glass of the compound microscope, presents in the right valve three divergent cardinal teeth, with well-developed laterals on the anterior side, and others more elongated and obsolete posteriorly; in the left valve there are also three cardinals, with, on the anterior side, a strong lateral, and another very inconspicuous one at the posterior end. The latter (*Lepton*) in both valves, shows *only* a single, rather slender, conical, pointed primary tooth projecting subhorizontally inwards, or at an angle of from 60°–90°; and the laterals in the right valve on each side are double, with a single lamina on each side in the left valve.

Mr. Jeffreys's scheme of dentition is greatly at variance with the preceding; but the error of that gentleman may have arisen in consequence of his having only dead, worn, and imperfect specimens, in which the laminar portion of the dentition is often wanting. If a pair of valves of the adult *Circe*, and another of these young objects, are placed in a parallel position as regards the dentition, it will be seen that in both it is identical. I have found this to be the case in every perfect shell of Mr. Norman's that I have examined.

The character of the beaks being caliculated is a very unimportant one, as many bivalves in extreme youth are so, but the calix, as the shell grows, wears away; and even in my live example, of only $\frac{1}{30}$ of an inch diameter, the commencement of the sloughing-off is seen; and it is not till then that the germ of the external ligament is visible, and the true beaks, with their slight anterior arcuation, become established.

It thus appears that there is not a congruous character in *Lepton* and *Circe*; they differ in contour, sculpture, dentition, ligament—in fact, in nearly all points. I therefore think the argument has sufficiently proved that the so-called *Lepton sulcatulum* is not a new species, and that it is one of the young conditions of the *Circe minima*.

I am, Gentlemen,

Your most obedient Servant,

Wm. Clark.

V.—*On the Development of* Pyrosoma. By Thomas H. Huxley, F.R.S., F.L.S., Professor of Natural History, Government School of Mines.

The following abstract contains an account of some observations which were laid before the Linnaean Society at its meeting of the 1st of December 1859.

A fine specimen of *Pyrosoma giganteum* having come into my hands through the kindness of Admiral Fitzroy, of the Marine Department of the Board of Trade, I sought in it for those singular compound embryos described by Savigny, but which I had been unable to find in the specimen which formed the subject of my memoir on *Pyrosoma** published in the 'Philosophical Transactions,' nearly nine years ago. Such embryos proved to be exceedingly abundant; and as might have been expected from Savigny's known accuracy, his account of their structure turned out to be perfectly correct, so far as it goes. The excellent state of the specimen, however, led me to endeavour to trace out the origin and mode of development of these bodies; and in so doing I came upon facts of such an anomalous character, that the inquiry assumed much larger proportions, and became invested with a far wider interest, than I had anticipated.

I must premise that the tissues of *Pyrosoma*, as of all Ascidians, are excellently preserved by immersion in tolerably strong spirit—so that the finest details, down even to the ends of the cilia, are admirably exhibited; while the cautious addition of glycerine to sections of spirit-specimens renders them more transparent, without, so far as I have perceived, doing them any injury.

I will now proceed to describe the process of development undergone by the impregnated ova.

As I have pointed out in the memoir referred to above, each zooid of a *Pyrosoma* contains a large testis, and a single ovum enclosed within an ovisac but little larger than itself. Until the ovisac attains a diameter of $\frac{1}{250}$th of an inch, or thereabouts, the duct which connects the ovisac with the wall of the atrium, or cloacal cavity of the zooid, is imperforate at its extremity, and its walls, like those of the ovisac, are composed of a single layer of cells without any limitary membrane or tunica propria. There are no cilia either on the wall of the ovisac or on that of the duct. The ovum consists of a large, spherical, clear germinal vesicle, containing a spherical, more or less solid-looking germinal spot, and surrounded by a yellowish, very finely granular yelk, which is totally devoid of any vitelline membrane. The germinal vesicle lies on one side of the yelk, and the spot on the same side of the vesicle.

In ovisacs of larger size (up to $\frac{1}{100}$th of an inch in diameter) the duct is pervious throughout; and, as it is open at its extremity, it is in free communication with the atrium, and, through that, with the exterior. The ovum still fills the ovisac, its yelk being in the same condition as before, but larger, both absolutely and in relation to the germinal vesicle. The latter has also enlarged up to a diameter of about $\frac{1}{170}$th of an inch, but it is

* Observations on the Anatomy and Physiology of *Salpa* and *Pyrosoma*, 'Philosophical Transactions,' 1851, p. 2.

still perfectly clear and transparent. The spot retains its previous form and dimensions.

In these ovisacs I have been always able to find spermatozoa either entering the mouth of the duct or, more usually, aggregated together into a sort of conical bundle or plug, at the wide end of the duct, where it opens into the ovisac. Not unfrequently the broad end of this plug was in direct contact with the yelk itself. I have assured myself of these facts by observing the contents of the ovisac when opened with a fine needle, or, more accidentally, by making thin sections with a razor; and I have satisfied myself that the bundle of filaments in question (itself very obvious) consists of spermatozoa, by comparing them with the contents of the deferent duct of the testis of *Pyrosoma**.

The spermatozoa must always come from some other zooid (if not from another individual), inasmuch as the testis of zooids containing ovisacs in this state is in a very rudimentary condition. At no period, either before or after impregnation, can any vitelline membrane be discovered; but what surprised me most was, that in ovisacs of larger size than $\frac{1}{100}$th of an inch in diameter the yelk itself was absent, at least in its previous form. Not a trace of it is to be seen; and I can only imagine that it is completely liquefied and dissolved in the clear fluid which forms the sole contents of the ovisac besides the germinal vesicle. The latter is naked, and attached to the epithelial lining of the wall of the ovisac (which is now differentiated into epithelium and tunica propria) close to the opening of the duct into it, and, so far as I have observed, always a little behind and to one side of that opening. This constancy in the position of the germinal vesicle becomes very important as a means of identifying the germinal vesicle in subsequent stages of development. Neither in this nor in any subsequent stage does the germinal vesicle attain a mean diameter of more than $\frac{1}{400}$th of an inch, while ova in an earlier stage, surrounded by their yelks, often measure $\frac{1}{150}$th of an inch, or fully double the size. Besides this, the germinal vesicle is at first perfectly transparent and clear, and the germinal spot, which retains its primitive size and appearance, is recognizable in it with the utmost ease. It is quite impossible, therefore, to confound the germinal vesicle with the ovum of earlier stages, or the germinal spot with the germinal vesicle of previous stages.

That no solid yelk, such as previously existed, now invests the germinal vesicle, is rendered obvious by opening the ovisac and everting that part of its wall to which the germinal vesicle is

* In my memoir on *Pyrosoma* (*l. c.* p. 584) I have described appearances which led me to believe I saw moving spermatozoa in the duct in living specimens.

attached. The sharp contour of the membrane of the germinal vesicle is then easily seen to be covered by nothing but a very thin continuation of the pale delicate epithelium of the ovisac which invests it and holds it in place, just as the discus proligerus holds the human ovum in its place in the Graafian follicle.

In the earlier stages, I have turned the ovum out of the ovisac with its yelk quite entire; so that there can be no question here of destruction by manipulation.

As the ovisac enlarges (up to $\frac{1}{40}$th of an inch), the germinal vesicle and spot retain their previous size; but the contents of the vesicle, instead of remaining transparent, become thick and troubled, and acquire a yellowish colour and a certain opacity, so as very nearly to resemble the previous yelk in consistence. I have observed that this deposit appears to commence on that side of the germinal vesicle which is turned towards the duct, in consequence of which, the membrane of the vesicle is apt to become shrunken and corrugated on the opposite side; so that, viewed under a low power, it may appear truncated on that side. Ultimately the whole vesicle is converted into a solid-looking flattened mass, in which the germinal spot is perfectly distinguishable, while the membrane of the vesicle is hardly visible as a distinct structure. The altered vesicle is now invested on its inner side by the epithelium, while externally it is in contact with the membrana propria of the ovisac.

There is now a slight gap (which I hope yet to be able to fill up satisfactorily) in my observations. Ovisacs of $\frac{1}{30}$th of an inch in diameter no longer show the solidified germinal vesicle; but occupying exactly the same place is a thin discoidal oblong body, about as wide as the solidified germinal vesicle, and of the same colour, but between two and three times as long. In this, no trace of the germinal spot is visible; but it is composed of minute celliform bodies, with distinct endoplasts or nuclei, of the same aspect as the germinal spot, though much smaller. The celliform bodies are above $\frac{1}{1800}$th of an inch in diameter, the endoplasts $\frac{1}{9000}$–$\frac{1}{10000}$th, while the germinal spot attains its full diameter of about $\frac{1}{2000}$th of an inch in very young ova, and neither increases nor diminishes in older ones.

This is the earliest rudiment I have discovered of the blastoderm. The ducts of ovisacs of this size have a shrunken, withered look; and if there are spermatozoa in them, they are few and not aggregated into a plug or bundle: on the other hand, scattered about over the surface and on the face of the blastoderm, I observe a number of minute rod-like solid bodies, curiously similar to the heads of the spermatozoa.

Simultaneously with, or slightly anterior to, the formation of the blastoderm is a very remarkable change in the epithelium of the ovisac, which becomes converted into a thick transparent substance containing many spheroidal excavations, which are, apparently, the cavities of the primitive epithelial cells.

I have little doubt that the germinal spot divides and subdivides, and that each of its portions appropriates to itself a segment of the semisolid contents of the germinal vesicle, to form the endoplast and its investment or one of the constituents of the blastoderm. At present, however, I have no absolute proof that such is the case, though I have seen a germinal vesicle with four or five granules of unequal size in the place of the germinal spot.

The blastoderm rapidly enlarges, and forms an oblong patch, which extends over a gradually increasing segment of the circumference of the ovisac, between the membrana propria (which gradually disappears over it as a distinct structure) and the epithelium, and at the same time becomes covered with a thickish layer of transparent substance, the rudiment of the future cellulose test of the *Pyrosoma*.

The elongated band-like blastoderm next becomes marked out, by four constrictions, into five portions. That segment which terminates one end of the series enlarges faster than the others, and invests one end of the ovisac with a sort of cap; the other four portions assume a heart-shape, the base of each 'heart' being turned towards the 'cap.' All five portions remain connected by narrow necks. In this stage the blastoderm extends over one half of the circumference of the ovisac, which is about $\frac{1}{30}$th of an inch in diameter.

Up to this point the ovisac has remained within a chamber of the sinus-system of the parent zooid, by whose blood it is bathed on all sides; but it has gradually thrust the atrial wall of that chamber before it, and eventually it breaks through the wall, and passes into the atrial cavity, a very large portion of which it occupies. The duct of the ovisac (now a mere thin cord as compared with the whole ovisac) is broken through in the course of this curious natural Cæsarian parturition, and soon ceases to be discoverable.

The young blastoderm itself is, as I have said, almost directly bathed by the parental blood so long as the ovisac remains in the sinus, while the thin walls of the ovisac must allow of such an abundant passage of nutritive matter into its interior that it must serve as a great reservoir of material for the developing embryo after birth. The contents of the ovisac, therefore, though neither a food-yelk nor a placenta, serve the purpose of both.

It would be impossible, without the figures with which I propose to illustrate the memoir presented to the Linnean Society, to explain in detail the further steps of the metamorphosis of the young *Pyrosoma*, the structure of the adult, or the agamogenetic development of young zooids in it; but I may mention that the 'cap' is the rudiment of the cloaca, a structure at first totally distinct from the four *Ascidiites* (as the members of compound Ascidians might be termed, in harmony with *Polypite*, *Somite*, &c.), and homologically equivalent to one of them. The four Ascidiites, connected by their gradually-lengthening intermediate necks of blastoderm, change their positions so as to become, as it were, wound half round the base of the rudiment of the cloaca, with which they become gradually united, without at first in any way opening into it. Enlarging faster than the rudiment of the cloaca, they next completely encircle it, and so extend, on each side, beyond it and the ovisac which it caps, as almost to hide both these structures. The different organs make their appearance, and the embryo attains a size of $\frac{1}{16}$th of an inch, or thereabouts. I have met with no embryo larger than this, and I doubt if such are to be found contained in the parent organism, as they fill the cloacal chamber of the atrium so completely that there seems to be no room for any further enlargement. Indeed, it is difficult to understand how they get out, so disproportioned are they to the diameter of the cloacal aperture of the zooid.

The largest embryos exhibit neither rudimentary buds nor reproductive organs, and each has two short canals passing from the inner or hinder end of its neural surface towards the aperture of the general cloaca. The latter lies altogether above the primitive rudiment of the cloaca; and into it the cloacal apertures of the four Ascidiites open. The primitive neck-like portion of blastoderm connecting the zooid nearest the rudiment of the cloaca with it is now converted into a long canal, which debouches just in front of the ganglion, while from the opposite side and end of the zooid, close to the end of the endostyle, a similar slender tube passes to the region in front of the ganglion in the next zooid. The other zooids are connected in the same way; so that the four Ascidiites and the rudimentary cloaca are tied together head and tail, like horses going to a fair,—the 'tail' of the last zooid, as of the last horse, being unfettered.

By the observations of Müller on *Entoconcha* and of Gegenbaur on *Sagitta*, the question as to the fate of the germinal vesicle after impregnation, or, rather, after yelk-division, has been reopened; and the observations I have detailed tend to show that in *Pyrosoma*, as in *Entoconcha* and *Sagitta*, the embryo-cells are the lineal descendants of the germinal vesicle, and that the doctrine of Remak and Virchow is applicable to the early stages of development.

The nearest analogy I am aware of for what occurs in *Pyrosoma* is the process of development of the embryo observed by Kölliker in *Ascaris dentata* and in *Cucullanus elegans*, where the yelk is a nearly clear fluid, which undergoes no segmentation, but merely serves to suspend the embryo-cells. These embryo-cells are, however, according to Kölliker, new products arising totally independently of the germinal vesicle; so that, if this be the case, there is a fundamental difference between the two processes—quite apart from the fact that, in the worms, there is a vitelline membrane, and that the representative of the ovisac plays no such part as in *Pyrosoma*. Indeed, in this respect the development of *Pyrosoma* appears to be unique, as our present knowledge stands; though I strongly suspect that the development of *Salpa* will some day be found to be very similar. No one of the many observers of the *Salpæ* (Krohn, Vogt, myself, Leuckart) have seen yelk-division in these animals; and the passage of the embryo into the atrium appears to be effected in them in essentially the same manner as in *Pyrosoma*.

On the other hand, although there is not an exact identity, it must be admitted that there is a very close analogy between the changes undergone by the ovisac of *Pyrosoma* and that through which the ovum of a bird passes, if we consider the vitelline membrane (*i. e.* what is ordinarily regarded as such) of the bird's egg to represent the tunica propria of the ovisac of *Pyrosoma*.

VI.—*On some new Anthribidæ.*

By Francis P. Pascoe, F.L.S. &c.

[With two Plates.]

[Concluded from vol. iv. p. 439.]

Xenocerus equestris.

X. niger; capite prothoraceque albo-lineatis; elytris sutura (apice excepto), fascia postica, vittaque basali albo-tomentosis.

Hab. Aru.

Elongate, tomentose, dull black; a white stripe, commencing at the apex of the rostrum on each side, divides beneath the eye, one branch, proceeding over its upper margin, is continued along the lateral border of the prothorax to the elytron, where, gradually tapering to a point, it terminates at rather more than half its length, the inferior branch, passing beneath the eye (which has thus a nearly complete border of white encircling it), joins the great mass of pure flake-white, which occupies the whole of the under surface except the pro- and mesosterna; another stripe, commencing between the eyes, passes along the centre of the prothorax, the scutellum, and suture, to near the declivity at