

imagine that the ions work their way through the solution by a continual series of interchanges between the parts of two solute molecules when in collision. The frequency of collision, and therefore the ionic velocity, would then vary as the square of the concentration, so that the conductivity would depend on the cube of the concentration.

(3) The potential difference at the contact of two solutions of different concentrations has the value calculated on the assumption that the ions migrate independently of each other, so that the faster-travelling ion enters the neighbouring solution first, and gives it a charge which continually increases till the electrostatic forces prevent further separation.

It is such phenomena as these, and not the numerical relations between conductivity and osmotic pressure effects, which seem to me to offer the most convincing evidence in favour of the dissociation theory.

W. C. DAMPIER WHETHAM.

Trinity College, Cambridge, April 24.

Mosquito-Bites.

AN acquired immunity from the bites of mosquitoes and "domestic pests" is not uncommon in British India, and I have rejoiced in it myself, but should not trespass on you for space for details. I can give them to any of your correspondents who may care to ask me.

There is lying before me a queer old case of mosquito-bite reported by a good witness, Pedro Teixeira, who sailed from Malacca to Mexico in 1600 A.D., and crossed the latter from Acapulco to San Juan de Ulua, on his way to Spain. Of this journey he says: "Almost all along this road is a plague of mosquitoes, so terrible and grievous that no defence avails against them, and they stung my best slave to death."

102 Cheyne Walk, Chelsea, April 9. W. F. SINCLAIR.

THE NATURAL HISTORY OF WORMS.¹

THIS is the third volume that has been issued of "The Cambridge Natural History." The previous volumes are vol. iii., Molluscs and Brachiopods (reviewed in NATURE, lii. p. 149), and vol. v., Peripatus, Myriapods, and Insects (reviewed in NATURE, liii. p. 322). In the multitude of the divisions in the animal kingdom with which it deals, the present volume differs considerably from its predecessors. It is true that one may even nowadays find most, if not all, of the many forms of life here described included in one heterogeneous section entitled Vermes; but the editors of the present book fully recognise the great distinction that exists between such forms as the Platyhelminthes or flatworms, the Oligochaeta or earth-worms, the Rotifera, and the Polyzoa, and they have very wisely distributed the various sections to authorities whom every one will recognise as among the most competent to deal with their respective subjects. Indeed it may be questioned whether the separation of the subjects has not been carried a little bit too far. It is true that pages ix. to xii. contain what purports to be the scheme of classification adopted in the volume, but this is little more than a table of contents, in which no attempt is made to show the relationships of the orders or families mentioned; and, apart from this, the only bond of union between the various sections appears to be the quotation, very happily adapted from André de Chénier, "Nous allons faire des vers ensemble." We should much like to have seen some attempt on the parts of the editors to present their readers, all of whom are not supposed to be familiar with the newest ideas of zoology, with a short introduction showing how and why it is that this "old group of Vermes" has gradually been dismembered, so

¹ "The Cambridge Natural History." Vol. II.: Flatworms and Mesozoa, by F. W. Gamble; Nemertines, by Miss L. Sheldon; Thread-worms and Sagitta, by A. E. Shipley; Rotifers, by Marcus Hartog; Polychaet Worms, by W. Blaxland Benham; Earthworms and Leeches, by F. E. Beddard; Gephyrea and Phoronis, by A. E. Shipley; Polyzoa, by S. F. Harmer. The whole edited by S. F. Harmer and A. E. Shipley. 8vo. Pp. xii. + 560; with numerous illustrations in the text. (London: Macmillan and Co., Ltd., 1896.)

that now we find not only such forms as the Platyhelminthes and the Polyzoa claiming to rank as independent phyla of the animal kingdom, but we also find, in the scheme of classification at all events, the genus *Phoronis*, the few forms composing the Dicyemida and Orthonectida, and the thirty or so genera of leeches placed on the same high level. When we are told, as

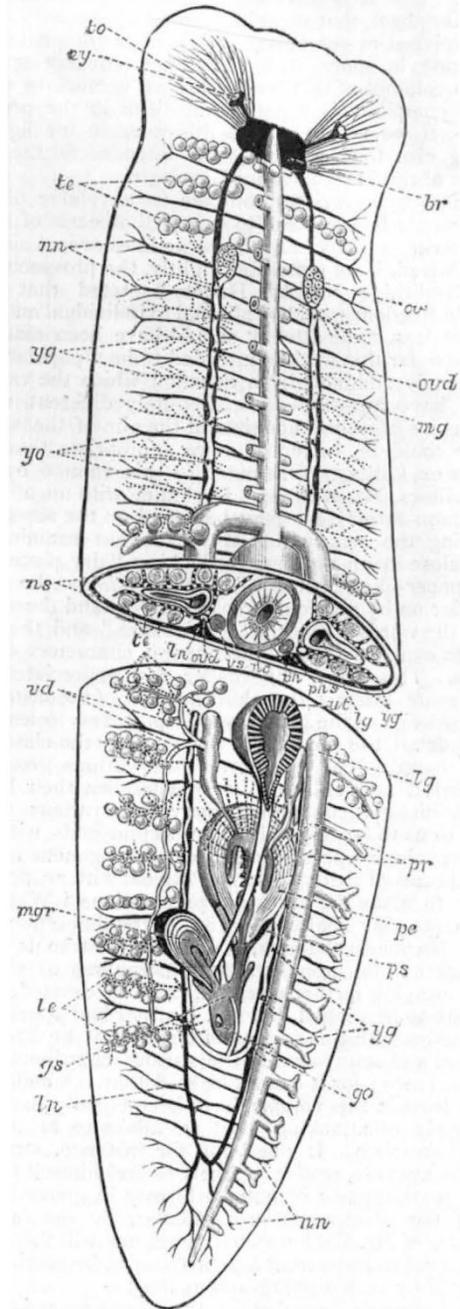


FIG. 1.—Diagrammatic view of the structure of *Planaria lactea*, a Turbellarian. $\times 7$. The body has been cut across and a portion removed.

Mr. Gamble tells us, that the Turbellaria "occupy the lowest position in the whole group of worms," that they "are most closely allied to that great extinct group from which they, the Nemertinea, Rotifera, and even the Annelids, offer increasingly convincing evidence of having been derived," then we ask, What are we to

understand by "the group of worms"? What are the characters of "that great extinct group"? while there may even be many who will ask, What does Mr. Gamble mean by the Annelids? All these questions will be asked in vain, so far as the "Cambridge Natural History" is concerned, if we except one small allusion to the "old term Annelida," which occurs in Mr. Benham's contribution; and it is answers to these questions, and to others like them, that we think should undoubtedly have been furnished by the editors. A similar complaint has been made in more than one place concerning the previous volumes of this series, and we venture to think that the complaint is especially justified in the present instance, if we are to regard this work in the light of anything else than a cyclopædia intended for the convenience of the fairly advanced zoologist.

When so many writers combine in a volume of this kind, it would be too much to expect that each of them should write on precisely the same lines or in a similar style; indeed, if we remember rightly, the prospectus of the "Cambridge Natural History" stated that considerable freedom would be allowed to individual authors. None the less, some attempt should have been made to settle how far this work is intended to be a popular one, since this is undoubtedly a question which the various authors have answered in exceedingly different ways. So far as we ourselves understand the aim of the series, nothing could be better or more appropriate than the chapters on Polyzoa, contributed to this volume by one of the editors, Mr. Harmer. Beginning with an allusion to common forms that may be found on the sea-shore, describing the beauty that a very slight examination will disclose in an unattractive-looking "dry piece of a brown paper-like substance," *Flustra foliacea*, he leads his reader on by gentle degrees to understand the meanings of the words "zooecia," "avicularia," and the like, and then explains to him the general characters of the Polyzoa. This done, the reader can appreciate with rather more interest the short account of the history of our knowledge of the group, and is prepared to learn in further detail the characters upon which the classification is based. The account of the various groups is interspersed and enlivened by remarks on their habits and life-history, containing many observations which appear to us to be original. The section ends with not the least valuable portion, a guide to the genera and to many species of British marine Polyzoa, with an account of how to make the necessary preparations. Whatever opinions we may hold with regard to the different points in Mr. Harmer's chapters, it does not seem to us that a better method for interesting and instructing, as well as for encouraging further research, could be devised.

It were to be wished that Mr. Harmer had opened the whole series with this section of his, or that he had had it printed and sent round to the various contributors for their guidance; for it cannot be said that his collaborators, at least in this volume, have been equally happy in their mode of attacking what we admit to be a very difficult problem. It does not, for instance, strike us that the average reader is likely to feel himself further drawn to the study of natural history in general or to that of the Chætopoda in particular, by the opening sentences of Mr. Benham's narrative, nor will the reader who has yet to learn what a gephyrean is, be particularly interested by such a paragraph as this:—

"The animals included in the above-named group were formerly associated with the Echinodermata. Delle Chiaje states that Bohadsch of Prague in 1757 was the first to give an accurate description of *Sipunculus* under the name of *Syrinx*, but Linnæus, who noted that in captivity the animal always kept its anus directed upwards, re-named it *Sipunculus*. Lamarck placed the Gephyrea near the Holothurians; and Cuvier also assigned them a position amongst the Echinoderms.

He mentions *Bonellia*, *Thalassema*, *Echiurus*, *Sternaspis*, and three species of *Sipunculus*, one of which, *S. edulis*, "sert de nourriture aux Chinois qui habitent Java, et qui vont la chercher dans la sable au moyen de petits bambous préparés"—a paragraph that forms Mr. Shipley's introduction to the group.

Adequately to discuss and to criticise these numerous contributions would lead us into details more fitted for a technical zoological journal; but there are one or two thoughts that have occurred to us in reading the book, and these may perhaps be mentioned.

Is it not rather misleading to retain a name of such definite meaning as the name Mesozoa for the strange animals that compose the families Dicyemidæ and Orthonectidæ, and moreover to print this name Mesozoa in the scheme of classification with similar type and in similar position to the names of the recognised phyla, when, as Mr. Gamble himself tells us, they "are most conveniently (and probably rightly) considered as an appendix to the Platyhelminthes"? If the name be kept at all, it should at least be explained to the inquiring mind what those features are which made Van Beneden, the discoverer of the group, consider these animals as intermediate between the Protozoa and the Metazoa.

A somewhat similar point is the hesitation as to the position of the Nemertines; they are treated in a separate section by a separate author, Miss L. Sheldon, and yet it is pretty clear that she inclines to the view that they should be placed among the Platyhelminthes—that is to say, if Bürger's recent discovery of flame-cells be not disproved. We do not mean to say that we wish Mr. Gamble and Miss Sheldon to exercise anything but a scientific caution. Nevertheless, these are excellent instances of the questions that might so well have been discussed in a separate chapter by the editors.

There is naught of popular interest to be said about the Nemertines, so that Miss Sheldon's chapter, perhaps inevitably, reads much like an excerpt from the ordinary text-book of zoology. Mr. Gamble's lot is cast in happier places; he has to deal with the tape-worms, the liver-flukes, the formidable *Bilharzia*—the cause of hæmaturia, and other creatures of as much economic as zoological interest. With reference to the liver-fluke of the sheep, Mr. Gamble speaks as though its intermediate host were only the water-snail, *Limnæa truncatula*, or varieties of that species. The Rev. W. Fielder and others, however, in Victoria, have recently discovered large numbers of the peculiar stages known as *redia* and *cercaria* in species of other fresh-water molluscs belonging to the genera *Isidora*, *Segmentina*, and *Planorbis*; and since these larval stages are similar in form to those found in *Limnæa truncatula*, there is reason to suppose that we have to do with the ordinary sheep liver-fluke. In any case, a large number of intermediate hosts, not mentioned in Mr. Gamble's table on pp. 71 and 72, have been noticed by the energetic Victorian naturalists.

A similar addition might have been made on p. 143, where *Strongylus*, a genus of nematodes or thread-worms, is mentioned as being found in horses, cattle, and sheep, birds, and reptiles, but not as having been found in man. Looss not long ago described a species, *Strongylus subtilis*, found in the intestines of Egyptian fellaheen, while more lately still Prof. Ijima, of Tôkyô, has stated that a species, which appears to be the same, has long been known in Japan as a human endoparasite. A plague that in March 1889 spread among the inhabitants of the Miura peninsula appears to have been due to the growth of this species. Mr. Shipley mentions that no intermediate host has been satisfactorily demonstrated; it may, therefore, be of interest to mention that Dr. Ogata, who investigated the Miura plague, and first discovered the existence of *Strongylus* in the stomach of one of its victims, believed, after much investigation,

that it had been brought about by the eating of certain oysters. The oyster has had so many attacks made on it of late, that it seems almost cruel to suggest that it might possibly serve as the host of this new endoparasite.

The next two writers present us in the course of their articles with a new classification apiece. Prof. Marcus Hartog deals with the Rotifers, animals which are known to all amateur microscopists in such beautiful and interesting forms as *Melicerta ringens*, with its little tube of pellets. It is, however, not only to the microscopist, but to the advanced morphologist, that the rotifers are, as Mr. Hartog says, "a subject of keen interest." The resemblance of some of them to the larval form known as a trochosphere caused Huxley, in 1851, to draw the conclusion "that the Rotifera are the permanent forms of Echinoderm larvæ, and hold the same relation to the Echinoderms that the Hydriform polypi hold to the Medusæ, or that *Appendicularia* holds to the Ascidians." The relation to the trochosphere has also been insisted on by no less writers than Lankester, Balfour, Hatschek, and Kleinenberg, while quite recently Haeckel has endeavoured to show that such a Rotifer as *Noteus quadricornis* presents a strong resemblance to what he, if not others, believes to have been the earliest type of Echinoderm. Mr. Hartog, however, has "been induced to take a view of the structure of Rotifers that brings it into close relationship with the lower Platyhelminthes, and with the more primitive larva of the Nemertines termed *Pilidium*."

"If we compare this organism with a Rotifer," he writes, "we find that the wreath corresponds in both, the funnel of the disc in such forms as *Flosculariidae* and *Microcodon* leading to the mouth of *Pilidium*, while the gut is blind in *Asplanchnidae* and in some of the highly developed *Seisonidae*. The circular nerve-ring of *Pilidium* is in many Rotifers only represented by its anterior part, the brain, though in Bdelloids a sub-oesophageal ganglion completes the ring. This leaves a difficulty with regard to the apical sense organ; but it is easy to understand that an organ of sensation should become an organ of fixation. In this case the foot with its glands would correspond to the sense organ of the Trochophore larva; and it retains its primitive ciliated character in the larvæ and males of many Rotifera, and the adult female of *Pterodina* and *Callidina tetraodon*. Embryology tells us that the anus of Rotifers cannot be homologous with that of Annelids, &c., for it is formed outside the area of the blastopore: it is an independent formation, probably due to the coalescence of the originally blind intestine at its extremity with the earlier genito-urinary cloaca. On this view we must change the orientation of the Rotifer, and place it, like a Cuttlefish, mouth downwards: for 'anterior and posterior' we must substitute *oral* (or *basal*) and *apical*; for 'dorsal' and 'ventral' we must use *anterior* and *posterior*; while 'right' and 'left' are unchanged."

We do not altogether agree with Mr. Hartog's views regarding the apical sense-organ. Nevertheless, it does not necessarily constitute a serious difficulty, since it is well known that sense-organs can be developed afresh in almost any part of the body where they may be required. The whole suggestion, moreover, is extremely interesting, and so far as the needs of such a Natural History are concerned, we can have no quarrel with Mr. Hartog, seeing that, "as these views are now published for the first time," he has "thought it wiser to keep to the accepted relations in the general description. a course which has the advantage of avoiding difficulties in the study of the literature of the Class."

Mr. Benham, in dealing with the Polychæta, has not been so wise, for he adopts a classification that has previously been put forward, and that in a slightly different form, only at the meeting of the British Association in

1894, and has not yet met with any acceptance. This classification, however, he not only reintroduces, but permits to govern the whole arrangement of his section. Apart from our strong presentiment that few workers on the Polychæta will accept this classification without considerable question, we cannot think that it is altogether fair to the readers to introduce so great a novelty in what after all professes to be a popular work. Mr. Benham, however, as we have already hinted, can hardly claim to have made his contribution particularly popular, except, indeed, where he quotes, as we are glad to say he does pretty often, that fascinating and suggestive writer, Sir J. Dalyell. Passing to Mr. Benham's chapter xii., we find that it purports to contain a "description of British Genera and Species." It is true that a certain number of species found in the British area are described in more or less cursory fashion, but whereas some of the species so described are definitely stated to occur around our coasts, others are merely put down with such a locality as "Atlantic," and it is not always stated whether or no they can be regarded as British. In other respects, too, this heading is not quite accurate, for many of the species mentioned are not described, while others which do occur are not even mentioned. We may note in passing that the curious parasite of crinoids known as *Myzostoma* recently found, by the way, to occur also in two genera of starfish, is regarded by Mr. Benham as a degenerate Chaetopod.

The Oligochaeta, which include the familiar earthworm, have been entrusted, most naturally, to Mr. F. E. Beddard. We notice that he includes in the group the little parasite of the crayfish, *Branchiobdella*, which, curiously, was omitted from his monograph. The family Discodrilidae, in which it occurs, is placed among the Microdrili. Here also comes the family Phreoryctidae, which Mr. Beddard considers to be low in the series, arguing from the generative organs of *P. smithii*. It should be noticed that Vejdovsky does not accept this position for the family, and would, in fact, refer this particular species to some other genus. In other respects, however, there can be little doubt that Mr. Beddard's account leaves small opportunities for criticism. There is just one small point in his account of the Hirudinea where, trying perhaps to be popular, he has fallen into a not uncommon error. "The former extensive use of the leech has led," he says, "to the transfer of its name to the doctor who employs it, the authors of the sixteenth century constantly terming a physician a leech." There seems little doubt but that it was the leech which derived its name from the physician. As Mr. Beddard's linguistic attainments might have shown him, the word *leech* is obviously derived from the Anglo-Saxon *læce*, a physician, a word which we still find in Scandinavian languages, as in the Danish *læge*. The use of *leech* as applied to *Hirudo medicinalis*, on the other hand, is strictly confined to the English language.

Following on the leeches comes Mr. Shipley with a remarkably up-to-date account of the Gephyrea, a group of some zoological importance as having so often and so long been placed with the Echinoderms, in consequence of their strong external resemblance to some Holothurians. Mr. Shipley, following most recent authorities, would derive them from the Chaetopoda, their nearest ally in that group being *Sternaspis*, and would place the Echiuroidea nearest to that phylum, while the Sipunculoidea are regarded as allied to them, but as having departed further from the annelid stock.

It is perhaps a pity that the remarkable genus *Phoronis* should have been described in the present volume. It is true that earlier writers supposed it an off-shoot of the Gephyrea, and that Caldwell and Lankester have associated it with those animals along with the Brachiopoda and Polyzoa, more especially with the last. Mr. Shipley feels tempted to accept the recent

researches of Masterman, which, if confirmed, must result in the placing of *Phoronis* among those peculiar allies of the early ancestors of the vertebrates known as Hemichordata. Perhaps it will be possible to introduce

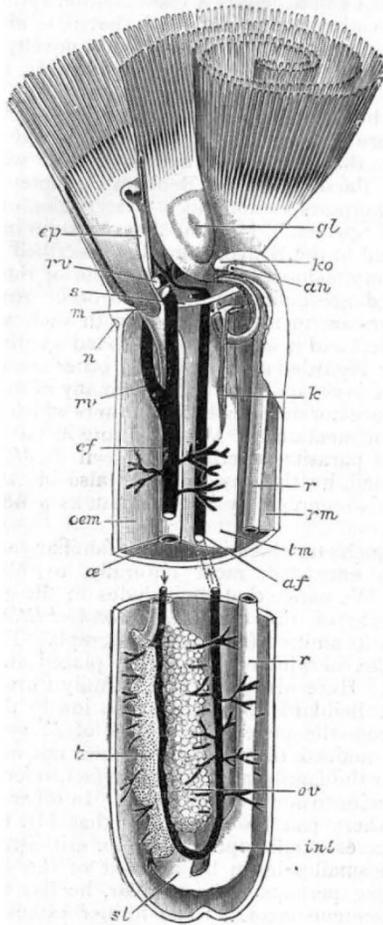


FIG. 2.—A schematic view of the interior of the body of *Phoronis*, with the middle $\frac{2}{3}$ omitted. Magnification, which is great, is not stated.

it again in a subsequent volume for the convenience of comparative study. With regard to *Phoronis kowalevskii*, Mr. Shipley tells us that it is a name "given by

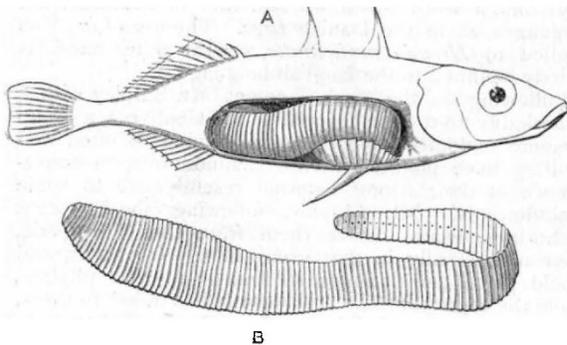


FIG. 3.—A. Stickleback (*Gasterosteus*) infested by an advanced larva of *Schistocephalus*. B. The larva. Both $\times 1\frac{1}{2}$.

Benham to the species from Naples described by Caldwell, and replaces the name *Ph. caspitosa*, which was given, but subsequently withdrawn, by Cori." This seems a roundabout way of stating that Cori's name was,

NO. 1435, VOL. 55]

as he has admitted, antedated by the name given by Benham. A name, once published, cannot be "withdrawn," even by its author

The volume concludes with an excellent index; but a review of any volume of the "Cambridge Natural History" that should conclude without an allusion to the admirable illustrations would indeed be incomplete. In this respect the present volume, though dealing with less picturesque animals, by no means falls short of its predecessors. As clear presentations of anatomical structure, we may draw attention to a diagram of *Planaria*¹ on p. 39, of *Leptoplana* on p. 14, of *Phoronis*¹ on p. 457, of *Alcyonidium* on p. 469, and many like them.

We may also notice the figures drawn from specimens in the Cambridge Museum, such as the stickleback¹ infested with a cestode larva, on p. 84, and many taken from the most modern writers, other than the authors, as Bürger, Haswell, Spencer, and others. Indeed, the only complaint we have to make with regard to the figures is that the name of the artist does not appear to be given in the volume.

Taken as a whole, the book is fully worthy of its place in this attractive series, and, even if the eye of a critical zoologist may detect a shortcoming here and there, his heart must be gladdened to see a general work published at last that treats these generally despised animals in a style to which their morphological importance entitles them.

INDIA-RUBBER AND GUTTA-PERCHA, AND THEIR SOURCES.

THE question of the supply of india-rubber to meet the present enormous demands caused by the progress of electrical science, and the rapid development of the application of the substance for cycle and carriage tyres, is one that has been much discussed of late, and continues to increase in interest. For some time past it has been well known that the trees which supply the best rubber known in commerce, namely, Para rubber, have been more and more difficult to get at, in consequence of the collectors having to proceed further into the forests in search of the trees (*Hevea brasiliensis*), which yield the valuable juice. But though greater distances have to be traversed in order to collect the rubber, there seems but little fear of the absolute failure of the rubber supply generally, or of this one particular kind. Though the quality of this rubber is of a very superior nature, we are fortunately not dependent alone upon it for the supplies of our markets, for from the East and West Coasts, as well as from Central Africa, and also from India and the Far East, we obtain very respectable quantities; indeed, the resources from tropical Africa in this respect have of late so much increased, that they promise to compensate for any loss of the American supplies, and the experiences of the past year or so, when a new source of rubber has been discovered at Lagos, is even more reassuring as to the future supplies, for other plants may yet be found capable of assisting in furnishing a substance that will probably, in the future, be in still greater demand than it is even now. So that it has become necessary for every one interested in this peculiar industry to take every precaution to prevent waste of material, both in the processes of collecting the milky juices and in the preservation of the plants yielding them.

It seems pretty certain that, whatever takes place in the discovery of new sources, the plants yielding these elastic juices must belong to one of three natural orders, for all the known plants furnishing rubber of commerce belong to the Euphorbiaceæ, the Urticaceæ,

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