a paper on the microscopic structure of the coal of the Doltz basin, M. Jenjourist shows that the coal contains remains of Sigillariæ and Lepidopendrons, while several Russian geologists are inclined to consider it as having originated only from marine Algæ. M. Dybovsky contributes to this volume a description of a new species of fresh-water sponge from Southern Russia, which is closely allied to the *Dosilia baileyi* of Mr. Carter, and to which he gives the name of *Dosilia stepanowii*; it is figured in a plate. Finally, M. Shevyreff gives a list of *Hymenoptera terebrantia* of the Governments of Kharkoff and Poltava; and M. Yaroshevsky publishes his fifth supplement to the list of Diptera of Kharkoff.

The last two volumes of the *Memoirs* of the St. Petersburg Society of Naturalists (*Trudy Sanctpeterburgskago Obschestva Estestvoispytateley*, vol. xiii. fasc. 2, and vol. xiv. fasc. 1) contain, besides the minutes of proceedings (which unhappily do not go further than March 1883), several valuable papers. Geology is the most favoured branch. Thus we find in vol. xiii. an interesting paper on the waterfalls of Northern Esthonia, by P. N. Vemikoff. The orography of the country whose Silurian deposits are cut towards the north by the abrupt terrace of the Glint, the lower parts of which contain looser strata easily destroyed by the water (as in the Niagara), favour the development of waterfalls, the chief of which are described by the author. In the same volume MM. Koudryavtseff and Sokoloff publish a geological description (with a geological map) of the district of Kromy in Orel. The Quaternary formations are represented by the "black earth," loess, and mighty sheets of boulder-clay which cover the chalk, the Jurassic clays, containing spherosiderite, and the Devonian limestones, marls, and dolomites, appearing in the north. The paper is accompanied with a map on a large scale. In vol. xiv. we find a very interesting orographical sketch of the Kola peninsula, by N. Koudryavtseff. The author has devoted much attention to the leading features of this tableland, and the modifications its surface has undergone under the action of the ice-sheet of the Glacial period. The structure of the mountains; the parallelism of the valleys; the glacial erosion, which has covered the whole of the country with numberless depressions running in the direction of the glacial striation, and producing what might be called "telescopic striation"; the finer glacial striæ, which run north and south, or north-north-west to south-south-east; the "glacial landscape" of the country; and finally its upheaval, are dealt with by the author. Several indications led the author to admit that the peninsula is rapidly rising up, the surest of them being the find of colonies of Balanides at a height of 8 metres above the sea, and the discovery of the *Buccinum undatum* (which still inhabits the White Sea), together with broken shells of Brachiopoda and Lamellibranchiata, about 280 feet above the present sea-level, at Kandalaksha. N. A. Sokoloff contributes to the same volume a note (with a plate) on the find of teeth of *Mastodon arvernensis* in the Crimea, at Zamruk, which would imply a wider extension of Pliocene in the yet unexplored steppes of the peninsula; and on the find, also in the Crimea, of teeth of *Hipparion gracile*, which was so widely spread during the Tertiary period from the prairies of the Missouri to the Himalayas. We notice also a note by P. P. Kudryavtseff, on prehistoric man on the Oka; and another note by M. Polyakoff on the bottom-moraine at Wiborg, in Finland.

In other branches of science we have to mention a sketch of the Phanerogam flora of the Government of Minsk, by W. Paszkewicz (vol. xiii.). It contains 958 species, the whole number reaching probably about 1000; 40 of them are new for this region. In vol. xiv. we find a note by M. Szihowsky on the chemical constitution of different parts of the *Zea Mays*, and two preliminary reports, botanical by A. Krasnoff, and zoological by A. Nikolsky, about explorations in the Altaï Mountains. The collections of 720 Phanerogams and 100 Cryptogams, which have been brought in by M. Krasnoff, will surely yield interesting data. As to M. Nikolsky, he gives a lively sketch of the fauna of the Altaï, followed by a list of observed species: 50 mammals, one of which, *Talpa altaica*, is new; 169 birds, a few reptiles and amphibia, and 16 fishes. A plate gives the comparison of the *T. altaica* with the *T. europea*.

RECENT MORPHOLOGICAL SPECULATIONS[1]

III.—*Non-segmented Animals*

THERE are certain groups of animals about whose systematic position naturalists never seem able to remain long agreed. These groups are changed from place to place in our schemes of classification; and often each new discovery seems to confute a current theory only to confirm that which preceded it. More than any other groups, the Polyzoa, Brachiopods, and Mollusks have been shifted from point to point, and it seems almost too much to expect that they have even now found a permanent resting-place.

The Polyzoa were brought into connection with "Mollusks" more than fifty years ago, when Milne-Edwards exhibited their supposed affinities with Ascidians, and their Molluscan affinities were more fully admitted when Von Siebold compared the Polyzoan lophophore and tentacles with the arms of a Brachiopod. Milne-Edwards, in combining Polyzoa and Tunicates in his new group Molluscoida, argued the identity of the type in every detail of structure, and Huxley ("English Cyclopædia," 1855), laying more weight than previous writers had done on the affinities of Polyzoa with Brachiopods (as Mr. Albany Hancock was perhaps the first to suggest) definitely included this last class also in the group Molluscoida. The Brachiopods seemed, in the light of that time's knowledge, to take a very natural position among the "neural Mollusks," between the Polyzoa on the one hand and the Lamellibranchs and the Pteropods on the other (*Proc. Roy. Soc.* 1854, p. 117).

But in the course of the next ten years Kowalevsky's discovery of Loxosoma seemed to supply a link between the Polyzoa and Worms, and Gegenbaur, and afterwards Haeckel, emphasised this relation, and finally included the Polyzoa in the latter group. The Tunicata had by this time obtained, through Kowalevsky's researches, an established position far removed from their former allies in the "Molluscoida," and Gegenbaur now analysed more critically the differences between Polyzoa and Brachiopods, and (denying that either had any affinity with Mollusks) maintained the eminently isolated position of Brachiopods, and asserted that their arms could no more be compared with the tentacles and lophophore of Polyzoa than these could with the branchial tufts of the Tubicolæ. The discovery by Kowalevsky (1874) of the apparently segmented larva of Argiope, &c., seemed to reveal almost obscured genetic relations with the Chætopods, and at the same time Morse, working chiefly on Lingula, argued elaborately that the Brachiopods are much modified Annelides. Ray Lankester, on the other hand, upheld the Molluscan affinities of both Polyzoa and Brachiopods, and Huxley, in his "Anatomy of Invertebrates," kept the three groups in close juxtaposition. Lankester compared Rhabdopleura minutely with the embryo of Pisidium (*Phil. Trans.* 1874), and maintained the common origin from a primitive ciliated girdle of the gill-filaments of Lamellibranchs, the lophophore of Polyzoa, the arms of Brachiopods, the tentacles of Phoronis, the velum of embryo Mollusks and of Rotifers, and the ciliated proboscis of Gephyrea. Huxley ("Invertebrates," p. 674), influenced on the one hand by Lankester, and by Steenstrup and Morse on the other, proposed to combine Polyzoa and Brachiopods under the name *Malacoscolices*, to indicate relationship both with Mollusks and with Worms. Lastly, Caldwell (*P. R. S.* 1882), by his researches on Phoronis, has thrown new light on the structure of both Polyzoa and Brachiopods, and, in Lankester's words ("Encycl. Brit.," Art. "Mollusca," 1884), "has established the conclusion that the agreement of structure supposed to obtain between Polyzoa and true Mollusca is delusive; and accordingly they, together with the Brachiopoda, have to be removed from the Molluscan phylum."

We may examine this last important view more closely, and try afterwards to discuss the probable ancestry of these three much-debated classes.

Actinotrocha, the larva of Phoronis, is, according to Caldwell, a perfect and typical trochosphere. The larvæ of Brachiopods and Polyzoa are trochospheres in which, by a shortening of the "dorsal" surface, mouth and anus have been approximated, and the ventral surface has been enormously distended. The same change takes place, and to an even greater extent, in the "metamorphosis" of Phoronis: the adult animal has both mouth and anus situated at one end of a long body; the line joining them is the contracted dorsal surface; an epistome, said to be the persistent præ-oral lobe of the larva, lies between mouth and anus; a lophophore, whose new tentacles are added on either side of the median dorsal line, surrounds the mouth; within its concavity, on either side of the anus, lie two ciliated pits, whose homologue is found in Rhabdopleura. A single pair of nephridia exist. The body-cavity is traversed by mesenteries, one of which is ventral, and attaches the outside of both descending and ascending limbs of the alimentary canal to the body-wall; two are lateral, and pass from the side of the stomach to the body-wall, dividing the

[1] Continued from p. 227.

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cavity into two anterior chambers and one posterior; and lastly a transverse septum shuts off the space within the epistome and tentacles from the rest of the body-cavity. The nephridia open into the posterior chamber of the body-cavity on the sides of the lateral mesentery. At no stage, either in the embryo or the adult, is any trace to be found of segmentation.

The parallelism between Phoronis and Brachiopoda is full and clear. An ectodermal post-oral nerve-ring exists in both. The body-cavity of the præ-oral lobe is in both separated from the rest of the body-cavity by a septum. The tentacles are arranged and developed similarly in both. In both the nephridia have the same relations and the alimentary canal is divided into the same *four parts*. And in both the præ-oral lobe of the larva is represented in the adult by an epistome. The Polyzoa, though immensely simplified in structure, seem undoubtedly to be built upon the same plan; and Caldwell considers it probable that the epistome of Endoproct and Hippocrepian Polyzoa and the so-called foot in Rhabdopleura represent, like the epistome of Phoronis and Brachiopods, the præ-oral lobe.

Mr. Caldwell closes the abstract of his yet unpublished paper with a remark upon the affinities of the Gephyrea. We know nothing to show that Sipunculus and Phascolosoma are not referable to the same type of structure as Phoronis, Brachiopoda, and Polyzoa.

But as regards the types from which all these mutually-connected forms sprang, we know little or nothing, and we look in vain for an unsegmented worm which shall show clear affinity with them.

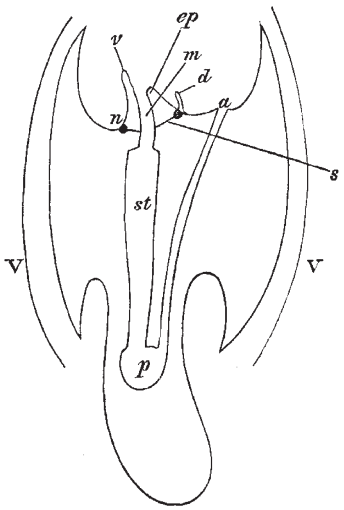
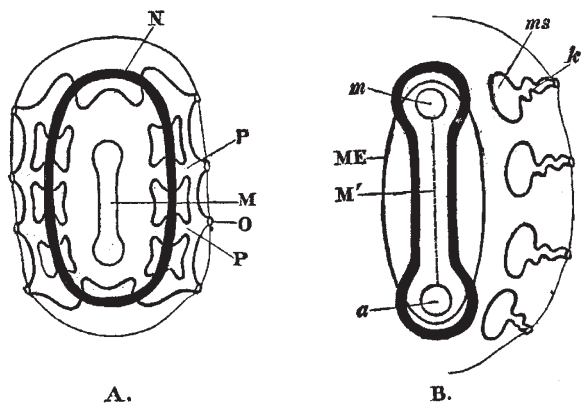


Diagram of body plan of *Brachiopod*, *Polyzoon*, and *Phoronis* (after Caldwell).—*m*, mouth; *a*, anus; *s*, septum; *n*, nervous system; *st*, stomach; P, second stomach; *ep*, epistome; *v*, tentacle of ventral series; *d*, tentacle of dorsal series; V V valves of Brachiopod skull,

Van Bemmelen, in a recent paper (*Jenaische Zeitschrift*, 1883) has compared at great length the Brachiopods with Sagitta, and arrives at the conclusion that the two types show such intimate agreement that they must be looked upon as very closely related. In the first place Dr. van Bemmelen recounts the histological resemblance between Sagitta and Brachiopods; and if he ascribes more weight to these than his readers may be inclined to do, he is not without weightier considerations in support of them. In both groups connective tissue is conspicuously scanty; in both a homogeneous intercellular substance or mesenchyme-layer is abundant. The epithelial layers are extremely simple and alike in both; the muscles in both are "built on an epithelial type;" the histological characters of the nervous system are identical in both. The chitinous hairs developed in ectodermal follicles on the mantle of Brachiopods are not without analogues in the Chætognatha. The three metameres of the larval Brachiopod are compared with the divisions of the adult Sagitta; the four genital glands of the former (Testicardines) are identified with the ovaries and testes of the latter. The gastro- and ileo-parietal bands of the Brachiopod are made homologous with the transverse septa of Sagitta, and the hood of Sagitta with the arms of the Brachiopod. It is obvious that the above characters, many of which are mentioned in the Hertwig's "Cœlomtheorie," are of very unequal value; and some are even wrong, for th gastro- and ileo-parietal bands of a Brachiopod are parallel with the gut, and in no way comparable to the transverse septa of Sagitta. But, on the other hand, there are other suggestive points of resemblance, and, though further developmental evidence in the case of Sagitta is sorely needed, I think that its possible affinity to the Phoronis type cannot be altogether passed over. Not only is the development of the mesoblast and body-cavity strikingly similar, but the dorsal and ventral mesenteries at first present in Phoronis agree with those of Sagitta, and the septum dividing off a part of the body-cavity within the head seems the same in both. Nothing in the nervous system offers great difficulty, and the relations of the hood in Sagitta seem not discordant with those of a lophophore. If we approximate the anus and mouth dorsally in Sagitta, the "olfactory organ" will assume the position of the two sense-organs of Phoronis and Rhabdopleura. The lateral mesenteries of Phoronis and Brachiopods arise late and secondarily, as does the transverse septum of the trunk in Sagitta. The anterior and posterior generative masses, arising first together, are no sign of true segmentation, and our embryological knowledge of the nephridia of Sagitta is too slight to permit us to make much use of them as arguments on either side.

If all this is true (and I am far from insisting upon it), it means that Sagitta (though extremely modified for a pelagic life) is akin to the unflexed, unsegmented worm, which, as it acquired a dorsal flexure and a more complex lophophore, gave rise to the proximate ancestors of the Phoronis type.



Sedgwick's theory of segmentation: A. Ideal ancestor of segmented animals; B. Invertebrate.—M, primitive mouth; *m*, mouth; *a*, anus; M', middle portion of primitive mouth or blastopore closed up; N, nervous system; P, pouch of gut; *ms*, mesoblastic somite; *k*, nephridium; O, external pore; ME, mesenteron.

And if we admit this even for a moment, it becomes worth while to consider the possibility of a distant Molluscan connection with the same line; for, possessing a trochosphere larva, a single pair of nephridia, and a nervous system with no trace of genuine segmentation, they are so far in agreement with our type. I cannot see that Caldwell's discoveries necessarily invalidate Lankester's old comparison of the Lamellibranch gills (and labial palps) with a lophophore; and even Lankester himself, in spite of his opinion already quoted, that, owing to Caldwell's research, Polyzoa, &c., must now be removed from the Molluscan phylum, yet still admits (*loc. cit.* p. 688) that "it is very probable that the labial tentacles and gill-plates are modifications of a double horseshoe-shaped area of ciliated filamentous processes, which existed in ancestral Mollusks much as in Phoronis and the Polyzoa, and is to be compared with the continuous præ- and post-oral ciliated band of the Echinid larva Pluteus, and of Tornaria;" and Langerhans' close comparison between the nervous systems of Sagitta and a Mollusk may be worth more consideration. The molluscan foot may, after all, be an epistome, as Lankester formerly said, and the "osphradia" of the Mollusk may turn out homologous with the sense-organs of Phoronis and Rhabdopleura. But the extreme modifications that the Molluscan type has undergone—the reduction of the body-cavity, the development of the foot, the various flexures, and so forth—leave any connection that we may trace with it and our Sagitta type at best a distant one; if such exists, a distant relationship will be again traceable between Mollusks and

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Brachiopods, though every argument on which their former connection was based is demonstrably false.

But to a great extent the whole matter turns upon our conception of *segmentation*, a subject which Mr. Sedgwick's recent speculations (*Q. J. M. S.*, No. xciii. 1884) may very seriously modify. Sedgwick derives all metameric segmentation from a Cœlenterate-like ancestor, with a *pouched gut* like that of all the Actinozoa. The blastopore, including both mouth and anus, is derived from the Actinozoan mouth, the double nerve-cord from the aggregation of the nervous system round the mouth of the polyp, and the nephridia from specialised parts of the pouches represented now by the circular canal of Medusæ or the mesenteric perforations of Actinozoa and the pores leading to the exterior in those forms from the mesenteric chambers. But it is impossible to discuss this theory fully; it is enough to point out that it postulates segmented ancestors of all animals above Cœlenterates. Mollusks, Brachiopods, and Sagitta must according to it have been once segmented, just like Vertebrates, Arthropods, and Worms. But surely this is a violent assumption. There is no evidence of segmentation among Mollusks save in Nautilus, for even the pedal commissures of Chiton in no way indicate a truly segmented condition; nor any among Polyzoa or Brachiopods save the four nephridia of Rhynchonella. And it is by no means clear that the development of Sagitta indicates its descent from an ancestor with "*three pairs* of gut-pouches." The vast number of animals with a single pair of nephridia can scarcely all be derived from ancestors with many pairs; and Hatschek's description of the origin of segmented nephridia (in Polygordius) from a single pair seems far from supporting Sedgwick's view. The still insufficiently investigated excretory organs of Rhynchonella, and the four gills, &c., of Nautilus, seem not enough to indicate descent of the groups to which these forms belong from segmented ancestors. On the contrary, it seems far more likely that the types we have more particularly discussed are all derived from some unsegmented trochosphere; and that the segmentation of the Chætopods only became marked after the ancestor of the Phoronis type had severed his course from the common stock of Worms. The distinction of segmentation and non-segmentation would thus divide the Invertebrata.

As regards the Gephyrea, there is much reason for connecting such members of the group as Sipunculus, Phascolosoma, and Bonellia with the unsegmented Phoronis type. But Hatschek maintains that the development of Echiurus proves it to be a degenerate Chætopod; and if so, Caldwell (*loc. cit.*) is ready to admit that the others may be further stages in such degeneration. But even as regards Echiurus this degeneration is far from clear. The Platyelminths seem also never to have been segmented, and their "water-vascular canals" may give us some indication of the organs from which are derived the nephridia of Phoronis, Gephyrea, Brachiopods, and Mollusks. The larva of Thysanozoon has many points in common with the trochosphere, though its want of an anus is strange and difficult to explain. The Rotifers are acknowledged to be persistent trochospheres. And accordingly all these forms may be older and more primitive, by virtue of their lack of segmentation, than all the Chætopods.

D. W. T.

SCIENTIFIC SERIALS

THE *Journal of Anatomy and Physiology*, January 1884, contains:—A. Milnes Marshall, M.D., certain abnormal conditions of the reproductive organs of the frog.—S. A. Waddell, M.B., the urea elimination under the use of potassium fluoride in health.—B. C. A. Windle, M.A., M.D., primary sarcoma of the kidney.—R. J. Anderson, M.D., transverse measurements of human ribs.—Arthur W. Hare, M.B., a method of determining the position of the fissure of Rolando and some other cerebral fissures in the living subject.—G. Hoggan, M.B., new forms of nerve terminations in mammalian skin.—J. Symington, M.B., the fold of the nates.—W. Ainslie Holles, M.D., researches into the histology of the central gray substance of the spinal cord and medulla oblongata.—D. J. Cunningham, M.D., the musculus sternalis.—C. W. Cathcart, M.B., movements of the shoulder-girdle involved in those of the arm on the trunk.—J. B. Sutton, the relation of the orbito-sphenoid to the region pterion in the side wall of the skull.—Anatomical notices.

April contains:—J. B. Sutton, the nature of certain ligaments.—F. Le Gros Clark, F.R.S., some remarks on nervous exhaustion, and on vasomotor action.—C. B. Lockwood, F.R.C.S. Lond., the development of the great omentum and the transverse mesocolon.—Arthur Thomson, M.B., notes of two instances of abnormality in the course and distribution of the radial artery.—Js. W. Barrett, M.B., the cause of the first sound of the heart, and the mode of action of the cardiac muscle.—Prof. Cleland, F.R.S., notes on raising the arm.—R. W. Shufeldt, M.D., osteology of *Ceryle alcyon*.—A. M. Patterson, M.B., notes on abnormalities, with special reference to the vertebral arteries.—Geo. Hoggan, M.B., on multiple lymphatic nævi of the skin, and their relation to some kindred diseases of the lymphatics.—Prof. Cleland, F.R.S., notes on the viscera of the porpoise and white-beaked dolphin.—W. Arbuthnot Lane, F.R.C.S., costal and sternal asymmetry.—Anatomical notices.

THE *Journal of Physiology*, vol. v. No. 1, contains:—E. Klein, M.D., F.R.S., the bacteria of swine-plague.—T. Lauder Brunton, on the rhythmic contraction of the capillaries in man, and on the physiological action of condurango.—J. Blake, on the connection between physiological action and chemical constitution.—H. H. Donaldson, and L. T. Stevens, note on the action of digitalis.—W. H. Gaskell, on the augmentator (accelerator) nerves of the heart of cold-blooded animals.

Archives Italiennes de Biologie, tome iv. fasc. 3, contains:—B. Grassi, the development of the vertebral column in bony fish.—L. Luciani, on the mechanical stimulation of the sensomotory centres of the brain-cortex.—A. Moriggia, on a new method of isolating the sensibility of the mobility of the nerves.—G. Magini, the induced unipolar current and the stimulation of nerves.—F. Marino-Zuco, upon the ptomaines with regard to toxicological investigations.—S. Richiardi, on the distribution of the nerves in the follicle of the tactile hairs of the ox, which are provided with a vascular erectile apparatus.—Ph. Lussana: (1) on the brain of the boa: considerations on comparative neuro-physiology; (2) on the sensibility of parts uncovered by skin; (3) on colour-hearing.—A. Marcacci, the areola-mammillary muscle.—P. Foà, contribution to the study of the physiopathology of the spleen.—L. Griffini and G. Tizzoni, experimental study of the partial reproduction of the spleen; novel researches into the total reproduction of the spleen: an experimental contribution to the hematopoetic function of the connective tissue.—J. Bizzozero and A. A. Torre, upon the origin of red blood-corpuscles in the various orders of the Vertebrata.—J. Cattaneo, fixation, staining, and preservation of Infusoria.

Tome v. fasc. 1 contains:—C. Giacomini, the fascia dentata of the hippocampus major in the human brain.—A. Borzi, new studies in the sexuality of Ascomycetes (preliminary note).—L. Solera, contribution to the physiology of the succus intestinalis.—F. Selmi, tolerance of arsenic in domestic animals, and its distribution in the organism.—Ph. Lussana, on the quantitative and qualitative secretion of bile in the state of inanition after the section of the two pneumo-gastric nerves.—L. Camerano, (1) on the development of the Amphibia, and on what has been called their "Ncotenia"; (2) researches on the prolongation of the branchial periods of the Amphibia.—G. Romiti, anatomical investigation of a case of death from the bite of a viper.—P. Fanzago, on the nest of *Geophilus flavus*.—E. Levier, the origin of the tulips of Savoy and of Italy.—P. Albertoni, critical and experimental studies upon the action and metamorphosis of certain substances in the organism, with respect to the pathogenesis of acetonæmia and diabetes.—L. Griffini, (1) an experimental study of the partial regeneration of the liver (preliminary communication); (2) on the total and partial reproduction of the follicular apparatus and of the calyciform papillæ in the rabbit (preliminary communication).—M. H. Peracca and C. Deregibus, note on *Cœlopeltis insignitus*.—L. Vincenzi, histological note on the true origin of some cerebral nerves.—A. Mosso, employment of the balance in the study of the circulation in man.

SOCIETIES AND ACADEMIES

EDINBURGH

Mineralogical Society, June 24.—This meeting was held at the Museum of Science and Art, Edinburgh.—Prof. Jas. Geikie, F.R.S., in the chair.—The following papers were read:—On forms of silica, by Prof. John Ruskin, D.C.L. The Chairman and Dr. Dudgeon made some remarks.—On the application of the periodical law to mineralogy, by Prof. Thos. Carnelley of Dundee.—On the origin of the Andalusite schists of Aberdeenshire, by

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