In connexion with the Mollusca certain points seem worthy of special notice.

In the first place, it is held by many comparative anatomists that the lacunar system of Molluscs has a partly enterocoelous origin, or at least has enterocoelous elements in its nature. If this be so, it is interesting to note that some cells of the lacunar walls may be glycogenous, for glandular surfaces seem to be specially characteristic of the ectoderm and endoderm. Moreover, these cells are also to be found on the mesenteries of Holothurians, which are undoubtedly enterocoelous.

In the second place, one of the greatest objections which can be urged against the feasibility of water inception by Molluscs is removed, if (1) the specific gravity and (2) the nutritive quality of the blood can be maintained in spite of the process. It is supposed that this would be accomplished by the discharge of the contents of the glycogenous vesicles.

Finally it is interesting to note, that one of the functions of the vertebrate liver seems in Molluscs with ease to be performed outside its domain, and this, moreover, in animals whose liver is essentially a digestive gland.

In conclusion I have to thank Professor Lankester and Professor Foster, to whom, as also to Mr. Langley, Mr. Lea, and Mr. Gardiner, I am very greatly indebted.

X. "On the Development and Morphology of *Phylloglossum Drummondii*. Part I. Vegetative Organs." By F. O. Bower, M.A., F.L.S., Regius Professor of Botany in the University of Glasgow. Communicated by W. T. Thiselton Dyer, M.A., C.M.G., F.R.S. Received June 18, 1885.

(Abstract.)

The morphological history of *Phylloglossum* has up to the present time rested on a very slender basis. The following brief summary given by Sachs ("Textbook," 2nd English Edition, p. 463) practically comprises the whole of it:—"A small Australian plant, only a few centimetres high. It consists of a stem arising from a small tuber, and bearing at its lower part a rosette of a few long leaves, and one or more lateral roots; it is prolonged above this as a thin scape, and terminates in a spike of small leaves bearing the sporangia. The plant is propagated by means of adventitious shoots, consisting of a tuber with a rudimentary leafless bud; in this respect it resembles our native *Ophrydeæ*."

The study of so reduced a form of a group, usually so remarkable

for luxuriant vegetative development, seemed to promise a good deal of interest. Baron Ferdinand von Mueller, K.C.M.G., F.R.S., Government Botanist, Melbourne, with the unfailing energy which prompts him to assist every kind of botanical work, after one or two attempts succeeded in transmitting to the Royal Gardens, Kew, a parcel of tubers in a living condition. These were successfully grown for the first time in Europe. Their examination in the Jodrell Laboratory has yielded the results now communicated to the Society.

The mode of development depends to a certain extent upon the size of the tuber: where the tuber is small only vegetative organs are formed, where it is relatively large, the plant may form sporangia. Taking first the simpler case, it is found that outgrowths appear on the broad apex of the tuber, which is before germination a simple, smooth and rounded cone; these outgrowths are leaves; their number may vary from one to six or seven. They are arranged in an irregular whorl, of which the members on one side take precedence of the rest in time of appearance; they constitute in fact a "successive whorl." From the first they are rounded at the apex, and have no single apical cell. The apex of the axis, which has a central position at first, becomes gradually depressed, and is overarched by the surrounding tissue; it develops directly into the apex of the new tuber, which is accordingly of exogenous origin, and represents in this simpler case the actual apex of the parent plant. By a peculiar localisation of growth this apex becomes inverted, and by a process of development very similar to that of the axillary shoot in certain orchids (*e.g.*, *Herminium monorchis*), it projects laterally from the parent plant. Meanwhile an outgrowth appears on the opposite side of the axis from that on which the tuber projects, and below the insertion of the oldest leaf: this is the first root. It has been clearly proved, by both external observation and by study of sections, that the root in *Phylloglossum* is of *exogenous origin*. Among other known examples of this anomalous mode of root-development it is interesting to note the root of the embryo of *Isoetes*. In those cases where the tuber is relatively large, sporangia are formed: these are, as is already known, borne upon an elongated axis, which is the direct product of the apex of the tuber. A different origin is necessary in this case for the tuber, and it has been found that the tuber originates in such plants in an adventitious manner, as a depression at the base of the sporangium-bearing axis or peduncle: the details of its development are otherwise similar in this case to that above described.

A comparison of both external form, and as far as possible of internal structure, between *Phylloglossum* and the young plants of *Lycopodium cernuum* described recently by Treub, shows many points of striking similarity: this is so marked that the author draws the

following conclusion: that, provided the oophore generation of *Phylloglossum* (which has never yet been observed) corresponds in its more important points to that of *Lycopodium*, we may regard *Phylloglossum* as a form which retains and repeats in its sporophore generation, the more prominent characteristics of the embryo as seen in *Lycopodium cernuum*: it is a permanently embryonic form of a lycopodiaceous plant.

XI. "Researches on the Theory of Vortex Rings. II." By W. M. HICKS, M.A., F.R.S., Principal and Professor in Mathematics in Firth College, Sheffield. Received June 13, 1885.

(Abstract.)

The communication forms a continuation of some researches the first part of which was published in Part I of the Transactions for 1884. In that paper was considered the case of a circular hollow with cyclic motion through it. In the present the more general case is investigated where the core is of different density from the surrounding fluid, has a hollow inside it, and circulations additional to that due to the filaments of rotational fluid actually present. It does not seem to have been generally noticed that even in the case of the ring ordinarily considered, where the density of the core is the same as that of the surrounding fluid, and there are no additional circulations, the full theory ought to take account of the existence of a hollow, for when the energy of the motion (as was pointed out by the author*) is increased beyond a certain point, depending on the circulation and the pressure of the fluid where it is at rest, a hollow will necessarily begin to form. As it seems impossible to account for the very great differences in the masses of the various elements on the vortex theory of matter unless the cores are of different densities, the investigation includes the case where the density is arbitrary. As soon as the existence of a core is postulated the ring at once becomes more complex, depending on the density (or even the distribution of density) of its core, on its vorticity, and on the presence or absence of additional circulations. The vorticity has been taken uniform; this not only greatly simplifies the mathematical methods, but is also the case we should naturally choose first to investigate. In the general investigation the density is taken to be different from that of the surrounding fluid, the ring is supposed hollow, with an additional circulation round it, and another round the outer boundary of the core. It is evident that the presence of the former necessitates the

* "On the Problem of Two Pulsating Spheres," "Camb. Phil. Proc.," iii.