a statistical report on the fisheries of the Gulf States, by Mr. J. W. Collins and Dr. H. M. Smith; a report on a collection of fishes from the Albemarle region of North Carolina, by the latter author; a paper on the spawning habits of the shad, by Mr. S. G. Worth; a report on the aquatic invertebrate fauna of the Yellowstone National Park, and of the Flathead region of Montana, by Prof. S. A. Forbes; and a report on the fisheries of the South Atlantic States. Finally, the volume contains a description, by Mr. Bashford Dean, of the methods of oyster-culture in Italy, Spain and Portugal, Germany, Holland, Belgium, and England. Oyster-culture, as practised in France, had previously been reported upon in connection with the U.S. Fish Commission. This article, like most of the others, is excellently illustrated. They all help to disclose the possibilities of fish industries in the United States, and indicate how "the harvest of the sea" may be increased in value.

WE have received a ponderous volume (vol. vi.) of the transactions of the Reale Accademia delle Scienze Fisiche e Mathematiche, Naples. The volume contains nineteen fine plates and eighteen papers, most of which refer to natural science subjects.

MR. ROWLAND WARD, the well-known taxidermist, has published the seventh edition of his "Sportsman's Handbook," containing information on the "practical collecting, preserving, and artistic setting-up of trophies and specimens, to which is added a synoptical guide to the hunting grounds of the world."

THE second volume of Priestley's "Experiments and Observations on Different Kinds of Air"—that is to say, the one in which he first gave an account of the discovery of oxygen in 1775—is reproduced in the seventh number of the handy "Alembic Club Reprints," published by Mr. W. F. Clay, Edinburgh. The next volume in this series will contain Scheele's work in connection with the discovery of oxygen.

THE Robert Boyle lecture, delivered by Lord Kelvin before the Oxford University Junior Scientific Club, in May last, on "The Molecular Tactics of a Crystal," has been published by the Clarendon Press. No student of crystallography should neglect to read the lecture, for in it the geometry of crystalline structure is dealt with in the simplest manner. The substance of the lecture is contained in a paper read by Lord Kelvin before the Royal Society on January 18, and reprinted in these columns on March 8.

MESSRS. GEORGE PHILIP AND SON have lately published a book, of fifty pages, entitled "Knowledge through the Eye," by Mr. A. P. Wire and Mr. G. Day. The authors explain how to use the optical lantern in illustrating lectures in science and other branches of knowledge, and describe a new method of preparing lantern slides without the use of a camera. A drawing of the required illustration is first made. A piece of specially prepared transparent paper (sold by Messrs. Philip) is then placed over it, and the drawing is transferred by tracing. A lantern slide is obtained by making a contact exposure in the ordinary manner, using the picture on the transparent paper as a negative. This method, however, has very little to commend it. Line drawings are easily made upon a plate of smoked or varnished glass, or upon glass having a thin film of collodion upon it; and as the illustrations have to be drawn in any case, it is just as well to do the work directly as to make a lantern slide of a tracing made from a drawing in the way described by the authors.

THE additions to the Zoological Society's Gardens during the past week include a Hairy Armadillo (*Dasypus villosus*) from South America, presented by Mr. George Simpson; a —— Bamboo Rat (*Rhizomys*, sp. inc.) from India, presented by Mr. Angus M. Kinloch; a Himalayan Monaul (*Lophophorus impeyanus*) from the Himalayas, presented by Captain H. R. H. Helpman; two Sharp-nosed Crocodiles (*Crocodilus acutus*) from Jamaica, presented by Dr. Poole; two Common Chameleons (*Chamæleon vulgaris*) from North Africa, presented by Mr. E. Palmer; two Smooth Snakes (*Coronella lævis*) from Hampshire, presented by Mr. E. Penton; two Common Vipers (*Vipera berus*), British, presented by Mr. Hugh Bromley; a Sykes's Monkey (*Cercopithecus albigularis*) from East Africa; two Heloderms (*Heloderma suspectum*) from Arizona, deposited; three Blood-breasted Pigeons (*Phlogœnas cruentata*) from the Philippine Islands, purchased; a Yak (*Poephagus grunniens*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

SOLAR ECLIPSE PHOTOGRAPHY.—Mr. Albert Taylor recently read a paper before the Royal Dublin Society, on the selection of suitable instruments for photographing the solar corona during total solar eclipses. The photographs obtained by other observers and himself during the total eclipse of April 1893, have indicated the best methods, both photographic and instrumental, to be adopted for the next observable total solar eclipse, on August 8, 1896. One of the most disputed points in eclipse photography, says Mr. Taylor, refers to the proper exposure required to obtain the faint extensions of the corona without fogging the plate by the sunlight. Two opposite opinions are held as to the best method of photographing these diaphanous coronal extensions. Short exposures and slight photographic action are believed by some observers to give the best results, but others hold that long exposures and great photographic action are necessary to attain the desired end. An examination of the photographs obtained during the eclipse of April 1893, shows that the latter view must be abandoned; and that nothing is to be gained by using photographic actions exceeding 15 or 16. Photographic action is determined by the formula $100 \frac{a^2}{f^2} t.s.$, where a is the aperture of the instrument employed, f the focal length, t the time of exposure, and s the sensitiveness of the plate. For obtaining photographs showing the detailed structure of the inner and middle coronæ, short exposures and a long-focus object-glass are recommended. The opinion is expressed that, with a twelve-inch object-glass of between forty and sixty feet focus, one hundred seconds' exposure would give nearly all the corona that is within reach of the photographic method of attack in the present state of photography. It is believed that with an instrument having a focal length equal to ten times the aperture, all the external corona would be obtained in about fifteen or sixteen seconds.

OBSERVATIONS OF SATURN AND URANUS.—Since the beginning of this year Prof. E. E. Barnard has used the 36-inch of the Lick Observatory in some observations of Saturn and Uranus (*Astronomy and Astro-Physics*, August). Measurements of the former planet were undertaken with a view of determining whether the ball was situated in the exact centre of the rings. Between the end of the ring and the limb on the following side of Saturn the angular distance was 11″·287, while similar measures on the preceding side gave 11″·167. The difference is less than one second of arc, and it may very well be due to some peculiarity in the measures. It is certainly not sufficient as yet to suggest that the planet is not exactly at the centre of its rings. Prof. Barnard has also made a series of measures of the polar and equatorial diameters of Uranus, and a series of measures of the position angles of the equator. From these it appears that "the equator of the planet coincides with the planes of the orbits of the satellites, thus verifying the supposition that Uranus rotates on an axis deviating but little from the plane of its orbit."

BIOLOGY AT THE BRITISH ASSOCIATION.

SECTION D, in spite of the loss of Physiology, had so many papers that it was necessary to meet on most days under the two departments of Zoology and Botany. A noteworthy feature was the large number of papers by distinguished foreigners, and the theoretical nature of a large proportion of the communications.

On Thursday, in addition to the Presidential Address (NATURE, p. 371), the following reports of Committees were taken:—

(1) The Naples Zoological Station. This contains an interesting letter from Dr. Dohrn on the future maintenance and administration of the station, statistics as to the work of the station during the past year, and an account by Mr. J. E. S. Moore of his investigations on the reduction division in cartilaginous fishes. He finds that the spermatogenesis stops short at a point corresponding to the formation of the first ovicyte in ovigenesis, and also that the archoplasmic vesicle of the Elasmobranch spermatid has an intranuclear origin, while in the mammalia it is of purely cytoplasmic construction.

(2) The Plymouth Biological Laboratory. This report contains a preliminary notice of Dr. Hickson's investigation of the anatomy and development of *Alcyonium*, and of Mr. Allen's researches on the later stages in the development of Decapod Crustacea. Mr. Allen's work has been chiefly on the cells and fibres of the central nervous system.

(3) The Zoology of the Sandwich Islands. Mr. Perkins has continued his explorations since the last report, and the Committee now propose that he should return to this country and give assistance in working out the extensive collections formed.

(4) The Zoology and Botany of the West Indies. Since last year ten reports have been published, on the insects and plants, chiefly from St. Vincent. The Committee have still to deal with the Coleoptera, and propose to explore Margarita.

(5) Index Generum et Specierum Animalium. The MS. consists now of 180,000 slips, representing 90,000 genera and species.

In the Zoological Department, Prof. Hubrecht (Utrecht) read a paper on the didermic blastocyte in mammalia, in which he showed the distinctness of the trophoblast cells from the embryonic cells of the blastoderm. Mr. W. Garstang, in a paper on the ancestry of the Chordata, gave reasons for his conclusion that the Echinoderms, Enteropneusta, and Chordata trace back their descent to a common pelagic ancestor which had many striking points of resemblance to the Holothurian larva "Auricularia."

Mr. W. E. Collinge read papers on the structure of the integument in *Polyodon*, in which he showed that the occurrence of scale-plates was very similar to those found in the embryos of *Lepidosteus*, &c., and indicated a relationship to the Palæoniscidæ of the coal measures; and on the vertebræ of *Amphisile*, in which the unique character of the vertebral column of this fish was described and the views of previous writers criticised.

In the Botanical Department, Prof. Johnstone showed Algæ which deposit calcareous matter in their tissues, and so probably are better able to resist the attacks of animals. He also exhibited Algæ which are able to dissolve calcareous matter and bore minute holes in the shells of Mollusca. In a second communication he discussed the genus *Pogotrichum*. Prof. Phillips described the great variety found in the development of the cystocarps of *Polysiphonia nigrescens* and other species. Mr. A. Church exhibited collections of Algæ.

On Friday a joint meeting of zoologists and botanists was held to discuss a few important papers dealing with protoplasm, the cell, and allied matters.

Prof. E. Van Beneden led off with a paper on the relations of protoplasm, in which he gave an account of his observations on the phenomena seen in the division of cells. He regards the nucleus as being not an independent organ in the cell, but as closely connected with the ordinary protoplasm. Some discussion followed, and, on the whole, the opinions expressed were highly favourable to Van Beneden's view.

Prof. Strasburger followed next, on the periodic variation in the number of chromosomes. He thinks that the reduction in the number of chromosomes in sexual generation has a phylogenetic interpretation, and is a recurrence to the primitive number of chromosomes possessed when the organism was asexual only. He considered that many cases of asexual plants were to be regarded as due to the loss of sexuality.

The third paper was Prof. Ray Lankester's, on chlorophyll in animals. He gave an account of its occurrence in several groups of the Invertebrata, and pointed out that in these casesi starch is produced as in plants, and that the animal does not become green if kept in the dark. He referred to the view that all such cases were to be explained by the presence of unicellular parasitic algæ, but pointed out that these arguments would apply as well to the presence of chlorophyll in plants, and he urged that the same interpretation should be given to the facts in the case of animals as in plants.

In the Zoological Department, Prof. E. Van Beneden read a paper on the origin and morphological signification of the notochord. He described the formation of the notochord and mesoblast in some bats from the external layer (apparently epiblast). He proposed that the two embryonic layers should be called blastophore and lecithophore. He also instituted a comparison with the young *Amphioxus* and *Cerianthus* (where the axis corresponds to the long axis of the vertebrate body), and pointed out how their essential similarity bore out the conclusions as to the origin of the Chordata reached by Sedgwick fifteen years ago.

Prof. Struthers gave a paper on the carpus of the Greenland right whale compared with that of finner whales. He showed that the arrangement of the cartilages in the wrist has no functional significance (the carpus merely functioning as a whole), and can only be explained by descent with modification from the less rudimentary condition seen in other mammals. He showed that the pisiform is actually the most important element, and the only one which has a distinct function.

Miss Kirkaldy gave a critical account of the various species of *Amphioxus*. She described in all eight species, referable to three genera (*Branchiostoma*, *Heteropleuron*, and *Asymmetron*), one of which, *Heteropleuron Singalense*, she considered to be new to science.

In the Botanical Department, Miss Benson described her investigations on the fertilisation of the Chalazogamic Amentiferæ, and showed that the pollen tube passes through the chalaza in *Corylus*, *Carpinus*, *Betula*, and *Alnus*. Miss Pertz had a paper on the hygroscopic dispersal of fruits in certain Labiatæ, in which she showed that there are cases where the capsule opens when moist; and Dr. J. Clark gave an account of his investigations on the hybridisation of orchids.

On Saturday, in the Zoological Department, after the reports (1) on the migrations of birds as observed at lighthouses (the digest of which has at length been completed by Mr. Eagle Clark), and (2) on the legislative protection of wild birds' eggs (in which the recent Bill was explained and criticised by Prof. Newton, Canon Tristram, and others), the following papers on the occurrence, distribution, &c., of marine animals were taken:—

On a tow-net for opening and closing under water, by Mr. W. E. Hoyle. Mr. Hoyle described his electrical tow-net, and explained that he was now waiting for an opportunity of getting into water of over 100 fathoms depth in a steamer fitted with electric power.

On temperature as a factor in the distribution of marine animals, by Dr. O. Maas (Munich). Dr. Maas considers that the great ocean currents are of primary importance in limiting the distribution of free-swimming forms, different species being found to north and south of them. He attributes greater importance to temperature than to pressure. He points out that the existence of eurythermal and stenothermal animals must be borne in mind, and that in drawing conclusions as to distribution all animals are not equally important.

On the marine zoology of the Irish Sea, by Prof. W. A. Herdman. The object in this investigation has been not merely to collect animals, but to investigate the condition of the sea-bottom in the various parts of the area, and correlate, if possible, the fauna with the environment. This report of the year's work gives (1) details of the dredging expeditions, (2) additions to the fauna—these include four new species of *Ecteinosoma*, one of *Bradya*, one of *Pseudocyclopia*, one new Amphipod, *Nannonyx spinimanus*, and one Bopyrian, *Pleurocrypta nexa*—and (3), finally, a discussion of the submarine deposits met with, their nature, distribution, origin, and influence upon the fauna. The importance of the nature of the bottom to the animals living on it is specially emphasised.

Prof. M'Intosh gave an account of the recent marine fish-hatching operations of the Scottish Fishery Board at Dunbar. He described the ponds and buildings, their mechanism and he movements of the hatching-boxes, and gave statistics showing how remarkably successful the first season's operations had been.

In the Botanical Department papers were read by Prof. L.

Kny on the correlation between root and shoot, and an exhibition of diagrams; and by Prof. Pfeffer on the sensitiveness of the root-tip.

On Monday forenoon a series of papers dealing with various points in the theory of evolution was taken before the Zoological Department. After the report of the Committee on Telegony, Prof. D'Arcy Thompson read a paper on some difficulties of Darwinism. He doubts the efficacy of the struggle for existence in the case of humming-birds, &c., and in these cases he regards the profusion of forms, colours, and other modifications as due merely to laws of growth, and thinks that growth may be more exuberant in the absence of struggle and hardship. In other cases which are usually interpreted as the result of natural selection, Prof. Thompson gave another explanation, *e.g.* he considers the form of the Guillemot's egg is merely the natural result of the pressure caused by a relatively large egg passing down a narrow muscular passage.

Then Prof. C. V. Riley followed, on social insects and evolution. He gave a summary of what is known of the habits and economies of bees, wasps, ants, and termites, especially as to the development of the young. He considered that the varied structures and habits of neuters are perfectly explicable upon the general principles which have governed the modification of organisms, amongst which he believes natural selection plays an important but limited part. He showed that the differences between the queen and the neuter resulted entirely from the treatment of the larva, and was at the control of the colony. In ants also the differences between the different individuals is again the result of food and nurture. He believed with Darwin that the variations in social insects have been guided by natural selection amongst colonies; but that this remarkable and somewhat unexpected social selection among individuals, as exemplified in these insects, simplified the origin of neuters. Competition had been between colonies rather than individuals. The author finally pointed out that just as in man among mammals, the higher intellectual development and social organisation is found correlated with the longest period of dependent infancy.

Prof. Haycraft read a paper on the *rôle* of sex in evolution, in which he argued that variation is a quality of protoplasm, and that it has and can acquire this quality in varying degree and apart from sexual conjugation; also that sexual conjugation tends to limit or diminish variations, and that this is the *rôle* of sex in evolution; to sex therefore we owe our fairly well-defined generic and specific groups.

Dr. F. A. Dixey, in a paper on the relation of mimetic characters to the original form, gave some interesting examples of mimicry amongst butterflies, and showed how a very perfect scheme of mimicry may be established by gradual changes from a very small initial resemblance.

Prof. Osborn treated of certain principles of progressively adaptive variations observed in fossil series. He appealed for a systematic analysis and investigation of variation, and for a suspension of judgment in regard to the factors of evolution. Recent works show a lack of analysis, since all adult variations are classed together without regard to the two following lines of cleavage; first, as to adaptation, whether progressive, retrogressive, or neutral; second, as to time of origin in the individual, whether palæogenic or neogenic. Neogenic variations which point to the future may be conveniently divided into (*a*) gonagenic; (*b*) gamogenic; (*c*) embryogenic; and (*d*) somatogenic according to lines suggested by the work of Kölliker, Weismann, Roux, and others. All previous inductions as to variation have failed to recognise that the adult may exhibit variations which have their immediate causes in all these periods, although all alike spring from the potentiality of the germ. A distinct consideration rises whether, besides the "minute variations" of Darwin and the "saltatory variations" of Bateson, there may not be variations so slight as only to be measurable by the comparison between two individuals separated by a long genetic series. Evidence for variation of this kind is seen in the contrast between the evolution of the premolars and of the molars in the eocene horse series. The limitation of variation to certain lines is seen in a comparison between the horse and rhinoceros molars of the miocene. The general conclusion drawn from these facts is that the pure selection principle is contradicted by them, and there is some unknown principle of teleological mechanics yet to be discovered.

In the discussion which followed, Prof. Poulton criticised Osborn's classification of variations, and argued in favour of the action of natural selection in picking out the minute characters which distinguish individuals and in building them up into varieties. The discussion was continued by Profs. Mivart, Lankester, Seeley, Hartog, and others.

In a paper on the wing of *Archæopteryx* viewed in the light of that of some modern birds, Mr. W. P. Pycraft showed that in the development of the primary wing-feathers, as well as in the general form of the manus, in the nestling of certain gallinaceous birds there was evidence that they had descended from a strictly arboreal form in which the manus of the nestling was armed with claws to assist it in climbing the trees in which it was reared, just as is the case in the young of *Opisthocomus cristatus* to-day. He showed that there is reason to believe that the claws of *Archæopteryx* were of prime importance only during the nestling period of life. A model of a restoration of the wing of *Archæopteryx* was exhibited, in which it was demonstrated that the remiges rested upon the third digit, the bases abutting against that of the second digit, the top of which was free. It was, however, suggested that this digit supported the semiplume-like feathers seen in the fossil which possibly functioned as coverts.

In the Botanical Department:—On the origin of the sexual organs of the Pteridophytes, by Prof. Douglas H. Campbell. Notwithstanding the radical differences, especially in the Archegonium, between the Bryophytes and the Pteridophytes, a comparison of the structure and development of the sexual organs of the higher Hepatics with those of the Eusporangiate Pteridophytes shows points of resemblance enough to warrant the hypothesis that here is to be sought the connection between the Bryophytes and the Pteridophytes. Notes upon the germination of the spores of the Ophioglosseæ, by Prof. Douglas H. Campbell. The author succeeded in germinating two species, *Ophioglossum pendulum* and *Botrychium virginicum*. In both the first division of the spore occurs before any chlorophyll is formed. On sterilisation and a theory of the strobilus, by Prof. F. O. Bower. The following are some of the leading points in Prof. Bower's theory:—The spore-bearing parts of the sporophyte are to be regarded as primary in the evolutionary history and in function. The homosporous vascular cryptogams attained the climax of numerical spore-production. As a consequence of increased spore-production arose sterilisation of sporogenous tissue in form of septa partitioning off loculi, and subsequently the formation of synangia, and separation of the sporangia. The sporogonial head is the correlative of the strobilus or flower, the latter has eruptions of the surface to form sporophylls upon which sporangia are borne. The evolutionary history of the sporophylls shows progress from small and simple to large and complex forms. Foliage leaves may have been derived from sterilisation of sporophylls. The following are the remaining papers brought before the Botanical Department:—Miss N. Layard, a method of taking casts of the interior of flowers; Prof. E. Zacharias, the function of the nucleus; Prof. Errera, exhibition of diagrams; Mr. G. Murray, on *Pachytheca;* Dr. Scott, the structure of fossil plants in its bearing on modern botanical questions; Prof. Marshall Ward, a Thames bacillus; Prof. Green, influence of light on diastase; and Mr. Seward, a contribution to the geological history of Cycads.

The following are the remaining papers and exhibitions brought before the Zoological Section; most of them were taken on Tuesday:—

Dr. W. B. Benham expounded a new classification of the Polychæta, which gave rise to some discussion. Prof. Jeffrey Bell exhibited lantern slides of some magnificent colonies of reef-building corals lately acquired by the British Museum.

Dr. W. B. Benham, on the blood of *Magelona*. It differs from that of any other Chætopod hitherto examined. Instead of a red (hæmoglobin) liquid plasma in which float either a few nucleated colourless corpuscles or free nuclei, the blood-vessels of *Magelona* are completely filled with very small spherical globules of a madder pink colour, in an extremely small amount of colourless plasma. These coloured globules are *not* cells. There are free nuclei scattered amongst them, but the coloured globules are not nucleated. The colour is due to a pigment similar to hæmerythrin occurring in some Sipunculids. The globules exhibit a very marked tendency to run together like oil-drops and fuse. This viscid mass seems to be intermediate between the absolutely liquid coloured plasma of chætopods and the red corpuscles of mammals which float in a small amount of colourless plasma. Further, these globules in

Magelona probably originate within cells, from which they are released.

Prof. G. Gilson (Louvain), on the nephridial ducts of *Owenia*.

The Rev. T. R. R. Stebbing, on zoological publication, &c., suggested that the leading biological societies should arrange the work of publishing between them, so as to avoid the overlapping which now takes place. He proposed that for every country there should be a single authorised journal to receive the names of new genera and species with brief descriptions, all claims to priority being dependent on the date of this record.

Mr. J. T. Cunningham, on the significance of diagnostic characters in the Pleuronectidæ, discussed the evolution of the characters which distinguish flat-fishes into subfamilies, genera, and species. He considers that the specific and many of the generic characters are not known to be adaptational, and are more probably due to generative isolation and divergent variation. His general conclusion is that animal variation is to be regarded as the resultant of two opposing influences, one internal and one external to the organism. The one is the internal tendency to definite divergent variations which have no direct relation to the struggle for existence, the other is the direct influence of adaptation, whether due to the selection of individuals or to the direct modification of individuals.

Mr. Goodrich described some of the methods adopted recently in displaying specimens in the zoological part of the Oxford University Museum. Dr. F. A. Dixey, on the plantar surface in infants, showed that his investigations on the skin of the foot in very young infants who had never walked, do not lend any support to the view that acquired characters can be transmitted by heredity.

Mr. W. E. Collinge, in a paper on the relations of the cranial nerves to the sensory canal system, showed that the canals are innervated in the Elasmobranchs chiefly by the facial nerve, in the Ganoids by the trigeminal and facial, and in the Teleostei chiefly by the trigeminal. Dr. H. B. Pollard exhibited, with remarks, models of the cranial skeletons of some rare South American and African siluroid fishes, made after the method of Born, with the addition that they were electroplated in order to give them sufficient firmness. Attention was drawn chiefly to the barbules round the mouth. These were maintained to be the homologues of the oral tentacles of *Myxine* and the cirri of *Amphioxus*, and a new theory of the origin of the head in Vertebrata, termed the cirrhostomial theory, was based on these homologies. The author contrasted this theory with the old vertebral theory of Goethe and Oken, and the subsequent theories of Gegenbaur, Balfour, v. Wijhe, and others.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

AT the Oxford meeting the popularity of the Geographical Section showed no abatement. Crowded meetings were the rule, even when papers of a severely scientific character were being read. This may be explained to some extent by the favourable situation of the section-room in close proximity to the reception-room; but perhaps the general use of lantern illustrations had more to do with it. By means of effective lantern diagrams the audience was able to follow with interest and pleasure, papers on detailed oceanography and climatology. The characteristic of the meeting may be given as the general high level of the papers offered, and the interesting discussions to which they frequently gave rise.

The President, in his address, dealt with oceanography in its widest sense, and was followed by a number of papers of similar character, though narrower scope. Unfortunately, it was found impossible for papers on similar subjects to be taken in all cases on the same day, as the convenience of the authors frequently made it necessary to alter the provisional arrangements which had been made. Mr. H. N. Dickson gave an account of the share he had taken on board H.M.S. *Jackal* in the international oceanographical observations initiated by Prof. Petterson, of Stockholm. The general conclusions arrived at were as follows:—

While the Atlantic current flowing over the Wyville-Thomson ridge attains its maximum velocity in winter, its speed is maintained during summer by the greater warmth of the upper layers of water in the Atlantic, and consequent higher level of the surface of that ocean compared with the Norwegian Sea. Passing over the ridge, the Atlantic current is cooled by mixture with the cold water of the Norwegian sea lying at the bottom of the Faeröe-Shetland Channel, and loses its horizontal motion. The warmer the Atlantic current the more rapidly does this mixture take place. Hence in a hot, windless summer a mass of Atlantic water, extending to a great depth, tends to collect on the northern and north-western edge of the North Sea bank. At all seasons Atlantic water is drawn from the Faeröe-Shetland Channel and forced into the North Sea by the tides between Orkney and Shetland. The tidal streams run north-west and south-west, and an eddy is formed to the north-west of the Orkneys, into which North Sea water is drawn, and perhaps also water from below. As the season advances the surface water of the North Sea becomes warmer, the upper layers probably receive smaller supplies of fresh water, but they become specifically lighter than the under layers, which they protect from the warming influences of the atmosphere. The upper layers becoming ultimately warmer than the Atlantic current, the surface of the North Sea becomes higher, and the surface water spreads outwards into the Faeröe-Shetland Channel, checking the surface supply of Atlantic water. Meanwhile, the mass of Atlantic water, collecting at the edge of the North Sea Bank, seeks entrance into the North Sea. Mixing with the cold bottom water already there, it increases its salinity, but reduces its specific gravity by warming it, and, at a certain stage of mixture, the temperatures and salinities of the two waters combine to form a ridge or axis of maximum specific gravity. This axis, which probably runs north-east from Shetland in the end of May or in June, turns slowly toward a north to south direction, and moves eastward. As it retreats, Atlantic water is gradually admitted round the north end of the Shetlands, passes down the east side of the groups, joins the tidal stream at the south end, and, guided by the axis of heavy water, is distributed along the east coast of Scotland, probably during July and August. Later in the summer, as the axis retreats still further, the Atlantic water is probably distributed more towards the eastward, perhaps until the latter part of September, when the diminishing supply from the Faeröe Channel, and the increasing outflow from the eastern side of the North Sea, bring about a gradual return to the conditions with which we started. Obviously the controlling conditions are complex, but it appears that the greater the winter cold and the spring supply of ice-cold water from the continent, the more slowly will Atlantic water penetrate into the North Sea below the surface; and the warmer the summer, the more will the surface supply be checked. At the same time, the warmer the summer the larger the quantity of Atlantic water seeking admission, and the greater its thermal power to drive back the axis of maximum weight.

M. A. Delebecque, of Thonon, sent an account of his methods of surveying and constructing bathymetrical maps of the French lakes, a series of which was exhibited. The geographical conditions of the English lakes were described by Dr. H. R. Mill, and in the discussion which ensued, Prof. Guido Cora, of Turin, took a leading part. Mr. J. Y. Buchanan, F.R.S., sent an account of the researches being carried out by the Prince of Monaco and himself on board the Prince's yacht *Princesse Alice*, in the Mediterranean and North Atlantic, which received considerable attention. He found that even at a distance of 600 miles south-west of the Strait of Gibraltar the salt water from the Mediterranean occupied the lower half of the whole depth, the upper half alone being occupied by Atlantic water. Numerous observations were made in the narrowest part of the Straits, with the effect of defining the manner in which the surface current of Atlantic water entering the Mediterranean is related to the deeper current of dense water escaping to the ocean.

Dr. John Murray gave a discourse on the geographical and bathymetrical distribution of organisms in the ocean, focussing all our knowledge of the distribution of marine life, and concluding with the belief that the existing distribution is a result of the gradual restriction of a universal fauna which flourished in a climate of world-wide warmth, possibly due to the larger size of the sun. This paper gave rise to an animated discussion. Although not formally organised, this was practically a joint discussion between Sections D and E, the participants in the discussion comprising Dr. Gunther, Mr. P. L. Sclater, Dr. O. Maas, Canon Norman, Dr. H. O. Forbes, and Mr. Garstang.

Papers dealing with new exploration were unusually numerous.