

constellations used by people earlier than the Greeks, but still much is to be hoped from the study of the Babylonian records. In these we have a snail being drawn along by the tail of a snake or dragon. It is quite possible that we may have there the origin of our constellation Draco, which is the northern constellation, and it is quite possible that this snail may indicate that the stars in it moved with very great slowness. But it is impossible at present to co-ordinate these different fancies together.

A very important paper has recently been published by Mr. Le Page Renouf suggesting that before the year 1500 B.C. the Egyptians really had an idea of meridional observations. These observations are recorded in several manuscripts found in tombs; they seem to have been given as a sort of charm to the people who were buried in order to enable them to get through the difficulties of the way in the nether world.

The hieroglyphs state that a particular star of a particular Egyptian constellation is seen at a particular hour of the night; we have twelve lines representing the twelve hours of the night, and it is stated that we have in these vertical lines the equivalent of the lines in our transit instruments, and that the reference "in the middle," "over the right eye," "over the right shoulder," or "over the left ear," as the case may be, is simply a reference to the position of the star.

If this should be confirmed, one of the remarkable things about the inquiry will be that the Egyptians did not hesitate to make a constellation cover very nearly 90°. In those days evidently they wished to have as few constellations including as many stars as possible, in order perhaps that things might be more easily remembered.

When the zodiac of Denderah was mentioned, I pointed out the constellation of the Hippopotamus very near the north pole. This constellation is referred to in the records in question.

Such then are some of the ideas which are suggested by the recent work of the Egyptologists. You see, I trust, that it is important that this work should be continued as closely associated as possible with astronomical ideas, because, merely taking a very small part of the area of which they have begun the consideration, we have come to the conclusion that, dealing with the temples alone, there seems a very high probability that 3000, and possibly 4000 B.C. the Egyptians had among them men with some knowledge of astronomy, and that 6000 years ago the course of the sun through the year was practically very well known, and methods had been invented by means of which it might in time be better known, and that not very long after that they not only considered questions relating to the sun, but began to take up other questions relating to the positions and the movements of the stars. It is quite probable that 1500 years B.C. at least they had an idea of meridional observations. If this be so, and if more and more can be proved, I think you will agree that, as I said before, astronomy will have a slight opportunity of repaying some of the great debt which she owes to the other sciences.

J. NORMAN LOCKYER.

THE LATER LARVAL DEVELOPMENT OF AMPHIOXUS.

THE memoir by Mr. Arthur Willey, B.Sc., of University College, London, on this subject, in the *Quart. Journ. Microsc. Science*, March 1891, deserves more than a passing notice. It is one of the most important contributions which have been made to a knowledge of this very interesting animal. In the summer of 1889, Mr. Willey was sent by Prof. Ray Lankester with the aid of a Government grant to collect the larvæ and embryos of *Amphioxus* at Faro, near Messina. He returned with a large series, and in the winter 1889-90 worked out in the laboratory of

University College, chiefly by means of sections, the history of the formation of the atrial cavity in this animal. In a paper published jointly by Prof. Lankester and Mr. Willey (*Quart. Journ. Micr. Sci.*, August 1890), it was shown that the atrial cavity does not form, as supposed by Kowalewsky and by Rolph, as the result of a down-growth of lateral epipleura; but that it forms as a longitudinal groove which sinks inwards along the ventral surface, becoming flooded in by a small horizontal growth on each side corresponding merely to that portion of the adult animal's ventral surface which lies between the two metapleura. The groove, now become a narrow tube, expands right and left, until it acquires the proportions of the adult atrial chamber.

The preserved material brought home by Mr. Willey in 1889 did not enable the observers to determine the mode of origin of the second row of gill-slits. Stages were noted in which there were as many as fourteen gill-slits of the first series (which are placed anteriorly on the animal's right side), and stages were observed, of no greater size, in which two rows of gill-slits were present—one series on the right side and one on the left side of the pharynx; whilst the mouth, which in the specimens with a single series was completely lateral (on the left side), had now taken up a median position.

Mr. Willey again visited Faro in the summer of 1890, for the purpose of determining, by the study of living transparent larvæ, exactly the mode of origin of the second row of slits, and the steps in the "symmetrization" of the larva. The brief account and few unconvincing figures given by Kowalewsky, in 1866, in relation to this matter had not commanded general confidence, although it was felt that so accurate and accomplished an observer could not have been completely mistaken. Balfour had said, in reference to Kowalewsky's observations on this matter, that he was "tempted to suppose that his observations were made on pathological specimens."

Mr. Willey completely and most successfully accomplished the object which he set before himself in his second visit to Faro, and the results obtained are given in the paper under notice, illustrated by three folding-plates. He confirmed the main feature of Kowalewsky's observations, viz. that the first row of gill-slits, after having (so far as the first eight are concerned) taken up a position on the *right* side of the pharynx, rotate downwards across the median ventral line, and rise up into position on the *left* side, whilst, simultaneously, a new series appears on the right side, not one by one, but as many as six being formed at approximately the same moment. Mr. Willey corrects Kowalewsky's brief account in one or two numerical details, and adds some very important facts, which are quite new. He shows: (a) that the anteriormost slit of the primary series closes up and disappears during the process of rotation; (b) that some of the hinder slits of this series, which are not far advanced when the rotation begins (there being usually fourteen, of which the last six are very small, and lie in the median ventral line), also close up; so that, when the rotation is complete, and the second series of gill-slits has advanced in development to the number of eight, a "critical phase" is reached in which there are only *eight* gill-slits on each side of the pharynx, all fairly well developed. From this time forward new gill-slits are formed on each side behind the last formed, and continue to increase in number so long as growth continues, which appears to be as long as the *Amphioxus* lives.

But the most important discovery made by Mr. Willey is as to the origin of the endostyle, a structure which has great importance from the fact that it can be clearly identified, on account of its minute histological structure, with the endostyle of the Ascidiæ.

In the anterior region of the buccal cavity, previous observers have described in very young *Amphioxus* larvæ (with only one gill-slit) an elongated gland; "the club-

shaped gland." It opens to the exterior on the left side, just in front of the big laterally-placed mouth, whence it can be traced, bending down across the median line and passing up at *right angles* to the long axis of the body along the deep surface of the right wall of the buccal cavity. It opens at its apex, as Mr. Willey has shown, into the buccal cavity. Its earliest appearance (as described by Hatschek) resembles that of a gill-slit, though it precedes both the mouth and the first gill-slit in date. Mr. Willey suggests that it is a modified gill-slit. By the side of this club-shaped gland and in front of it, immediately associated with it, is a band-like tract of modified

but the <-shaped epithelial tract does not; it grows rapidly at its angle along the line or interspace between the two series of slits, forming a double tract of modified epithelium consisting of parallel extensions of the two limbs of the <. It is now the epithelium of the hypopharyngeal ridge or endostyle.

Mr. Willey regards the club-shaped gland so intimately associated with the first stages of the endostyle as a modified gill-slit belonging to the secondary (the permanent right-side series). Its early development in *front* of the mouth indicates this; since, when the mouth acquires a median position (passing from the left towards

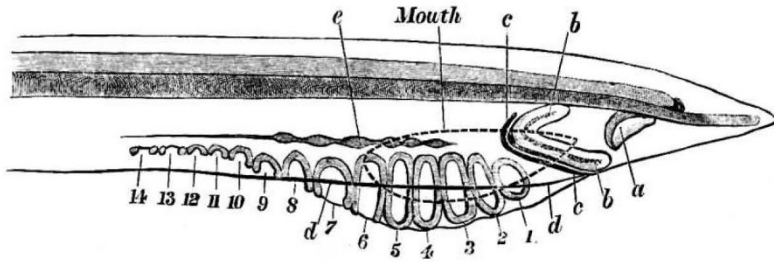
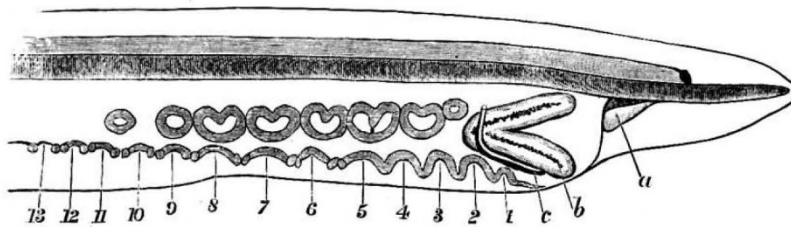


FIG. 1.



[FIG. 2.

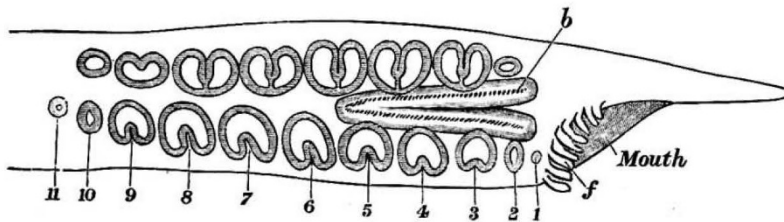


FIG. 3.

FIGS. 1, 2, 3.—Diagrams showing three stages in the development of the gill-slits and endostyle of *Amphioxus*. Figs. 1 and 2 are seen from the right side; Fig. 3 from the ventral aspect. In Fig. 1 the position and shape of the mouth, which lies on the left side of the animal, are indicated by a dotted oval. The primary series of gill-slits are numbered in all the figures. The secondary series are not numbered. Fig. 2 shows the rotation downwards of the primary series of gill-slits and their nearly complete disappearance from view on the right side; at the same time the secondary series have developed to the number of eight, and the endostyle has become <-shaped, and is pushing its angle between the two rows of gill-slits. Fig. 3 shows the atrophy of the most anterior primary gill-slit, whilst some of the hindermost have disappeared and numbers 10 and 11 are in course of closure and disappearance. *a*, præoral ciliated pit, opening on the animal's left side, but seen through the transparent integument; *b*, the endostyle (<-shaped tract of modified epithelium); *c*, the club-shaped gland; *d*, the edge of the right meta-pleur (the atrial cavity is not yet formed in the anterior pharyngeal region); *e*, the six thickenings which develop the six anterior gill-slits of the secondary (permanent right-side) series; *f*, the præoral tentacles.

intra-buccal epithelium. When there are about eight gill-slits of the primary series present, it is noticeable that the apex of the club-shaped gland is bent over, so that the gland tends to become <-shaped, with the angle directed backwards; the adjoining epithelial tract faithfully follows the bend. At first the upper limb of the < is a good deal smaller than the lower, but as the primary series of gill-slits move from the right side of the pharynx to the left, the two limbs of the < become nearly equal in length, and the angle takes up a position between the primary and the new secondary series of slits. The club-shaped gland-tube now atrophies entirely,

the right by a relative growth, the reverse of that which brings the primary gill slits from the right to the left!), structures just in front of it would be thrown round to the right side, the side of the secondary series of slits. He suggests that it is the early-developed anterior member of the secondary series of gill-slits; and points out that just as this modified gill-slit atrophies, so does its pair in the primary series, viz. the first.

Mr. Willey points out the possible importance of these facts in reference to the views of Dohrn and of Van Beneden, and makes an interesting comparison between the Ascidian tadpole and the *Amphioxus* larva, with a

view to suggesting some explanation of the extraordinary asymmetry of the latter. Mr. Willey thinks that a cause of the one-sided position of the mouth and of the primary series of gill-slits in the Amphioxus larva may be found in the excessive anterior prolongation of the notochord at an early period of development, necessitating a pushing to either one side or the other of the mouth. There appears to be nothing in the mode of life of the larva—a free-swimming ciliated creature—which can be correlated with its asymmetry. The gradual process of “symmetrization,” by which the Amphioxus establishes more or less completely a bilateral symmetry on its way to the adult form, is exactly the converse of that process by which the symmetrical larva of the Pleuronectid fishes becomes one-sided; but in the latter case the asymmetry is clearly correlated with a peculiar life on the sea bottom, whilst in the former case we can discover no such relation to environment.

E. R. L.

THE CARDIFF MEETING OF THE BRITISH ASSOCIATION.

TO arrange for the reception of the members of the British Association who will visit Cardiff in August next, an influential Local Committee has been formed, with the Most Honourable the Marquis of Bute, K.T., Mayor of Cardiff, as Chairman, and a substantial sum has been subscribed for the purpose of defraying the cost of the meeting.

Several sub-committees have been formed, all of which report to the Executive Committee, to which also the Council of the British Association has assigned the duty of electing new members and associates. Up to the present time 7 life members have been added, and over 200 annual members and associates, and as the time for the meeting approaches the number of new members and associates will be largely increased.

It may be convenient to describe what has been done by the sub-committees, so as to give a systematic account of the preparations already made and in progress to provide for the comfort and entertainment of our expected visitors.

(1) *Hospitality and Lodgings.*—Many of the principal residents in Cardiff and the neighbourhood have signified to the Committee their desire to entertain members of the Association, and as the date of the meeting draws nearer numerous additional offers will be made by those of the townsmen who are unwilling or unable to fix their engagements so long beforehand. It is understood that those ladies and gentlemen who have offered to invite guests will send out invitations as soon as it is known to the Committee who are coming.

The hotel and lodging accommodation is not so great as in some other towns, but the Committee feel sure that with the private hospitality which will be offered there will be enough for the needs of our visitors. The list of hotels and lodgings will be ready for distribution about the middle of July, it having been delayed to make the list as complete as possible. The list will be accompanied by a map of Cardiff taken from the most recently executed ones.

(2) *Reception and Section Rooms.*—The reception room will be at the Town Hall, practically the whole of which has been placed at the disposal of the Local Committee for the use of the Association. The vestibule will be devoted to the sale of tickets, the distribution of programmes, and other information, whilst the Assembly Rooms will be fitted up as a drawing-room with writing-tables, post-office facilities, and a book-stall. The Council, Committee of Recommendations, and General Committee will meet in various rooms, and others will be set apart for the officers of the Association.

As the Town Hall is about half a mile from the Section room furthest away, a portion of the Drill Hall, the use

of which has been kindly granted by Lord Bute, Colonel Gaskell, and Colonel Page, will be fitted up as a drawing-room, and the remainder will be used as a luncheon-room. As the Drill Hall is situated within very easy distance of almost all the Section rooms, the members of the Association will doubtless appreciate the advantage of having a drawing-room and dining-room so close at hand.

The majority of the Section rooms are very close together, and the greatest distance is not more than half a mile; tramcars and busses, however, run frequently between the extreme points, so that even that distance should offer no difficulty in the way of members wishing to attend different Sections.

(3) *Entertainments.*—The usual *conversazioni* will be given on Thursday, August 20, and on Tuesday, the 25th, and it is hoped that scientific men will aid the Committee in contributing towards the entertainment of our guests by the exhibition of novel experiments or specimens. The Park Hall, in which the *conversazioni* will be held, is well suited to this purpose, and it is the desire of the Committee to introduce as many scientific novelties as possible.

A garden party, to which all members of the Association will be invited, will be given by Lord and Lady Bute, probably on the Friday afternoon, though the date may be subject to alteration. Other social entertainments are projected by Lord Windsor and others, and Cardiff will probably in this respect not fall behind what the members have been accustomed to at other places of meeting.

(4) *Excursions.*—A considerable variety of excursions has been provided for both the Saturday and the following Thursday. For the former, arrangements are being made by Sir W. T. Lewis for a party of members to visit the Cardiff Docks; by a committee appointed by the Board of Directors to visit the Barry Docks; by the Mayor of Newport and the Chamber of Commerce for a party to visit Newport and Caerleon. A special excursion is being arranged by the Colonel commanding the Severn Valley division of submarine miners for officers of the British Army to inspect the Severn Valley defences. The steamer will land the officers at the steep and flat holmes, and will continue with the civilians on board to Weston, from which they will visit Worlebury Hill and camp.

Other excursions will be of geological and archæological interest, and will include excursions to Penarth and Lavernock, where the finest section of Rhætic beds in England is exposed; to the interesting dolmens at St. Nicholas and St. Lythan's; to Llantwit-major, where a year or two ago the remains of a Roman villa were unearthed, and where a college is said to have existed in the fourth century; to Tintern Abbey and Raglan Castle, the Forest of Dean, Merthyr, Brecon, and to some of the numerous collieries and iron-works in the South Wales coal-field. A practical natural history excursion is being organized by the Cardiff Naturalists' Society to the Vale of Neath, which from the beauty of the spot should prove attractive. Several owners of works in the neighbourhood of Cardiff have expressed their willingness to throw them open to the members, and arrangements will be made for visits to some of them.

(5) *Publications.*—A guide-book to Cardiff is being prepared for distribution to all members and associates, and the descriptive articles have been intrusted to the gentlemen who were best fitted to write them. The article on the history and archæology of Glamorganshire has been written by the veteran G. T. Clark, of Dowlais, whilst that on the topography of Cardiff was undertaken by the late James A. Corbett, who, unfortunately, died before it was quite complete. Mr. T. Forster Brown, President of Section G, has undertaken the description of the mining, geological, and statistical features of the district; the industrial portion being in the hands of Mr.