards the apex the pharynx becomes suddenly narrow, and is here lined by vibratile cilia, and marked by circular striæ which possibly indicate the presence of sphincter fibres. It now turns towards the anal side, and then bends downwards towards the base, and enters a thick-walled subcylindrical stomach. This runs towards the base parallel to and a little within the anal edge of the test, and is ultimately continued into a short straight intestine, which terminates by an anal orifice in the mantle cavity near the outer opening of the latter. From the upper part of the walls of the pharynx a narrow bundle of fibres passes to the apex of the mantle cavity.

Upon each side of the pharynx and lying against the stomach and intestine is a large oval mass. Its situation would suggest the probability of its being a hepatic organ, but it is altogether so enigmatical that it would be rash with our present knowledge of it to insist on assigning to it any special significance.

In contact with each of these enigmatical organs is a small tubercle, from which a bundle of short fibres pass off in a radiating direction. The resemblance of these bodies to a pair of nervous ganglia is obvious, but the author was more inclined to regard them with Schneider as indicating points of attachment of the contained animal to the two valves of the test.

The smaller of the two openings in the base, that, namely, which is situated near the ab-anal edge of the animal is, like the other, surrounded by a hollow membranous lobe with ciliated margin. This is uninterruptedly continued round the ab-anal side of the opening, but is deficient on the opposite side. The opening leads into a special chamber entirely shut off from the cavity of the mantle and from the pharynx. The walls of the chamber are lined with cilia, and it has within it, or in immediate connection with its walls, two peculiar structures. One of these is a somewhat pyriform organ which, with one end close to the orifice of the chamber, extends from this point into its cavity; it is composed of a mass of spherical bodies. The other extends over the roof of the chamber in form of a cap; it consists of two portions, one of which lies directly on the walls of the roof, and has a transversely laminated structure, which, however, disappears towards the ab-anal side of the chamber; the other is an oval mass of globular cell-like bodies and lies on the free convex surface of the laminated portion.

Here again this part of the *Cyphonautes* is in the highest degree enigmatical, and yet it is difficult not to believe that in the structures just described we have an ovary and testis with associated accessory structures.

The author observed no further fact which might tend to throw light on the ultimate destination of *Cyphonautes*, and more especially nothing which might tend to confirm the remarkable views lately published by Schneider, who believes that he has traced its devolopment into the polyzoal *Membranipora pilosa*. The structure is considerably more complicated than Schneider seems to be aware of, while the opinion of this observer that the whole of the proper *Cyphonautes* structure becomes absolutely obliterated and the body of the animal converted into an amorphous mass of cells from which the *Membranipora* becomes evolved not by a process of budding but by a differentiation of structure is so startling that notwithstanding the partial assent lately given to it by Nitsche we are compelled to wish for further confirmation of the evidently careful observations of the German zoologist.

If the ab-anal chamber described above with its associated structures really belongs to the generative system—and it is hard to say what else it can be—the view that *Cyphonautes* is a polyzoal larva is scarcely tenable.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, Aug. 19.—M. Faye in the chair. MM. Jamin and Richard read the second part of their paper on the laws of cooling, and the cooling power of gases. The authors have determined the amount of heat abstracted by a gas from a warm solid placed in its midst.—A. and P. Thenard presented a memoir on the action of ozone on indigotic sulphate and on arsenius acid. The authors find that ozone decolourises three times as much indigo as the law of equivalents would lead one to suppose, and that this reaction takes place in two well-marked periods. Two-thirds of the indigo are decolourised, in the first of these periods, almost instantaneously, and one-third in the second period after the lapse of several hours. The authors ascribe this second action to hydric peroxide (*eau oxygenée*) formed by the ozone. The authors are led to doubt whether ozone is really a triple atom molecule, or whether it is simply oxygen in which is condensed a powerful selective force. They intend to thoroughly investigate this question.—M. Daubrée reported his examination of the meteorites which fell at Lancé and at Anthon (Loir-et-Cher) on the 23rd July, 1872. The Lancé stone weighed 47 kilogrammes; the one which fell at Anthon, 12 kilometres from Lancé, was much smaller. Their structure was granular, and some of the grains acted strongly on polarised light; they were evidently portions of the same mass. Specific gravity, 3·8. Elements found: iron, cobalt, nickel, copper, sodium, sulphur, chlorine, silicon, and oxygen.—Max Marie followed on the determination of the perimeter of the region of convergence of the series of Taylor, &c.—M. Mallard read a paper on the action of silicic anhydride and analogous oxides on sodic carbonate at a high temperature.—On the combined use of morphia and chloroform during surgical operations, and on a new mode of administering the latter. M. Demarquay, the author, convinced of the great danger incurred by the combined use of these agents, has abandoned it and devoted himself to the improvement of the apparatus employed for the administration of chloroform. The apparatus in question consists of a flannel mask stretched on a wire frame; the chloro-