considered requisite. It seems unlikely that the same herring spawn twice a year, but that the fish which spawn in the spring and autumn of one year do not spawn again respectively till the spring and autumn of the next year, in which case it is difficult to account for two distinct races of herring. It may be supposed that at first all herring were in the habit of spawning about the same period, but as time went on they were found spawning during every month of the year. Specimens of ova, for example, have been sent nearly every week from the Aberdeenshire coast, showing that herring have been spawning uninterruptedly in one district for at least ten months, from August 1883 to June 1884. The explanation of why at the present day there are two great spawning periods is not that spring and autumn are the two best periods for the depositing and hatching of the eggs, but that these are the two most favourable periods for the appearance of the fry, as then the surface-forms on which they feed are more abundant, as examination of the Ballantrae Bank showed. In the case of the herring the number of individuals does not depend so much on the number of eggs hatched as on the number of fry that survive. These when hatched are at first protected by their minute size and great transparency, and, given sufficient food, are likely to pass safely through the larval stage. If the larval food were more abundant in autumn and in spring, more fry would naturally survive at these periods, and this would ultimately result in the formation of great shoals of autumn and spring herrings. All that has been written on the migration of the herring leaves us still very much in the dark as to either the extent or the causes of it. Meantime, we may suppose that the movements of the herring are regulated during a greater part of the year by the supply of food, which naturally renders their movements very inconstant, and during the rest of the year by what may be termed their spawning instinct. This seems to imply several things, but it specially leads the herring to select ground suitable for the deposit of eggs, waters having a suitable depth, and water which will provide abundant food for the young fry. It has been long known, and was placed beyond doubt by the Fishery Board investigations of 1862-63, that herring were wont to spawn on hard ground. A very complete survey of the Ballantrae not only corroborated this fact, but showed that the herring even preferred to deposit their ova in the basin-shaped gravel-coated areas, where presumably the water is stiller than over the stone-covered ridges, and where it covered many square yards with a layer nearly half an inch in thickness. Eggs were also often found arranged in low masses over the surface of the long stems of laminaria. In several instances the dredge had apparently come upon part of the bank where the eggs lay "to a very great depth," but on examination it was found that the spawn, instead of forming thick masses, was arranged in irregular heaps ranging from a quarter to half an inch in thickness, and varying in size from scarcely an inch to nearly six inches square. By laying the portions side by side in a tank it was possible to obtain a very accurate notion of the arrangement of the undisturbed ova, which certainly often form a regular layer covering several yards of the bottom. On the east coast, judging from the specimens brought up by the long-line fishermen, the herring seem to select hard ground plentifully covered with sea firs, especially *Hydrallmannia* and *Antennularia*. Fishermen and others believe that there is some relation between the herring deserting any given spawning-ground—such as the once much-frequented bank off Dunbar and the equally famous Guillam Bank in the Moray Firth—and the loss of herring-nets during storms, or when over-fished. The reason is that nets loaded with putrefying fish, when left on the ground, cause the herring to seek more agreeable banks elsewhere. This pollution would be continued and extended by portions of the net continuing to fish during the whole season, so that not only might the eggs first deposited be destroyed, but fish which might have spawned on other portions of the bank be taken, and their eggs, though shed, rendered useless. In this way not only the greater part of a shoal, but, what is of even greater importance, nearly all the eggs deposited during the spawning period might be destroyed, and the survivors of the comparatively small brood hatched desert their birthplace as spawning-ground and cast in their lot gregariously with the first large shoal they met with. In the artificial fertilisation and hatching of herring ova the natural process of spawning was followed as far as possible, and many thousands of eggs treated in this way on March 8 hatched out on March 28, 29, and 30, the temperature varying from 41° to 44° F. When the eggs had been plentifully supplied with pure water, the extremely active embryos kept revolving or wriggling inside the capsule, till this ruptured and allowed the larval herring to escape head-foremost. But if the supply of pure water had been limited, the capsule gave way prematurely, the long, slender body escaped, but the head remained within, and the embryo usually perished in spite of all efforts to escape. The hatching was greatly expedited by the temperature of the water being slightly raised. As soon as the fry escape, they begin to try and ascend towards the surface, which they generally succeed in reaching on the fourth day, when they are found swimming freely about. This instinctive desire to rise to the surface as soon as they escape from the egg-capsule is evidently intended to bring them to the vicinity of the food, on which, after the fourth or fifth day, they depend for nourishment. Sketches are given (Plates iv. v.) of herring, illustrating the different positions of the fins. A map of the Ballantrae spawning-bank (Plate vi.), and drawings of a colony of *Hydrallmannia falcata* (Plate vii.) and *Antennularia antennina* (Plate viii.), with cluster of eggs attached. A series of figures (Plate ix.) show the eggs deposited artificially on glass and naturally on stones, gravel, and on a lost net dredged at Ballantrae.

A number of interesting specimens received by the Board are likewise described and figured:—(1) A new Blenny (*Lumpenus lampretæformis*, Plate x.), believed to be the first specimen recorded from the shores of the British Isles; it measured 10·7 inches in length, and was taken in forty fathoms of water, fifteen miles off St. Abb's Head. (2) A fine *Torpedo nobiliana* (Plate xi.) taken off Lybster in forty fathoms of water. (3) A Comber (*Serannus cabrilla*, Plate xii.) taken off Shetland, the first recorded in the North Seas. (4) A Turbot (*Rhombus maximus*, Plate xiii.), dark on both sides, with an eye on each side of the head and rounded frontal process, taken off Anstruther. (5) A splendid Opah (*Lampris luna*), four feet in length, taken in seventy-five fathoms of water off Fluga, Shetland, and now being examined by Prof. Turner, F.R.S. Another item is a list compiled by Miss Maclagan of edible British fishes and mollusks, with their Latin, French, Italian, and German synonyms.

THE BRITISH ASSOCIATION

Section D—Biology

Department of Zoology and Botany

Remarks on the Characteristic Features of North American Vegetation, by Prof. Asa Gray.—The first impression produced on a visitor from Europe to the Atlantic coast would be the similarity of the flora to that of England, many of the plants being almost or quite the same. The larger number of these are obviously introduced. The mullein, the toad-flax, the rib-worts, the milfoil, the clovers, thrive by every roadside as in England, and perhaps with even greater luxuriance, the competition being less. This strongly suggests the idea that the distribution of plants is not always due so much to adaptation as to opportunity. As one proceeds westward and southward, the difference becomes more marked, the European type gradually disappearing. But as European settlements extend, the settlers carry their plants with them, and the plants are well up to the time, and travel by rail. On the other hand, some plants, but a much smaller number, are carried from America to Europe, and naturalised there. Such are *Impatiens fulva* and *Erigeron canadensis*. Turning from similarities to differences, one of the first points that strikes a European visitor is the great wealth of trees and shrubs. This Prof. Gray illustrated by giving the number of European and North American species in the most important arborescent orders. The reason of this is probably to be found in the different conditions of the two continents during the period of glaciation. The flora of Europe is exceptionally poor in trees, and, on the return of a warmer climate, the return northwards of those that survived in the south was barred by the Mediterranean. The fossil remains of trees belonging to many tropical orders are found in our Miocene and Pliocene strata. In America, on the contrary, there was nothing to prevent their gradual return from the south, and accordingly we find solitary examples, or in some cases a larger number of representatives, of many tropical orders among the trees of the Northern States. Such are *Menispermum* (Menispermaceæ), *Liriodendron* (Magnoliaceæ), *Diospyros* (Ebenaceæ), *Tecoma* (Bignoniaceæ), and many others. This difference is also promoted by the greater heat of the American summer as compared with that of Europe. On the high lands of North America are also many Arctic plants, which remained after the Glacial period had passed away; but this flora is insignificant compared with that of Europe. A few species are found on the cool shores of Lake Superior, the shores of Labrador, and certain summits of the Appalachian Mountains. One of the most interesting features of North American botany is an outlying region of a true tropical flora which extends northwards up the Atlantic coast as far as the "pine-barrens" of New Jersey. Proceeding westwards, whether in the States or in Canada, a gradual striking change is observed: not only do the European importations disappear, but European genera give place to those specially characteristic of the western continent. Here above all is to be observed the extraordinary wealth of Compositæ, which make up about one-eighth of the total phanerogamous flora of North America; great numbers of species of *Aster, Solidago, Eupatorium, Silphium*, and other genera. Between the wooded region of the Atlantic and the wooded region of the Pacific coast, there is an immense tract of woodless prairie land, the home of the "buffalo" and of many grasses; and in the spring the number of bright coloured herbaceous plants is also very large. These plains are destitute of water, and probably never grew trees, and are capable of growing nothing but herbaceous plants, which completely disappear in the hot dry summer. Then comes the great chain of the Rocky Mountains, which are well wooded on their sides, and have on their summits a flora of about 200 Arctic species. When the traveller reaches the Sierra Nevada, he enters perhaps the noblest coniferous forest in the world. But while the Pacific coast is extraordinarily rich in Coniferæ, it has a smaller number of trees belonging to other orders than the Atlantic coast; the entire absence of oaks, ashes, and maples, is especially remarkable.

Observations on the Trapping of Young Fish by "Utricularia vulgaris," by Prof. Moseley.—Small perch just out of the ovum were found in the bladders of *Utricularia vulgaris*, some of them caught by the head, some by the tail; but very close observation failed to detect the actual act of capture. No process of digestion has been discovered, and the object of the capture requires further investigation.

On the Jessop Collection, to Illustrate the Forestry of the United States in the New York Natural History Museum, by Albert S. Bickmore.—The great importance of the forest industries and lumber trade of the United States led Gen. Walker, the Superintendent of the Tenth Census, to provide for a corps of competent experts, under the direction of Prof. Charles S. Sargent, who have made new explorations of our forest lands, and gathered original data regarding their present extent. The results of these elaborate researches have been partially published from time to time in the form of bulletins, and the completed work will soon appear in two large quarto volumes of the census series. To place this great fund of valuable information before the artisan and labouring classes in an accessible form, a great collection of our forestry and its products was needed, and this Mr. Morris K. Jessop offered to provide at his own expense. After the field work planned by the census had been finished, Prof. Sargent directed his assistants to return to the forests, and to carefully select the individually largest and soundest tree of each species. Prof. Sargent is preparing a manual which will be a guide to the collection, and which contains all the most important information in the large census volume that will be useful to the visitors and to the artisan classes. The museum is most fortunate in its location in Central Park, where more native and domesticated species are flourishing than can be seen together at any other place on the continent. This is the first effort yet made in this country to gather the native woods together into one collection on a scale commensurate with the extent of the new continent and the importance of its forests.

On the Origin of Fresh-water Faunas, by W. J. Sollas.—The author commented on the lack of interest which had been previously taken in the subject, and then referred to the experiments made by Bourdon in changing salt water into fresh. The old idea that salt water had been the mother of life was now generally acknowledged. In the River Jumna, one thousand miles from its mouth, were found marine forms of mollusks. We had to look further than change of temperature and the composition of the water for the manner in which marine specimens obtained their distribution. The currents of rivers always flowed seaward, and if free-swimming larvæ got a short distance up a river they were certain to be washed down again. The case was different with swift-swimming fish, the Salmonidæ, for instance, which were able to swim up stream and lay their eggs in lagoons. According to a table which he had prepared, nearly all the groups of fishes were both fresh-water and marine. He referred to the evidence afforded by geology to show that fresh-water forms were but modifications of those found in salt water. He believed the sea-water fauna had become fresh-water fauna in the times when tracts of salt water had become fresh-water lakes. He dwelt on the subject of secluded development, and concluded that the higher the organism the less possible was it to diverge from the parent stem. The tree of life at the present time rather put out new leaves than fresh branches.

Prof. Murat of Harvard briefly criticised the paper. The subject was one, he said, rather for suggestion than dogma.

On the Concordance of the Mollusca inhabiting both sides of the North Atlantic, by Dr. Gwyn Jeffreys.—It was recommended that this paper should be printed entire in the *Proceedings*.

On the Identification of Animals and Plants of India which are mentioned by early Greek Authors, by Prof. Valentine Ball, F.R.S.—He said that upon examination it had been found that many of the animals mentioned by Herodotus, Strabo, and other Greek historians, which had usually been regarded as myths by commentators, were easily identified as animals which were found to-day in the forests of India. For instance, the marticora mentioned by old classical writers, and usually regarded as a combination of tiger and scorpion, was really a tiger. It was said by the Greek writers that the marticora had poisonous whiskers and a sting at the end of the tail. In India to-day the inhabitants still regarded the whiskers of the tiger as poisonous, and when one was killed they always took care to burn the whiskers. With regard to plants, Herodotus mentioned the "Indian reed" or *Calamus indicus*, which was generally regarded by scholars as the bamboo. This was, however, impossible, as the bamboo did not grow large enough to furnish material for canoes, as Herodotus expressly stated that the *Calamus indicus* did. The speaker thought it was the Palmyra palm which grew in the valley of the Indus, and which was known in the Sanskrit language as the "Father of Reeds." There were many others of these animals and plants which could be identified, and when the writer's investigations were published he hoped it would be found that he had exonerated the old travellers from the imputations which had been cast on their veracity.

On the Rudimentary Hind Limb of the Humpbacked Whale, Megaptera longimana, by Prof. J. Struthers.—He said the humpbacked whale was extremely rare on the British coast. One had been seen often spouting for some weeks in December in the Firth of Tay; it was mortally wounded, and finally towed ashore dead near Aberdeen. It was a male, forty feet in length. After it had been exhibited for a couple of weeks at Dundee he had partially dissected it. Having been preserved, it was further exhibited, and he had only completed his dissection immediately previous to coming out. The presence of a rudimentary thigh-bone had been discovered in this species many years ago by the late Prof. Reinhardt of Copenhagen. The thigh-bone was composed entirely of a cartilage of conical shape, in length five and a half inches on the right side, four inches on the left; it was incased in fibrous tissue, and rested loosely on the pelvic bone without articular surface. Looking at the anatomical facts and comparing them with those of the other species he had referred to, the conclusion which must be arrived at was that the thigh-bone in the humpbacked whale was a rudimentary structure, a vestige of a more complete limb possessed by ancestors, from which it was descended. The skeleton of this whale would be placed in the Dundee Museum, he hoped, before the Association met in Aberdeen next year.

On the Value of Nerve-supply in the Determination of Muscular Anomalies, by Prof. D. J. Cunningham.—He spoke of the muscula sternalis as a new muscle in man, which had no counterpart among animals. It was, according to his experience, found more frequently among females than males, while Prof. Sheppard, of McGill College, had, he learned, had three cases, all among males.

Prof. Moseley said that this subject of the anomalies of the muscles had a very important bearing in solving many of the riddles of the evolutionary theory.

Prof. Struthers said that while it was not at all impossible that new muscles were starting up within us, it was also possible that the muscles might have existed before, and not been discovered, as our predecessors did not examine things as closely as did the modern investigators in muscular anomalies.

Dr. G. E. Dobson regarded this muscle as a rudimentary vestige of a muscle found in all the lower animals, by the use of which they are enabled to draw in their head and forelegs when they erect their spine.

On the Mutual Relation of the Recent Groups of Echinoderms, by Prof. A. M. Marshall.—Of these there were four groups, the common starfish, brittle starfish, sea-urchins, and holothurians. He said the nerve-system was originally derived from the skin. In some animals the nerve-system sank below, in others it remained near the skin, these latter being in a more primitive condition than those in which the nerve-system had sunk down.

Prof. Moseley characterised the paper as very valuable, having fully borne out all the discoveries of Prof. Carpenter, whose advancing age had prevented his being present.

A paper *On the Fœtal Membranes of the Marsupials*, by Mr. A. H. Caldwell, who was sent to Australia by the British Association to investigate certain interesting biological questions, was read, in his absence, by Mr. Sedgwick. It gave an account of the development of the marsupial embryo, which has been hitherto a riddle in biology. A letter from Mr. Caldwell as to the progress of his investigations in Australia was also read.

On Some Peculiarities in the Geographical Distribution and Habits of Certain Mammals Inhabiting Continental and Oceanic Islands, by G. E. Dobson, M.A., F.R.S.—The geographical distribution of mammals inhabiting continental and oceanic islands has been lately so ably treated of by Mr. Wallace, in his work "Island Life," that I do not purpose entering upon the subject from a general point of view, but will limit my remarks to some peculiarities of distribution which have attracted my attention while engaged in the special study of certain mammalian orders: I refer particularly to the Chiroptera and Insectivora. It is an interesting fact, not hitherto noticed, that many of the most characteristic species of the Chiropterous fauna of Australia have their nearest allies, not in the Oriental, but in the Ethiopian Region, thus contrasting remarkably with the avifauna. The remarkable genus *Chalinolobus* is represented only in Africa south of the equator and in Australia, a single species extending into New Zealand. Again, the species of the sub-genus *Mormopterus*, which belongs to a genus (*Nyctinomus*) of world-wide distribution, is limited to the same zoological regions, being found only in Africa south of the equator, Madagascar, the Mascarene Islands, Australia, and Norfolk Island. The presence of a species of this genus in Norfolk Island and its absence from New Zealand is very remarkable, for, as I pointed out for the first time about ten years ago, one of the two New Zealand bats known, namely *Chalinolobus tuberculatus*, is also common in Australia. The species of the extraordinarily specialised genus *Megaderma* have their headquarters in the Oriental and Ethiopian Regions; yet the largest species not only of the genus, but also of all known insectivorous bats, namely *M. gigas*, lately described by the writer from Central Queensland, has its nearest ally, not in any of the Oriental species, but in *M. cor* from Eastern Africa. Another very remarkable leaf-nosed bat, the type of my genus *Triœnops*, found in Madagascar, Eastern Africa, and Persia, but unknown in the well-searched Oriental Region, has its nearest and only ally in *Rhinonycteris aurantia* of Australia, the type of another very peculiar genus. Finally, Australia agrees much more closely with Madagascar and the Mascarene Islands than with the Oriental Region in the species of the large genus *Pteropus*, for, while species of the section of which *Pt. vulgaris* of Madagascar is characteristic are well represented in the former regions, they are absent from the latter. Furthermore it is noticeable that, while 80 per cent. of the species of the genus inhabit the Australian Region and Madagascar with its islands, a single species only has found its way to the great continent of Hindostan and to Ceylon.

On the Geographical Distribution of the Laridæ (Gulls and Terns) with Special Reference to Canadian Species, by Howard Saunders.

Result of the Investigations of Insular Floras, by W. B. Hemsley.

Some Observations on the Direct Descendants of Bos primigenius in Great Britain, by G. P. Hughes.

On Natural Co-ordination as Evinced in Organic Evolution, by Dr. W. Fraser.

Department of Anatomy and Physiology

On the Presence of Eyes and Other Sense-Organs in the Shells of Chitonidæ, by H. N. Moseley, M.A., F.R.S., Linacre Professor of Human and Comparative Anatomy in the University of Oxford.—The Chitonidæ have hitherto been regarded as characterised by an entire absence of organs of vision, the presence of eyes in the shells of numerous genera having been entirely overlooked by naturalists. The author first discovered eyes in a specimen of *Schizochiton incisus*, dredged by Capt. Chimmo, R.N., in the Sulu Sea, in which species they are larger and more conspicuous than elsewhere, and on examining carefully the shells of certain other forms, found eyes present there also. The eyes are entirely confined to the shells, and to the exposed parts of these, the "tegmenta" not occurring at all on the "articulamenta." They never occur on the girdle or zone, or any other part of the mantle. They appear as bright, highly-refracting, convex beads on the shell-surfaces, encircled by zones of dark pigment formed by the choroid layers. The eyes are usually circular in outline, and very minute, measuring in *Schizochiton incisus* about 1/175th of an inch in diameter, in *Acanthopleura spiniger* 1/350th of an inch, and in *Corephicum aculeatum*, in which they are oval in outline, 1/600th of an inch by about 1/400th. In the case of all the intermediate shells the eyes are confined to the areæ laterales, or to the lines of demarcation between the areæ laterales and the area centralis, which latter is usually entirely devoid of them. In some genera of Chitonidæ, such as Acanthopleura and Corephicum, the eyes appear to be often destroyed and obliterated in the older regions of the shells by decay and delamination of the tegmental surface, or its destruction by boring Algæ or animals. They are, however, constantly re-formed by the mantle in the process of growth of the shell at the growing margin of the tegmentum, and may be observed in this situation in all stages of construction. In other genera, such as Tonicia, the eyes lie in shallow pits of the shell-surfaces, and thus escape destruction by wear, nearly the entire number which have been formed being thus found present in fully-grown shells. The tubercles and prominences by which the tegments are covered in some forms serve, perhaps, as protections to the eyes from attrition. The entire substance of the tegmentum in the Chitonidæ is traversed by a series of branching canals, which are occupied in the living animal by corresponding ramifications of soft tissue and nerves. The strands of soft tissue are continuous with the tissues of the mantle along the line of junction of the margin of the tegmentum with the upper surface of the articulamentum by means of a series of tubular perforations in the shell-substance. Further, in the intermediate shells of most genera there are a pair of lateral slits (incisuræ laterales), one on either side in each shell in the lateral laminæ of insertion; these slits lead each to a narrow tract in the deep substance of the shell, which follows the line of separation between the area centralis and area lateralis. This tract is permeated by longitudinal canals, into which open a series of five apertures on the under surface of the shell. By these apertures numerous nerves enter the tract from the bed of the shell, and, traversing the longitudinal canals, give off a series of lateral branches on either side from it to the network within the tegmentum. In the cases of the anterior and posterior shells, there are usually a considerable number of slits present in the laminæ of insertion, each connected with a similar nerve-supply to the tegmentum. The network terminates at the surface of the tegmentum all over in a series of elongate cylindrical organs of touch, the plug-like ends of which are somewhat dice-box shaped, and can be protruded beyond the level of the tegmental surface from a series of pores, "macropores," by which this surface is covered. These larger organs of touch give off from their sides five branches of soft tissue, which pass vertically to the surface of the tegmentum, and terminate there in minute plug-like organs like the larger ones, but much smaller, and which are protrusible from a series of smaller pores (micropores) in the shell-substance. These smaller and larger touch-organs, and their corresponding pores, are disposed on the surface of the tegmentum with more or less exact regularity in different genera of Chitonidæ; in many cases in very definite lines and patterns. The eyes are connected with the same network of soft tissue as the touch-organs, and are apparently to be regarded as having arisen in development as special modifications of them. The soft structures of each eye lie in a more or less pear-shaped chamber excavated in the substance of the tegmentum. The stalk of the pear, which forms the canal for the passage of the optic nerve, is directed always towards the free margin of the tegmentum, and here its wall is pierced by a circular aperture, which is covered by the cornea. The cornea is calcareous, resisting the action of strong boiling caustic alkalis, but collapsing at once when treated with acids.

In section it is seen to be composed of a series of concentric lamellæ. Its substance is continuous with the general calcareous substance of the tegmentum at its margins. The pear-shaped cavity of the eye, formed by the shell-substance, is lined by a dark brown pigmented choroid membrane of a stiff and apparently somewhat chitinous texture. This membrane exactly follows the shape of the cavity, but, by projecting inwards beyond the margin of the cornea all round, forms an iris of a less diameter than the latter. A perfectly hyaline, strongly bi-convex lens is placed behind the iris aperture. It is composed of soft tissue, and dissolves in strong acetic acid. The optic nerve at some distance from the retina is a compact strand, but before reaching the latter has its numerous fine fibres separated and loose. The retina is composed of a single layer of rather short but extremely distinct nucleated rods of roughly hexagonal section, with their free ends presented to the light. Immediately behind them is a dense mass of nerve-fibres with numerous nuclei and nerve-cells interspersed. The retina is on the type of that of Helix, and not, as might have been supposed, on that of the dorsal eyes of Oncidium. A large part of the peripheral fibres of the optic nerve do not pass to the retina, but pass outside the eye-chamber by a series of apertures in the choroid round the iris margin, and end at the shell-surface in a zone of touch-organs encircling the eye. The touch-organs are identical in structure with the smaller touch-organs already described as appended to offsets of the larger touch-organs all over the shell. In giving off nerves to a series of such small organs, the eye thus corresponds exactly in structure to these larger touch-organs, and its homogeny with them is thereby clearly indicated. The arrangement of the eyes varies much in the different genera. In *Schizochiton incisus* the eyes are restricted to single rows traversing the lines separating the lateral area from the area centralis, and corresponding in portions with the incisuræ laterales and courses of the principal nerves. There are six rows of eyes, with six marginal slits on the anterior shell, and six on the posterior, and a single pair on each of the intermediate shells, twenty-four rows in all, with an average of about fifteen eyes in each, or, in all, 360 eyes. In *Acanthopleura spiniger* the eyes are irregularly scattered around the bases of the tubercles with which the surface of the tegmentum is covered, and are confined in the specimens examined to the region of the margins of the shells adjoining the mantle. The surface of the older regions of the tegmentum seems in this species especially liable to flake off, carrying the eyes with it, and it will probably be found, when series of examples of various ages are examined, that the eyes are originally more widely extended over the shell surfaces. In *Corephicum aculeatum* the eyes are very small, with corneas oval in outline, the long axis of the oval being directed vertically to the shell margin. They are never placed on the tubercles with rows of which the shell-surface is covered, but between the bases of these. The two kinds of pores lodging the organs of touch are arranged in vertical parallel lines with great regularity, the large pores occurring at intervals in the lines of smaller pores. The eyes are present in enormous numbers, the anterior shell alone bearing more than 3000, and the entire eight shells more than 11,500. In *Tonicia marmorata* the eyes are arranged in single straight radiating rows on the anterior and posterior shells. On each lateral area of the intermediate shells there are from two to four similar rows of eyes. In Ornithochiton the eyes are disposed somewhat similarly. In the genus Chiton, eyes appear to be entirely absent, though the touch-organs of two sizes and corresponding pores are present. In Molpalia, Mangina, Lorica, and Ischnochiton, I have as yet detected no eyes. In Chitonellus there are no eyes, and the supply of touch-organs is scanty and confined to the margins of the tegmenta. The arrangement and structure of the eyes and organs of touch will probably be of great value in the classification of the Chitonidæ, which has hitherto proved so difficult a problem. No traces of any structures resembling the eyes and touch-organs of the Chitonidæ can be detected in the shells of Patella or allied genera. The tegmentary part of the shells of this group appears to be something *sui generis*, entirely unrepresented in other Mollusca. Its principal function seems to be to act as a secure protection to a most extensive and complicated sensory apparatus, which in the Chitonidæ takes the place of the ordinary organs of vision and touch present in other Odontophora, and fully accounts physiologically for the absence of these latter in them. Dr. W. B. Carpenter observed the perforate structure of the tegmentum in Chiton, though he did not examine the nature of the contained soft network. The late Dr. Gray, in his well-known paper on the structure of Chitons, recognised the fact that the tegmentum in the Chitonidæ is something *peculiar* to the shells of this family.

On a Method of Studying the Behaviour of the Germs of Septic Organisms under Changes of Temperature, by Rev. Dr. Dallinger.—Description of a new apparatus invented for this purpose.

A Vegetable Organism which Separates Sulphur, by A. W. Bennett.—Description of *Beggiatoa alba*, an organism found in the effluent water from sewage-works, known as the "sewage-fungus," which has the property of separating sulphur out of the organic matter in the water, or in the salt used in precipitating the sewage, in the form of minute sharply refringent globules.

On the Coagulation of Blood, by Prof. H. N. Martin and W. H. Howell.—The blood of the Slider Terrapin, a turtle easily obtainable in Baltimore, had been used for a number of experiments, the object of which was to determine whether the views entertained by Hammarsten or by Schmidt were most reliable. The general conclusions went to show that the views of Hammarsten were more in accordance with the results of these observers.

Prof. Schäfer asked if the authors had made any experiments with reference to the addition of lecithin and white corpuscles respectively to the blood plasma.

Prof. Martin replied that no experiments had been made with lecithin, but that he had found that the plasma did not clot when entirely free from white corpuscles or a watery extract of them.

On the Blood of Limulus polyphemus, by Francis Gotch and J. P. Laws.—The paper was chiefly interesting, as Prof. Schäfer remarked, on account of its indicating the combination of copper with a proteid replacing the usual iron.

On Vaso-motor Nerves, by Prof. H. P. Bowditch.—He gave an account of some experiments he had been making to determine the need of vaso-motor nerves. He had employed an entirely new method, namely, the use of the plethysmograph.

Demonstration of the Co-ordinating Centres of Kronecker, by Prof. T. W. Mills.—This subject had been previously practically demonstrated to most of the physiologists present. The view, in brief, held by Prof. Kronecker is that there is constituted in the ventricle of the dog's heart a centre which, when injured, is paralysed, and whose function of co-ordinating the muscular movements to form a beat is thus lost, the heart going into what is known as fibrillar contraction, which is wholly insufficient to propel the blood through the body.

Dr. Martin had seen this phenomenon when working on the coronary artery, and thought it due rather to injury of the nerves.

Prof. Schäfer held a somewhat similar view.

Dr. Bowditch asked if, as the injuries referred to were mostly superficial, they did not differ very much from the case in point, which was a deep injury.

Prof. McKendrick thought that if it was merely an injury of a nerve that caused the phenomenon, the heart might be brought back to its natural action; while the fact was a dog's heart, he understood, had never been recovered.

Dr. Mills also stated that Prof. Kronecker would, in consequence of injury of this centre, explain deaths from slight pricks of the heart, sudden death in heart disease in certain cases, and death from chloroform.

Prof. Schäfer thought that from the evidences it was clear electric excitation should not be used to recover hearts suffering from chloroform administration, inasmuch as the phenomenon could itself be caused by the application of an electric current.

Dr. Osler thought the strength of current usually used by physicians in such cases was not so strong as those Prof. Schäfer had in view.

On the Cardiac Nerves of the Turtle, by Profs. Kronecker and Mills.—This communication went to show that in the sea turtle there were nerves whose function was perfectly analogous to that of the vagi and accelerantes in mammals. The course of these nerves varied a good deal in different species and in different individuals. It had also been discovered that the pulsating great veins of the land turtle were under the influence of the vagus.

Prof. Martin had found in the Slider Terrapin a ganglion, apparently answering to the thoracic ganglion of the dog, from which the accelerator nerve passed to the heart.

On the Functions of the Marginal Convolution, by V. Horsley and Prof. Schäfer.—The object of their experiments was to ascertain the effect of stimulation of localised areas of the marginal convolution in the monkey, and their results filled up a gap in the well-known work of Ferrier in that they were able to show that removal of certain areas, the excitation of which had previously caused movements of muscles of the trunk, &c., on both sides led to paralysis of muscles of the trunk of such a degree that the animal was unable to stand. By removal of the frontal lobes no paralysis of voluntary movements were obtained. These results were in opposition to those of Munk, of Berlin.

Ova of Monotremes.—The President stated that he had a most important announcement to make. He had just received a cablegram from Sydney, from Prof. Liversidge, announcing that Mr. Caldwell, the Balfour Student, who was sent out to Australia to investigate the mysteries in connection with the mammals of that country, had discovered that the Monotremes were oviparous. He did not consider that a more important telegram in a scientific sense had ever passed through the submarine cables before. The Monotremes formed two families characterised by the duck-billed Platypus and an animal which was known to the Australians as the ant-eater. These were the lowest forms of mammals, and it had never been known how they produced their young. The extraordinary discovery was now made that these mammals laid eggs, and that the development of these eggs bore a close resemblance to the development of the eggs of the Reptilia. This discovery proved that these animals were more closely connected with the Sauropsida than with the Amphibia.

On Sensory Nerve-Sacs in the Skin of Amiurus, a Siluroid Fish; and *On the Function of the Air-Bladder in Amiurus, and its Relationship to the Auditory Organ*, by Prof. R. Ramsay Wright.—He referred to the numerous species in North American fresh waters, and their remarkable uniformity, almost all belonging to one genus, Amiurus, while tropical fresh waters teem with many different genera differing extremely fr m each other in form. All the species, however, live in muddy waters, and, to make up for the want of the powerful eyesight which characterises the salmon, are provided with an exceedingly sensitive skin and with special tactile appendages on the head. The lecturer described the already known forms of sensory organs in the skin, and then pointed out that certain structures recalling the nerve-sacs of ganoid fishes, like the sturgeon and gar-pike, are scattered all over the body from head to tail, and both on the upper and lower surfaces. This diffusion of these organs is of interest as indicating probably an ancient type of their arrangement. The second point touched upon was the function of the air-bladder and its relationship to the auditory apparatus. Prof. Wright believes the fish becomes sensible of alterations in the pressure of the surrounding water in the auditory apparatus, and suggested that the air-bladder is also an important channel through which sounds are communicated to the terminal organs of the auditory nerve.

In the discussion which followed Prof. Alfred Haddon of Dublin confirmed the latter point, and suggested that this particularly delicate apparatus for receiving sounds was present on account of the fact that tropical Siluroids, at any rate, are capable of producing sounds by means of a stridulating apparatus, some forms of which he had himself described.

Section H—Anthropology

Mr. Horatio Hale read an interesting paper *On the Origin of Wampum*. He said that amongst the Indians it represented mammon, or money, and was equally valued. It had once been actually accepted in Massachusetts and New York as legal currency, owing to lack of silver, and was largely used in the Indian trade. Wampum consisted of a kind of bead or shell, but must not be confounded with the cowries of the East. Indians on the sea-coast drove a large trade in this article, and Long Island was a mine of wealth. The word wampum was of Algonquin origin, and meant white. The speaker explained the various uses to which this material was put. It was generally used in strings and belts, and at the great Iroquois ceremonies it was considered indispensable. Black wampum was more valuable than white. Of the many thousands of belts that had been known to exist during the last three centuries, scarcely fifty remained, and Mr. Hale regretted the dull indifference that had been displayed by the Americans with regard to this interesting and valuable material, valuable as forming a chronicle of the tribes who manufactured the belts. Mr. Hale exhibited an historical belt of wampum, composed of white beads, with four black squares, which, he said, represented four towns. This belt, he said, was one hundred and sixty years old. Another and still more remarkable belt was also shown by the speaker, who explained the emblems upon it, which, he said, were intended to represent the signs of the Christian religion. There were three crosses representing the Trinity, a lamb, executed in a primitive manner, and a dove. These objects, Mr. Hale said, had been evidently suggested to the Indian artist, who had done his best to represent them, but he said that his artistic powers should not be judged by this specimen. The speaker also displayed some strings of beads, and said that these were used in the Indian chants, the beads recalling certain verses to the singers. Mr. Hale showed to the Section a photograph of some Indian chiefs of the six nations who had met at Brantford and explained to him the meaning of their wampum belts. Shell beads, he said, were used in large quantities by the mound-builders, and he argued that it was probable that the art of manufacturing this medium had descended to the modern tribes from their more advanced ancestors. Some beads, which had been found in an enormous burial-place in Orillia county by Mr. Hirschfelder, were shown by Mr. Hale, who said that these were undoubtedly used by the Hurons. Crossing the Rocky Mountains, he said that wampum would be found in actual use, the material itself and the labour devoted to its ornamentation making it extremely valuable. Being susceptible of a high polish, it forms very handsome ornaments, and is better adapted for this purpose than for currency, for which it is cumbersome. Speaking of the amount of shell money possessed by the primitive Indians, Mr. Hale said that the average man owned about one hundred dollars' worth, that being, he said, about the value of two women, two grizzly bear skins, twenty-five cinnamon bear skins, or three ponies. Mr. Hale remarked on the districts in which wampum was found, and quoted some sentences from a work of his own with regard to the discovery of wampum in the Kingsmill Islands of Micronesia in the Pacific Ocean. There, he said, he saw strings of alternate wooden and shell beads. He exhibited to the Section specimens of beads from the Kingsmill Islands and from California, some of these having lost their lustre from the long time which they had been buried in a grave. Mr. Hale made some interesting remarks upon the history of Chinese money or "cash," tracing its origin to the tortoise-shell disks used in earlier times. Mock money, he said, was sometimes burnt at sacrifices, as the Californian Indians burnt their shell money at funerals. He traced the passage of this currency between Asia and America, showing how it could have been brought from one district to another. It was used, he said, by Indians in Eastern North America, those in California, the inhabitants of Micronesia, and the Chinese. He thought that the monetary system was indigenous to China, and that by early intercourse it had been conveyed to this continent. He noticed the fact that Chinese junks and Micronesian prows may have been wrecked on the western shores of America, and that their crews may have introduced the system of shell money amongst the Indians.

Major J. W. Powell read a paper on *The Marriage Laws of the North American Tribes*. In the course of his observations, the speaker remarked upon the custom of burying articles with the dead. There were two classes of property amongst the Indians, communal, or that belonging to the tribe, and personal, or that belonging to the individual. In order to prevent controversy the latter was buried with its owner. With regard to the marriage laws, Major Powell said there were many strange customs. For instance, in some tribes, marriages were arranged by officers of the tribe, and the choice of wife or husband was limited to certain groups of persons. Marriage was therefore not by personal choice, but by legal appointment. But marriage could be performed by elopement, or running away, when, if the couple could remain in safety from detection and punishment until after the day of jubilee, or the day when all offences are considered forgiven, then that marriage would be considered legal. Wives could also be obtained by trial of battle, a contest of some kind, when the woman became the helpmate of the victor. There was also marriage by capture. The methods of obtaining a wife were so common that the custom of marriage by legal appointment was much neglected. But though this was the legal and proper method, the others had become legalised by long custom, and now the capture, contest, or elopement were merely simulated.

Mr. C. A. Hirschfelder of Toronto, as representative of the Numismatic and Antiquarian Society of Montreal, read a paper *On Prehistoric Remains in Canada*. The ancient remains of