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POLAND'S "FUR-BEARING ANIMALS."

Fur-bearing Animals in Nature and Commerce. By Henry Poland, F.Z.S., 1 vol., 8vo. (London: Gurney and Jackson, 1892.)

ALTHOUGH, as civilization spreads with ever-quickening progress over all parts of the world's surface, wild animals necessarily diminish in numbers year by year, few people have any idea of the enormous quantities of furs and pelts still annually imported into the United Kingdom, and of the extent of the commerce in such commodities still carried on. Mr. Poland's useful treatise on Fur-bearing Animals will afford us much information on this subject. In the introduction to his volume full statistics about the past and present condition of the fur-trade are given, and it is stated that at the great fur-sales now held at the College Hill sale-rooms in London the annual value of all classes of fur-skins sold is little short of £1,000,000.

But it is with the main portion of the present work that naturalists will be most interested, as, so far as we know, this is the first occasion on which a large amount of practical knowledge of the subject has been combined with a certain amount of scientific information. Mr. Poland takes the fur-bearing animals systematically, mostly, it appears, according to the order and nomenclature employed in the list of animals in the Zoological Society's Gardens, and gives us under each head particulars as to their localities, distribution, coloration, and varieties, together with information as to the quantities of skins imported and the uses to which they are devoted.

Beginning with the Quadrumana, we find that the skins of about twenty-five Monkeys and Lemurs are used in commerce. Of these the most abundant is the "Black Monkey" of Western Africa (*Colobus vellerosus* and other allied species), of which some 90,000 are imported every year. Another species of Colobus, the Guereza of Abyssinia and Eastern Africa, also furnishes a "rare and much esteemed skin," of which the value is from 10*s.* to 15*s.* We may remark that the Tcheli Monkey (*Macacus tcheliensis*) is not from Cochin China, as stated by Mr. Poland, but from Mantchuria, north of Pekin, where it ranges further north than any other Monkey now existing. There is a fine example of this species at present living in the Zoological Society's Gardens. The "China Grey Monkey," described as having a "long white tail," is evidently of quite a different species, the Tcheli Monkey having only a very short caudal appendage.

The Carnivora, which next follow, take up the greater part of Mr. Poland's volume, nearly 150 species of this extensive group supplying pelts which are more or less useful to mankind. Commencing with the larger Cats, our author calls attention to the great difference between the Bengal Tiger and the Mongolian or Chinese variety of the same animal, in which the fur is very thick, often from 1½ to 2 inches in length, and makes a long fringe round the face. Skins of the Chinese Tiger are much esteemed on this account, and fetch from £10 to £40 each, according to quality; whereas a good Bengal Tiger skin may be purchased at about £4 or £5. The Lynx is another of the true Cat-tribe which furnishes a rather important article of trade, the quantity of Lynx-skins imported by the Hudson's Bay Company ranging up to 40,000, and in exceptional years reaching even to 70,000. Coming to the Musteline Carnivora or Weasels, we find the Mink (*Mustela vison*) an animal of still greater importance in trade. In 1890 upwards of 360,000 skins of the Mink from North America were sold in London, and converted mostly into muffs. On the other hand, an allied species of the same genus, the Ermine (*M. erminea*), formeriy so much esteemed, and regarded as a princely fur to be devoted exclusively to royalty, is going quite out of fashion. "It has become very much neglected. and a few years ago was practically unsaleable."

The fur of the Skunk, *Mephitis mephitica*, many persons will be surprised to hear, in spite of its "powerful scent," which "cannot be entirely got rid of," is largely used. In 1891 nearly 700,000 skins of it were imported, and worked up into muffs and capes. But the prince of furs of this division of the Carnivora is that of the Sea-otter, *Enhydra lutris*, of the north-west coast of America, an animal generally supposed to be almost extinct in consequence of long ages of persecution. But 2369 Sea-otter skins were imported by the Alaska Commercial Company and other traders in 1891, and sold at an average price of £57 apiece. "The fur is principally consumed in Russia, where it is used for collars of noblemen's coats."

From the Sea-otter we pass by an easy transition to the Fur-seals—a group still of sufficient importance to have brought three of the greatest nations of the world nearly to loggerheads, but in bygone years much more abundant than now. From South Georgia in the Antarctic Seas one million two hundred thousand Fur-seal-skins are said to have been taken soon after its discovery, and nearly an equal quantity from Kerguelen Island, but the natural consequence has followed that the animal has become practically extinct in the Antarctic seas. The only species of Otaria that still yields its skin year by year to supply the ladies of Europe and America with "sealskin jackets" is the Alaska Fur-seal, *Otaria ursina*, which, owing to the stringent regulations enforced for its preservation, is still abundant in certain parts of the North Pacific. According to the best authorities about 4,500,000 of this Fur-seal resort to the Pribylov Islands every breeding season, and until 1890, when the number to be slaughtered was reduced, 100,000 were killed every year. Smaller quantities are obtained from other parts of the North Pacific. We need not here go into further details upon this animal which has lately been the subject of so much discussion, except to say that unless even more severe regulations are made for its preservation than those now existing, the Alaska Fur-seal will indubitably share the fate of its Antarctic brethren, and cease to furnish an article of commerce.

Of the order Insectivora, which follows the Carnivora, Mr. Poland only mentions two species as supplying fur for the use of mankind. These are the Common Mole (*Talpa europœa*) and the Russian Musk-rat or Desman (*Myogale moschata*). The skin of the Mole is so small as to be of little value, but several thousands are collected annually and converted into those most comfortable of garments, moleskin waistcoats. The fur of the

Russian Desman (*Myogale moschata*) is sometimes used in this country for mantle-trimmings, but is more appreciated in America. The Desman of the Pyrenees (*M. pyrenaica*), which Mr. Poland confounds with that of Russia, is a much smaller and quite different animal.

We now come to the great group of Rodents, many of which supply their skins in enormous quantities for the benefit of mankind. Mr. Poland's list contains thirty-three species of this Order. The Beaver, formerly of such pre-eminent importance, is now much reduced in numbers, but 63,419 Beaver-skins were sold by the Hudson's Bay Company in 1891. Another Canadian Rodent, the Musquash (*Fiber zibethicus*), still ranges over the "north-west" in enormous armies, from three to four millions of their skins being obtained every year. In 1891 the Hudson's Bay Company alone sold 554,104 of them. Another much appreciated little animal of the Rodent order is the Chinchilla from the highlands of Chili and Bolivia. Its fur, which is remarkably soft and delicate, is principally used in England, France, and America. Several allied species of the peculiar South American family *Chinchillidæ* are also called by the general name of "Chinchilla."

Of the Leporidæ or Hare-family, which concludes the Rodents, the Polar Hare and the Common Rabbit supply the largest numbers of useful skins. Of the Russian or Polar Hare (*Lepus glacialis*)—one of the best-known denizens of Arctic latitudes—from 2,000,000 to 5,000,000 skins are said to be collected annually, mostly in their thick white winter coats. But Rabbit-skins are employed in much more enormous quantities. Since the great increase of this Rodent in Australia and New Zealand, where, as is well known, the Rabbit has become an awful pest, the number of its skins sent to London for sale from those colonies has increased year by year, until, according to Mr. Poland's calculations, from fifteen to twenty millions are now imported. Very large numbers of Rabbit skins are also brought to England from France, Germany, and other countries, mostly taken from domestic varieties.

The American "Buffalo" (more correctly "Bison") is extinct as regards trade purposes, so that we need not go into the quantities of "Buffalo-robes" formerly imported, which in Catlin's time reached 200,000 in the year; nor will the other species of the order Ungulata, of which Mr. Poland gives forty-six in his list as affording skins more or less used in commerce, detain us long. The most important of them are the different varieties of the domestic Sheep and Goat, which are spread all over the world and supply mankind with every variety of clothing-materials. The extent of this commerce is enormous. Of tanned Goatskins alone 7,259,212 were imported into this country in 1891, and 5,613,996 skins of "East Indian Sheep" were sold in London.

The Edentates, Marsupials, and Monotremes, with which Mr. Poland concludes his volume, are of small importance after the preceding orders. "Australian Opossum," however, under which common name are included skins of several different species and varieties of the genus *Phalangista*, forms an exception, as the annual supply of this article exceeds two million skins, which are much appreciated for their "cheapness, light weight, pretty colour, and general usefulness." Of Kangaroos of all sorts over 120,000 skins were imported in 1891, so that, what with these and the Phalangers and its twenty million Rabbit-skins, Australia has a fair share of this lucrative commerce. But altogether, no doubt, the Dominion of Canada and adjoining district of Alaska still get the lion's share of the traffic in "furs and pelts."

In concluding our somewhat lengthy notice of Mr. Poland's volume we may say that it is replete with information that a zoologist cannot obtain elsewhere in a convenient form, but at the same time contains many errors in the identification of the species, some of which we have pointed out. In a second edition, which will doubtless be called for, the author should obtain the assistance of a scientific expert. He would also do well to cut out of his list some of the less important species (such as the Dingo, Great Anteater, and Echidna), which are not really used for trade-purposes, and to bring up his statistical information under every head to the most recent date.

SPINAL NERVE—IMPULSES AND ELECTROMOTIVE CHANGES.

The Structure and Functions of the Brain and Spinal Cord. By Victor Horsley, B.S., F.R.C.S., F.R.S. (Griffin and Co., 1892.)

As stated in the preface, the present volume (being the Fullerian Lectures for 1891) discusses the spinal cord and ganglia alone, and is to be followed by two others, dealing respectively with the brain and with physiological psychology.

Most books of this character have to be considered in their relation to two classes of readers—those who are experts in its subject-matter and those who are not—a distinction that applies with special force to the outcome of Royal Institution lectures. We shall therefore take two readings of the volume before us.

The table of contents and a cursory glance at the text very soon bear out the author's modest remark that these lectures have no pretensions to form a monograph upon the subject of which they treat. Nor are they an elementary review of it (in the ordinary sense of these words), but rather a series of vignettes—historical, zoological, and speculative—relating to the nervous system. The historical lecture is interesting; the curious and hideous figure on p. 13, from a twelfth-century manuscript in the Bodleian Library, very aptly fulfils its purpose, viz., to demonstrate that no advance is there apparent upon the ideas of Aristotle. Prof. Horsley avoids plainly asserting that Sir Charles Bell discovered the sensory and motor functions of the nerve-roots; the statement is implied, not made; at first reading we think it is made, on second reading we recognize that it is not made, on third reading that it is positively implied. It is evident that Prof. Horsley has read Bell's original pamphlet, "Idea of a New Anatomy of the Brain" (1811);[1] he does not, however, go

[1] Not an easy matter—we only know of one copy in London, that at the British Museum, misdated 1802—nor a superfluous matter, as any one knows who has compared the "reprints" of 1824 and of 1830 with the original paper in the Phil. Trans. of 1821 on the nerves of the face. Correct reprints of Bell's first paper have been published in "Documents and Dates of Modern Discoveries in the Nervous System," (? by A. Walker), London, 1839, and in the "Journal of Anatomy and Physiology" for 1869, by A. Shaw.

on to say that Bell's two roots (before 1824) were an anterior "cerebral" root, subserving motion and sensation, and a posterior "cerebellar" root serving to govern vital actions. The *principle* of localization in nerve-roots, far more clearly stated by Walker in 1809 and the facts demonstrated by Majendie in 1822, are not alluded to. In the second lecture Kleinenberg's cells are figured and described, and on the next page admitted to be mythical; thus Prof. Horsley is enabled legitimately enough to utilize this time-honoured if anatomically incorrect illustration to enforce the essentially correct principle of differentiation. Lecture III. treats of jelly-fish, star-fish, and cray-fish, with reference to rhythm, "localization" and co-ordination of movements. "Localization" is used as a term to denote a physiological property or function (pp. 48–49); *i.e.*, as used by psychologists to denote an act of the subject, rather than as used by physiologists to indicate observed relations between parts and functions. This use of the word is perfectly legitimate, but it is rather apt to create confusion of thought. "Localization" is sometimes used in a similar sense in relation to brain-function, and with a similar inconvenience; "localization" *by* the brain in a psychological sense is properly localization by the subject, localization *in* the brain is an object of physiological experiment. No doubt it may be said that psychological localization rests upon physiological differentiation and localization; none the less the use of the term to denote a physiological property or function is not advisable without very careful definition. Lecture IV. deals with vertebrates—nerve-fibres, gullet theory of canalis centralis, spinal cord, and nerve-roots. Lecture V. with ganglia. Here we must criticise. Looking to the class of readers addressed, Fig. 26 may be misleading as regards the anatomy of anterior and posterior roots. Fig. 28 (altered from Hirschfeld and Leveillé) is very confusing, and the anatomy of the brachial and lumbar plexuses is strange. A reader who should gather his notions of the functions of spinal ganglia from pp. 110–113 would have a very wrong idea of the state of our physiological knowledge; nor does the odd expression, "the immense discovery by Claude Bernard, of the so-called vaso-motor system of nerves," possess much justification as regards historical accuracy.[1]

The four last lectures contain—necessarily mingled with familiar elementary considerations—a statement of the results arrived at by Professors Gotch and Horsley from their electrical investigation of nerve-impulses in afferent and efferent nerve-channels, and to the expert form the most important part of the book. We begin, therefore, to read more closely, still bearing in mind, as indeed is suggested by the style, the requirements of non-expert readers. Nothing arrests attention on the first two pages. On p. 129 we pause at this sentence:—"It is very interesting to see that the protoplasm of a nerve-conductor has a distinctly longitudinal arrangement, which, it is not going too far to suggest may, by virtue of this fact, be more adapted for the polarization of its molecules for the better transmission of nerve-impulses." Having dissected out the possible meaning of this sentence we proceed. Two pages further we are stopped for a moment by a confusion between the local excitability of nerve and its conductivity. On the next page (p. 132) we demur to the assertion that "secondary tentanus depends upon the electrotonic state of the first preparation." On page 138 we find no reason to accept the distinction that "no doubt may reasonably exist that active nerve yields products of oxidation, which doubt certainly exists as to the acidification of nerve." Both facts are possible but unproven; no proof whatever has been attempted of the first; the second has been investigated with positive and with negative results. Page 146 includes a figure in which the current is *not* shown as an action current, but the reverse; moreover instrument figured (capillary electrometer), *no current* is under observation.

But these twenty pages are enough, and we shall have but little space to discuss what forms the main positive differentia between Prof. Horsley's book and other books of the same class, *i.e.*, the conclusions derived from electrical data.

The conditions of criticism in this connection are altogether different, and we need not stop to examine into the accuracy of elementary points. Prof. Horsley is now addressing himself to an expert audience; his reasoning and his data have yet to pass through the refining fires of doubt and of objection, with, it is to be hoped, ultimate confirmation. The principle of the method of investigation is a well-established one; we know that electrical variations are indicators of functional variations; in the spinal cord, as elsewhere, functional activity may therefore be roughly gauged by galvanometer or by electrometer. Gotch and Horsley did this as regards efferent channels and afferent channels; as regards the first they found by the electrometer that the character of discharge in the pyramidal tract does not differ from its character in motor nerves; as regards the afferent tract they find that impulses pass up the cord chiefly in the posterior column of the same side. These conclusions may be admitted without imprudence. But the conclusions that may not safely be admitted without further experimental elaboration, are those relating to the functional discharges (inferred from electrical discharges) up and down the anterior and posterior roots, and to the quantitative distribution of centripetal impulses in the various columns of the cord. As regards this second point the physical conditions are not sufficiently analyzed (either in this volume or in the original paper) for us to admit, *e.g.*, that average galvanometric swings of 60 and 20 indicate a passage of afferent impulses in the proportions 60 and 20 per cent. in the posterior and in the lateral columns respectively. That the deflection was proportional to the number of fibres excited, is an assumption requiring proof (p. 212, *cf.* also pp. 145, 159, 160).

As regards the first point, it was found that electrical discharges pass easily *down* as well as *up* the posterior

[1] In point of time Brown-Séquard is the true discoverer of vaso-motor nerves. Bernard's experiments were made subsequently, and interpreted otherwise.

"D'après ces expériences, il n'est donc pas possible d'expliquer le réchauffement des parties par une prétendue paralysie des artères, qui, à raison d'un élargissement passif, laisseraient circuler une plus grande quantité de sang. . . . .

"Si alors [*i.e.*, en galvanisant] les artères, comme les veines, se ressèrent et reviennent sur elles-mêmes, çela tient à ce qu'il n'y a plus de sang pour les distendre, mais ce n'est pas du tout l'effet d'un resserrement actif des vaisseaux.

. . . . . "il ne peut venir à l'idée de personne de penser à rapporter le phénômène circulatoire qui succède à la section du nerf sympathique] à une paralysie pure et simple des artères." Bernard, *Annales des Sciences Naturelles*, 1854, p. 198.)

root, but are "blocked" *up* the anterior root, and diminished *down* that root. But in the inferences *qua* functional impulses derived from these data, two considerations appear to have been insufficiently borne in mind—(1) The rapid death of interrupting grey matter as compared with the endurance of white matter, and (2) the disproportionate magnitude of negative variations by *electrical* excitation as compared with negative variations by *functional* excitation. The contrast between interrupted and non-interrupted tracts, as regards the transmission, gauged electrically, may have been in part due to the first cause, and an adequate recognition of the second fact would have withheld Prof. Horsley from expressing astonishment—"a revelation to us" is his phrase—at finding the electrical variation in a nerve eight or ten times as great by direct electrical excitation as by discharge of a nerve centre. Du Bois-Reymond's analogous deflections obtained on strychninized frogs were 1° to 4° *versus* 40° by direct electrical excitation. A functional discharge *down* posterior roots, if proved to occur, is a new and surprising phenomenon; but its existence is not *at present* proved by the existence of an electrical discharge; electrical effects by electrical excitation are tainted evidence, electrical effects down the posterior roots by functional excitations above, although incidentally touched upon, were not exhaustively examined, and considering the recognized dangers of experimental fallacy, we may not admit as proved that nervous impulses are discharged down afferent channels. Prof. Horsley infers unreservedly that functional discharge occurs *down* the posterior roots, and that centripetal impulses *up* the anterior roots are blocked at the cord. This he regards as striking evidence of the truth of the kinæsthetic doctrine (*i.e.*, that nerve action starts from the afferent or sensory side of the nerve centre, p. 170); but the connection between this presumed functional downflow in afferent channels and kinæsthesis is not made apparent; up-flow in afferent channels is matter of common knowledge; up-flow by efferent channels has (so far as we know) been contended for by no one since Lewes. But as regards these last points, they may be expected to receive fuller and more precise analysis in the promised volumes on the brain and on physiological psychology. A. D. W.

ELECTROTECHNICAL TRAINING.

Electrical Engineering as a Profession and How to Enter It. By A. D. Southam. (London: Whittaker and Co., 1892.)

THIS book consists of a collection of extracts from the notices of various firms regarding apprentices and articled pupils, and from the prospectuses of colleges which give an education in electrical engineering. It reminds us of the gorgeous but depressing volumes one has met so often in one's summer outing, containing particulars of hotels in Aden, hotels in Algiers, hotels in Andermatt, &c., each hotel possessing, at least so it is said in the gilt-edged page advertisement, every possible attraction—a magnificent view, a first-rate cuisine, electric light, ascenseur, and all the other dreariness of a bandboxy barrack.

First we thought that the length of description which the author had given to a particular technical educational establishment was a measure of its goodness, but that idea we dismissed when we found that only three pages of description were given to that technical college in South Kensington, regarding which the author says: "This institution deservedly stands at the head of all the technical institutions in this country." Next it occurred to us that the author might have acted on the "good wine needs no bush" principle; but that hypothesis had to follow the other, for we feel sure that the Walker Engineering Laboratory at Liverpool is not bad, and yet it requires fifteen pages of talking about. Then we wondered whether each professor had been asked to write as much as he liked, so that the length of the description of a particular set of laboratories was in proportion to the leisure of the writer; and lastly, we have been speculating whether the likeness to the "Hotels of the World" book might not be quite complete, and the length of the description was a measure of the length of the purse of the advertiser.

However, be the plan of the compilation what it may, the book contains a good deal of information, also some salutary advice with which we quite agree:—"Undoubtedly the best training for a young man entering the electrical profession is to go through the course at one of the technical schools or colleges, and then when thoroughly grounded in the theory and having a general idea of the practice of his profession, to be articled for some months to a good firm of electrical engineers, where he will be able to acquaint himself with the practical part of his business as actually carried out on commercial principles;" and again, "if he then goes to both a Technical College and is also articled, it is advisable that the former should precede the latter, for the reason that when he is placed in the workshop his previous technical training will enable him to appreciate and see the importance of much which he would otherwise have overlooked."

For the fathers who desire to place their sons directly in a works on leaving school, there is given a long list of engineering firms who are willing to receive £300 and the lad; some are willing to take only one hundred and twenty guineas a year, from year to year, or even as little as £100 a year—and the lad. In many cases a month's trial is allowed, but judging from the ignorance of elementary mathematics and science displayed by many articled pupils in works, we presume that either these subjects are not required, or a month is not a long enough time for this astonishing ignorance to be discovered. Naturally enough these firms do not bind themselves to provide work for these articled pupils when their term is finished; indeed we know of a firm with over 100 articled pupils which is applying elsewhere for an assistant.

When will the parental idea die out that a lad who is pitchforked into a works must turn out an engineer? No doubt many of our successful engineers never received any education in a technical college; so many of our battles were won by men armed only with bows and arrows, but that is no reason for confining the equipment of a modern regiment to these primitive weapons. Either the teaching given at a technical college materially helps the lad in his subsequent practice in the works, or it is a fraud and ought to be stamped out. If it affords real help to the lad, then why, we ask, do not the firms insist on their pupils obtaining it before they enter the works?

Mere evening instruction for a lad who has been hammering, say, from 6 a.m. to 6 p.m. is well-nigh useless, and at the best ought to be regarded only as a makeshift for those who are compelled to spend the day earning their living. To place a lad at a technical college for two years, and then for two years at a works would cost, as far as fees and premium are concerned, about £250. To article him for three years at the works about £300. When will parents see that the cheaper course is far the better, and when will firms refuse to take an articled pupil unless he has already acquired that theoretical knowledge which is necessary to enable him to benefit by a works training? The father who articles his son to an engineering firm immediately the lad leaves school and expects him to pick up his technical education at odd moments, may be more liberal in his money, but certainly is no more liberal in his ideas than the parents who sent their sons to receive their practical training at Dotheboy's Hall. "Now, then, where's the first boy?" "Please, sir, he's cleaning the back parlour window." "So he is, to be sure," rejoined Squeers. "We go upon the practical mode of teaching, Nickleby. . . C-l-e-a-n, clean, verb active, to make bright, to scour. W-i-n, win, d-e-r, der, winder, a casement. When a boy knows this out of a book he goes and does it."

P. D.

HYGIENE AND PUBLIC HEALTH.

A Treatise on Hygiene and Public Health. Edited by T. Stevenson, M.D., F.R.C.P. (Official Analyst to the Home Office), and Shirley Murphy (Medical Officer of Health of the Administrative County of London). Vol. I. (London: J. and A. Churchill, 1892.)

THIS is a treatise consisting of various contributions from different writers. In the selection of authors it has been wisely decided not to limit the choice to members of the medical profession, and the wisdom of this decision has been exemplified in the acquisition of two of the very best articles which the book contains, *i.e.* that by P. Gordon Smith, F.R.I.B.A., and Keith D. Young, F.R.I.B.A., entitled "The Dwelling," and that by W. N. Shaw, F.R.S., headed "Warming and Ventilation."

There are at present several excellent small works upon hygiene and public health, but these of necessity treat of the subject in far too cursory a manner—indeed, they are designed more to meet the repuirements of candidates for the Public Health Diplomas now granted by many examining Boards. This work is evidently intended as a book of reference, and there is no doubt that it will be of great value to those from whom a special knowledge of public health work is demanded. While, then, the last year or two have been remarkably fruitful in the production of works upon the subject here treated of, the volume before us will not be one jot the less appreciated on this account, for it meets a want which must long have been felt among those who desire a better and more inclusive knowledge of public health matters than was hitherto accessible in a collective form.

It is needless to insist that the work is all well done, and that any shortcomings must, of necessity, be faults of omission rather than of commission, for the list of contributors includes those who occupy some of the foremost positions as authorities upon the subjects of which they treat. It is not an easy task—and one is conscious of running great risk of appearing arrogant—to single out those sections especially deserving of praise. If this is permissible in such a work, we should point to the two articles already mentioned as occupying a foremost place—indeed, the article upon "Warming and Ventilation" is a little too exhaustive and technical in its physical aspect, and deals too briefly and sparingly with the commoner provisions now used for both the purposes of warming and ventilation;—a shortcoming which has the effect of somewhat sacrificing the practical utility of the article to its bulk, when viewed from the health officer's standpoint. It would not be easy to speak in terms too high of the all-round excellence of the article upon "Disposal of Refuse," by Prof. W. H. Corfield, M.A., M.D., and Louis C. Parkes, M.D., D.P.H., and the work of compiling this section could not have been entrusted to more capable hands. "Water," by T. Stevenson, M.D., is a capital article, but one would like to have seen in it more about the methods of collecting water and distributing it, and of the risks which the water runs of pollution in and around dwellings.

In the preface we read that "it has been the desire of the editors that the several papers which these volumes contain should present a fair account of the knowledge, so far as obtainable, of the subjects of which they treat"; and this is invariably achieved, for where the account is not an excellent one, it is always more than a "fair" one.

The contribution upon "Air," by Prof. J. Lane Notter, M.A., M.D., is too short, and does not nearly include all the material given in his edition of Edmund Parke's work; and the same fault may be found with the articles upon "Hospital Hygiene," by H. G. Howse, M.S., and "The Inspection of Meat," by E. W. Hope, M.D., D.Sc.

"Systematic Physical Education"—a subject which has been all too little studied in this country—is well and spiritedly treated of by F. Treves, F.R.C.S.

The articles upon "Baths," by H. Hale White, M.D.; "Clothing," by G. V. Poore, M.D.; "Food," by Sidney Martin, M.D.; "Soil," by S. M. Copeman, M.A., M.D., D.P.H.; "Meteorology," by G. F. Symons, F.R.S.; "The Influence of Climate upon Health," by C. T. Williams, M.A., M.D.; "Offensive and Noxious Businesses," by T. W. Hime, B.A., M.D.; and "Slaughter Houses and their Administration," by E. W. Hope, M.D., D.Sc., are all good, though some of them might have been fuller. The article upon "The Influence of Climate upon Health" might with advantage have considered much more fully the reasons why the various climatic conditions influence the health of man in the way they do. The contribution upon "Meteorology," which is capitally illustrated, and one of the most useful in the book, might also have considered the physical causes which affect the readings of the various instruments, and dealt more fully with the principles upon which these are constructed. The article upon "Food" is excellent in some respects, but an attempt to convey to the reader, in an abstract form, the methods of food analysis fails—as it always does when such a subject is treated of in brief space—to be of great assistance to the reader.

The index is good, and the book is a valuable addition to Public Health literature.

OUR BOOK SHELF.

Lehrbuch der Botanik nach dem gegenwärtigen Stand der Wissenschaft. Bearbeitet von Dr. A. B. Frank. Erster Band: Zellenlehre, Anatomie und Physiologie. 8vo. 670 Seiten, mit 227 Abbildungen in Holzschnitt. (Leipzig: Wilhelm Engelmann, 1892.)

THIS is essentially a fifth edition of Sachs's renowned "Lehrbuch der Botanik," the fourth and last German edition of which appeared as long ago as 1874. An English edition, emended and augmented by the translator, Dr. S. H. Vines, was published in 1882. Now, ten years later, Dr. Frank has written a completely new work. As the author tells us in his preface, he was requested in 1890 to prepare a new edition of Sachs's book; but he has adopted the wiser course of making himself responsible for the whole. Nevertheless, free use has been made of Sachs's excellent illustrations, upwards of ninety out of the two hundred and twenty-seven having been taken from that source, "because the author could not replace them by better ones." About sixty are borrowed from other authors, and about seventy of them are original, or at least Dr. Frank's own, for some of them have appeared elsewhere. A number of them are reduced from Frank and Tschirch's "Wandtafeln." Certainly the book is admirably illustrated. In the limitation and arrangement of the material the author has followed Sachs in a general way, though he has separated the physiology and anatomy from morphology and classification. The two latter branches are to be dealt with in a second volume, promised early next year. So far as the present volume is concerned, we can strongly recommend it to the student familiar with the German language. It is written in a clear, succinct style; and, so far as we have been able to test it, it is well up to date. Dr. Frank is well known as a writer and teacher of botany, and especially for his researches and experiments relating to the nutrition of plants. The sources of the nitrogen of plants and symbiosis are two subjects to which the author has devoted much attention, and they are discussed in some detail from his own standpoint. We are glad to see that copious and complete references are given to the books and articles of the principal writers on the various subjects, whose views are discussed or adopted. Unfortunately there is no index, and it is not easy to find one's way through the table of contents. True, a "carefully prepared" index is promised with the second volume, but a separate one to each volume would be far more convenient and time-saving. It is not as though the second volume was a continuation of the first; and it is to be hoped that the author and publisher will even yet see their way to provide this facility for using the work.

Arithmetical Chemistry. Part II. Book B. By C. J. Woodward, B.Sc. (London: Simpkin, Marshall, Hamilton, Kent, and Co. Birmingham: Cornish Bros., 1892.)

THE student will find in the present edition of this work what is practically a new book, as the author has enlarged and entirely rewritten the original publication. The opening lessons treat of analyses, the formulæ of minerals, Dalton's law of partial pressures, gas analysis, &c., and are on the whole satisfactory. The introductory portions of the lessons, which embody the principles involved in the exercises, and contain typical examples fully worked out, are clear, as a rule, and the exercises themselves are both suggestive and useful. The same may be said of the concluding part of the book, wherein are briefly discussed atomic weight determinations, and the various means of controlling atomic weights, calorific power and intensity, heats of formation, dissociation, and gaseous phenomena, comprising the kinetic theory, diffusion, and absorption by water.

The intermediate lessons on molecular weights are, however, not up to the standard of the others. It is not made plain when discussing Avogadro's law that a vapour density observation, when possible, is the decisive mode of fixing the molecular weight of a compound. The vague description of the apparatus used in measuring osmotic pressure can only confuse the reader, and loose statements such as "*solutions* behave as gases," p. 51, must have the same effect. The relationships established in connection with the vapour-pressures of solutions only hold if the dissolved substance is practically non-volatile, this point is omitted, and the definition given of equimolecular solutions is not the one in common use. Indeed, the entire treatment of the properties of solutions as applied to molecular weight observations, although it may perhaps enable the student to solve problems, is much too fragmentary and loosely put together to give him an adequate idea of what is known on the subject. It may also be pointed out as somewhat late in the day to give a few of Kopp's conclusions as an account of specific volume.

Among minor corrections it may be noted that on p. 6, in the first erratum, solvent should be solution, vapour-tension might often be replaced by vapour-pressure, xylol should be xylene, and amyl benzoat should be amyl benzoate, on p. 48. "Ostwald's Solutions" might be included in the list of English works to which the student is referred.

The book contains an index, a list of answers, and a collection of the questions in arithmetical chemistry set at the Honours examinations of the Science and Art Department, and at the B. Sc. examinations of London University. A portion of the author's A B C Five-figure logarithms is presented with this edition. J. W. R.

Lessons in Heat and Light. By D. E. Jones, B.Sc. (London: Macmillan and Co., 1892.)

THE success of a previous work on "Heat, Light, and Sound," has led Prof. Jones to extend the two former parts, and publish them separately for the use of schools and junior classes in colleges. As an introduction to the study of experimental physics, the book cannot fail to be of great value. The principles of the subjects are very clearly stated, and the experiments from which they have been deduced are fully described. Most of the experiments may be easily performed by students, the instructions being sufficiently clear to guarantee success. Numerous arithmetical examples, partly selected from the author's "Examples in Physics," are added at the ends of the various chapters. The physiographic bearings of the subject of heat have been brought well to the front; thus the origin of the Gulf Stream, trade winds, and the formation of rain and snow are explained. Many of the diagrams have been carefully drawn to scale, in order to give the student an idea of the dimensions of the apparatus which may be conveniently employed in performing the experiments.

Elements of Magnetism and Electricity. By John Angell, F.C.S., F.I.C. (London: Collins, Sons, and Co., 1892.)

THIS is a new edition of one of the best-known text-books for use in connection with the classes under the control of the Science and Art Department. The book calls for no special remark; but the fact that a hundred thousand copies have already been disposed of seems to demonstrate its usefulness. Experiments and illustrations are its special features.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Further Notes on a recent Volcanic Island in the Pacific.

THE volcanic island—Falcon Island—in the Tonga group in the Pacific, of the recent appearance of which an account is given in NATURE, Vol. xli., p. 276, has recently been passed by a French vessel of war, the *Duchaffault*, which reports that the island is not now more than 25 feet high.

In October, 1889, when examined by Commander Oldham, it was 153 feet high, and a little over a mile long. Nearly entirely composed of ashes, it was rapidly washing away, and by the account above, it would seem that more than one-half the island must now have disappeared. W. J. L. WHARTON.

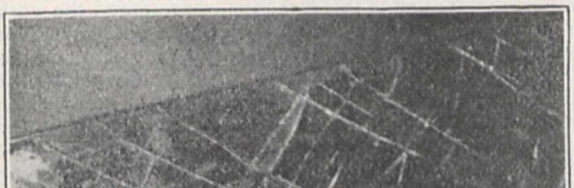
October 20.

Earth-fractures and Mars "Canals."

ON seeing the figure of the so-called "canals" of Mars, published in NATURE of a few weeks back, I was at once reminded of the pattern assumed by the cracks of glass broken by torsion, as in Daubrée's well-known geological experiment.

I enclose a photograph of part of a large slab of glass broken in this way in a class experiment of my own, and although other slabs, which have unfortunately not been preserved, exhibited, if I remember rightly, still more Martial-looking networks, I think that the general resemblance is obvious enough in this case.

It may perhaps be well to explain to non-geological readers of NATURE that Daubrée's glass-breaking[1] is regarded by many as reproducing in miniature the kind of fractures which are found to occur in those portions of the earth's crust with which we are acquainted, and that by torsion only has it proved possible to imitate the peculiar pattern assumed by such fractures, whether



they be joints or dislocations. It is further held by many that such lines of fracture in such patterns are a necessary result of the shrinking of the outer coat of a planet in course of cooling.

Mere fractures, such as we meet with in our own planet, could, of course, not be seen from any considerable distance, and if the circumstances of denudation were the same in Mars as with us, the "canals" could certainly not be the representatives of our usually hidden and featureless earth-cracks. There seems, however, to exist, in the extraordinarily rapid melting of gigantic ice-fields described by Prof. Norman Lockyer, some evidence of denuding power in Mars on a scale enormously larger than is the case with us. Earth-fractures—and for the matter of that Mars-fractures too—must many of them be lines of weakness along which denudation acts more freely than elsewhere, and if this denudation be phenomenal and cataclysmic, as appears to be likely in Mars, wide valleys or channels capable of being distinguished at great distances would soon be scoured out along them.

[1] Not "*ice*-breaking" as a mistranslation of the word "g'ace" has caused it to be described in some English text-books.

I would wish especially to draw attention to the three following points observable in the photograph, viz., the two marked directions in which the crack-lines run, one set crossing the others often at, or very nearly at, right angles; their occasional doubling and rough parallelism for some distance; and their frequent sudden stoppage—three of the features most noticeable in the Mars lines. G. A. LEBOUR.

Durham Coll. Science, Newcastle, October 13.

A Wave of Wasp-Life.

MR. HUDSON'S charming work on "The Naturalist in La Plata" reminds me of a very interesting wave of wasp-life which appeared in Wisconsin in the summer of 1886. We were living at the time in our summer-house at Pine Lake, and were making observations on the habits of the different animals in the neighbourhood.

In the latter part of July we suddenly found ourselves surrounded by large numbers of yellow-jackets and hornets. Everywhere through the woods and fields a veritable plague of wasps seemed to have descended upon the earth. During all the month of August we heard the same report from summer residents within a radius of twelve or fifteen miles of Pine Lake. In our immediate neighbourhood we knew of forty-seven nests. Allowing 1500 wasps to a nest—a very low estimate for that season of the year—this gave us over 70,000 wasps. Plates of meat and bones that were set outside for the cats were immediately covered with them, and in spite of screens in doors and windows they even entered the house, alighting on the food at the dinner-table, or darting about and catching flies.

The cause of this sudden increase in the number of wasps was evidently a general one, since it acted in the same way upon three species—*Vespa vidua*, *V. maculata* and *V. germanica*. An examination of the Signal Service statistics does not show anything unusual in the preceding winter and spring, but either the weather must have been especially favourable, lessening the ordinary death-rate of the queens, or there must have been a marked decrease in the parasites or other enemies which ordinarily keep these species in check.

The duration of the favourable conditions proved brief enough. It is probable that every one of our forty-seven nests furnished, at the very lowest estimate, one hundred developed and fertilized queens to start forty-seven hundred new nests in the following year; yet the increase in the checks to the too great ascendency of these species more than counter-balanced the abnormal increase. The winter of 1886-87 was not especially severe, but in the following summer the most careful search on our part, and on the part of others, whose efforts were stimulated by the offer of rewards, only gave us four nests in our neighbourhood, and on all sides we were met by the inquiry: "What has become of the wasps?"

G. W. PECKHAM.

Milwaukee, Wisconsin, October 12.

Note on the Occurrence of a Freshwater Nemertine in England.

A FEW days after reading M. de Guerne's "History of Freshwater Nemerteans," published in the August number of the *Annals*, I happened upon a specimen of the group amongst the roots of some water plants, which I collected in the river Cherwell, close to Oxford. I was, at the time, searching for the cocoons of a new Rhinodrilid worm, of which a description will shortly appear. The gathered roots, with the cocoons, were placed in a bottle of water, in order that the worms might hatch out. On examining the bottle two days later, namely, on September 5, I noticed a small bright orange animal, about half an inch long when extended, creeping amongst the cocoons. Further observation with the microscope showed that it was a species of *Tetrastemma*. Unfortunately the animal was crushed before I had done more than sketch the general appearance and make some few observations, and I have not yet succeeded in finding more specimens; so that I am unable to state how far it agrees with or differs from the previously known freshwater forms enumerated by M. de Guerne, most of which are included by Silliman and later authors under the title *Tetrastemma aquarum dulcium*.

In one or two points, however, my sketches show certain differences from those of Silliman:—

(*a*) The colour (orange) is due to pigment in the skin, and not to the red colour of the nervous system; I may mention that Dugès' species, "*Prostoma clepsinoides*," was yellow ochre, and "*Pr. lumbricoideum*" was yellow marbled with red; whilst Leidy's "*Emea rubra*" was yellowish flesh-coloured (probably due to the hæmoglobin in the nervous system).

(*b*) The anterior pair of eye-spots is further from the prostomium than in Silliman's drawing; I found no third pair of eye-spots, which, however, it is stated, is absent in the young.

(*c*) The ciliated pits are further forward, being midway between the brain and the anterior end of the body.

(*d*) The proboscis and its retractor muscle are much more undulating, when withdrawn into the body, than Silliman shows.

The proboscidial spine, with its groups of accessory spines, agrees very closely with the figures given by Silliman.

I can say nothing about the generative organs. For the present, then, I must leave undecided the specific name of this British *Tetrastemma*. W. BLAXLAND BENHAM.

Anatomical Department, Museum, Oxford,
Oct. 12.

Protective Mimicry.

MR. BATESON's letter on "Aggressive Mimicry" (NATURE, October 20) recalls to my mind a curious case of protective mimicry which came under my notice last August on Dartmoor. Large patches of the heath had been burnt, a common practice on the moorlands to ensure a fresh young growth for the sheep. The whole ground was alive with a common species of orthoptera (Locustina), the small green grasshopper with short antennæ. They leapt aside at every step in the short grass and scrubby heath; upon the burnt patches they were equally numerous, but with this difference—all, without exception, were coal black on abdomen, thorax, and head, whilst the wings were of an ashen hue. So much did the colour adaptation resemble the blackened turf and heath they hopped amongst it was almost impossible to follow them with the eye; we made many amusing attempts, but were nearly always defeated. I measured one of these burnt patches, and found it to be from thirty to forty yards square. A yard or two from this, on the untouched herbage all the Locustina were bright green. I found one specimen on the borderland in a transition state, not dull all over as I had expected, but in spots and patches of bright green and black. One enemy at least of these insects abounded on the moor, namely, the common lizard (*Zootœa vivipara*), for I have observed there is no food lizards will eat more greedily than grasshoppers. I have seen some that I have in captivity swallow twenty or thirty in two or three minutes, even after their usual meal of worms. They always became greatly excited, if one may apply so warm an expression to such cold-blooded animals, and rushed about the case when a collection of live grasshoppers were thrown to them. Certainly I was much struck by the rapid action of the power possessed by these Locustina on Dartmoor of assimilation to environment, and did not doubt but that this colour adaptation was for the purpose of protection, the eye producing by reflex action the change in the pigment cells. ROSE HAIG THOMAS.

STELLAR PARALLAX.[1]

THE Delegates of the University Press have recently published the results of Prof. Pritchard's systematic investigations into the parallax of those stars of the second magnitude whose North declination permits the inquiry to be made with facility and advantage in these latitudes. Our first feeling on glancing over the contents of this *brochure* must be one of hearty congratulation to the distinguished professor that he has been permitted to see the full outcome of a protracted inquiry, conducted at a period in his life when a less energetic astronomer would have felt himself justified in withdrawing from active participation in scientific research. Prof. Pritchard might well have been content to rest on the laurels he had won, and to have staked his reputation upon that career of acknowledged utility which has marked his direction of the Oxford University Observatory.

Immediately on the completion of the photometrical examination of Argelander's Uranometria, and with a zeal that admitted of no delay, Professor Pritchard busied himself with this inquiry into the parallax of stars of the second magnitude. But if the inquiry was undertaken with eagerness, and pursued with ardour and resolution, it was not characterized by hurry, or its success imperilled by incompleteness. Confident himself that photographic methods possessed the requisite accuracy to make the research successful and trustworthy, the Savilian Professor set to work to establish the reliable character of measurements made on sensitized films, and not till that confidence was demonstrated did he embark upon the larger work now under notice. These preliminary inquiries have been published in a series of papers in the proceedings of the Royal and Royal Astronomical Societies, and the confidence gradually acquired by enlarged experience induced him to proceed with the determination of the parallax of 61 Cygni, the results of which are published in detail in the third fasciculus of the Annals of the University Observatory. In this case he selected four stars in the immediate neighbourhood of the principal star, and sought the difference of parallax between each of the components and of the four stars of comparison. This long research may be regarded by some as a work of supererogation, inasmuch as the labours of Bessel and that of many later astronomers have satisfactorily settled the parallax of this star within very approximate limits. But if we properly understand the motives of Prof. Pritchard, his intention was not so much to seek anew the parallax of that system, as to discover with what degree of accuracy the method of photography, hitherto unapplied in this direction, represented the work of others made directly in the field of the telescope. Nor was this his only view. By selecting four stars in the immediate neighbourhood of 61 Cygni and seeking the difference of parallax between these stars of comparison and each of the components of the system, he instituted a very severe inquiry as to the trustworthiness of that method, which he had imagined as capable of dealing with the delicate question of stellar parallax. The severity of the test consists in deducing the same value of the parallax (eight in all) from each set of measures, and as a matter of fact the accordance, *inter se* between these several determinations is as close as could have been anticipated, and likewise in satisfactory unison with the work of other astronomers.

The completeness of this inquiry and the publication of it in detail have had two happy results. In the first place, Prof. Pritchard has, in the present instance, been able to confine the printing within very narrow limits, so narrow, indeed, as possibly not to have done himself justice. The details of his process, the mutual agreement of his measures, and his method of discussion having all been fully set out in his previous work, he has not felt himself obliged to enter into these minute particulars, but has contented himself with presenting the results. This method of arrangement, no doubt suggested in the first place by economical motives, has afforded opportunity for adding a very interesting history of the processes and results that have hitherto been followed with more or less success by others, and also the exhibition in a concise form of the different values of the more trustworthy determinations, derived by previous observers. The second advantage, immediately arising from the earlier investigations, is, that an examination of those results has shown that no increase of accuracy (commensurate with the increased labour at

[1] "Researches in Stellar Parallax by the aid of Photography." By Charles Pritchard, D.D., F.R.S., Savilian Professor of Astronomy in Oxford.

least) was obtained by continuing the observations of the stars throughout the whole of the year, that is, to secure observations in all positions of the parallactic ellipse. If the measures were confined to those epochs when the parallactic displacements were greatest, and a sufficient number of observations secured at those critical times, a determination of parallax could be relied upon to within about one-thirtieth of a second of arc. This is approximately the limit of accuracy that Professor Pritchard hoped to reach, and in this selection he appears to have been guided by the conviction, that in the present condition of cosmical inquiries, to which stellar parallax bears the closest relation, it is of more importance to know within very narrow limits the parallaxes of many stars than seek with the utmost accuracy the parallax of a very few. And in this respect there can be no doubt but that Prof. Pritchard's judgment is correct. The former is the view of a philosopher; the latter that of a conscientious and painstaking observer. Guided by the broader view, the result of his work has been to enrich the data at the command of students of cosmical science by assigning the approximate distance to some thirty stars, a number which bears no inconsiderable proportion to the total number of separate determinations made by all other astronomers combined.

Prof. Pritchard's view of the history of stellar parallax is that of a scientific struggle, a continual and severe wrestle on the part of the astronomer with the inevitable inaccuracy of observation and imperfect instruments, in which sometimes one opponent, sometimes the other, has the mastery. He passes in his historic survey rapidly over those days when from various obvious causes the detection of stellar parallax was scarcely possible, moved however to admiration by, and induced to linger over, the success that attended the early observations of Molyneux in the case of γ Draconis when discussed, a century later, by Auwers, a success that later observers have struggled to repeat ineffectually. He brings before us, but touches with a light and kindly hand, the dispute that embittered the lies of Brinkley and of Pond, but it is not difficult in reading a little between the lines to see with whom his sympathies rest. Later on in the history of the research, Henderson meets with his deserts, as a clear-sighted astronomer of distinguished ability, cautious and persevering, and one who in the struggle after accuracy obtained an undoubted measure of success. This historical introduction will we think be read with pleasure by many who may have no particular interest in this special subject of inquiry. The comments of one who has encountered and overcome many similar difficulties, and has kindly sympathy with all who have travelled along the same path, cannot but be of interest and of value, and we could have wished that this portion of the book had been considerably extended. How many astronomers are now acquainted, with any degree of adequacy, with the serious difficulties that attended the early application of the heliometer in this department of research, and with the dispute that raged long and dubiously around the names of Wichmann and of Schluter? All are willing to admit that in the hands of many competent observers—it would be invidious to mention any without naming all—the heliometer is doing splendid work, but the difficulties with which the early masters had to cope are now all but forgotten, and it is certainly wise to treasure a sympathetic remembrance for the earlier exponents of the improved and successful methods now in vogue.

The last portion of Prof. Pritchard's history is occupied with the bearing of stellar parallax on the problem of the construction of the stellar universe. He seems to have had before his mind two questions, which, long hovering in an unexpressed form, were first formally enunciated by Dr. Gill. The first question is, What are the average parallaxes of stars of the first, second, third, and fourth magnitude respectively compared with those of fainter magnitude? To this question the Savilian Professor replies very cautiously. The researches of Dr. Elkin on stars of the first magnitude point to an average parallax of $0''.089$ for stars of that class, and just as certainly Prof. Pritchard's researches point to an average parallax of $0''.056$ for stars of the second magnitude. But he pertinently asks what can be understood by an average of distances (as indicated by parallaxes) in cases where the separate elements vary from actual zero to half a second, and where moreover many of the brighter members are the furthest removed from us? Notwithstanding these exceptional cases, which challenge attention, the fact remains, and it is apparently the only conclusion which can be drawn with any certainty, that the stars of the first magnitude are on the whole nearer to us than those of the second, and that these again are as a whole nearer to us than the faint stars with which they have been compared. With conclusions of this sort it would seem that astronomers will have to content themselves for some time to come.

The second question which Dr. Gill suggested or formulated was—What connection does there exist between the parallax of a star and the amount and direction of its proper motion?—or can it be proved that there is no such connection or relation? The answer given to this second query is even less satisfactory than to the former. Prof. Pritchard contents himself by exhibiting in a tabular form the parallax and the proper motion of all stars that have been successfully handled, and the only conclusion drawn or warranted, is a suggestion that there is at least quite as close a connection between the apparent proper motion of a star and its distance from us, as there is between its distance and its magnitude.

If we examine or attempt to trace any connection between the mass, the brilliancy and the distance of a star, we are baffled by the same kind of uncertainty, arising in some measure from the paucity of instances in which it is possible to make the inquiry, and we are reluctantly forced to admit that such investigations are premature. At least that would be the conclusion of an ordinary mind, but here it is that Prof. Pritchard sees his opportunity for future efforts and renewed vigour. With an energy that must be the admiration of his friends, he selects for further investigation two subjects, either of which might fully occupy the time and the hands of a younger man. He proposes in the first place to determine the parallaxes of several stars of the Pleiades, a few of the brighter as well as a few of the fainter, with the view of discovering whether the faint and the bright are indiscriminately mixed at that distance. The second subject of his proposed inquiry is not less interesting. It consists in the investigation of the distances of some of the binary systems from our sun; and from a more complete knowledge of the masses, the mutual distances, and the parallaxes of these systems, Prof. Pritchard thinks it not unlikely that many interesting and possibly unexpected associations may reasonably be anticipated, thereby affording us some further insight into the constitution and the mechanism of the Stellar Universe. We can only hope that Prof. Pritchard's health and strength may be spared to witness the completion of this programme, but in that case we are assured he would immediately sketch out for himself some new field of inquiry, and court even longer and more protracted labour.

CONTRIBUTIONS TO THE STUDY OF DISINFECTION.[1]

PROFESSOR J. MASCHEK, whose name is already familiar to us through his investigations on water bacteria, has brought together in pamphlet-form a large

[1] "Beiträge zur Theorie und Praxis der Desinfection, von Prof. J. Maschek." Im Selbstverlage des Verfassers, Leitmeritz.

number of experiments on the relative value of various disinfectants and disinfectant processes. Since the introduction of Koch's methods, the study of the subject of disinfection has been immensely assisted, and it is now possible to take a more accurate measure of the extent to which micro-organisms are affected by different treatment, whether chemical or mechanical. The stimulus which it has thus received has not unnaturally drawn a large number of workers into this particular field of inquiry, and the literature is already very unwieldy.

One of the principal difficulties which surround the study of micro-organisms is their individuality, their apparent idiosyncrasies, and this is not confined to closely allied varieties, but is found amongst members of one and the same species. Thus, the previous history of a micro-organism, the nature of the culture material used, the temperature at which the cultivation has been kept, the age of the growth, &c., are all points which have to be taken into consideration as likely to influence the behaviour of the particular specimen under observation. This sensitiveness of bacteria may possibly to some extent account for the discrepant results which have been obtained by different investigators, although working in similar directions, which has rendered the accurate appreciation of the value of these results a by no means easy task. Again, what succeeds in a laboratory is not necessarily equally successful when carried out on a large scale, and it is this difficulty which has so frequently led to such disappointing results in actual practice.

Prof. Maschek has endeavoured by a series of most arduous and painstaking experiments to throw a little more light on some of the problems of disinfection, and in gathering up his work has wisely abstained from attempting an exhaustive survey of the general literature, restricting himself to a brief introduction and particular reference to those investigations with which he has been more closely concerned. In the majority of the experiments the author employed Koch's well-known method of sterilized silk threads, each of which was subsequently impregnated with pure cultivations of a number of different pathogenic micro-organisms. These were distributed in various parts of a room about 19-ft. long, 13-ft. wide, and 15½-ft. high, on the ceiling, walls, corners, floor, &c., whilst in some cases they were wrapped up in different materials, such as filter-paper, muslin, linen, in order to imitate as nearly as possible the actual conditions under which the organisms might be supposed to be present in an infected room. In each case, after the application of the disinfectants under observation, these silk threads were submitted to plate-cultivation, and in some instances their pathogenic properties were also tested by inoculation into animals.

The first elaborate series of experiments was made with the vapour of corrosive sublimate, which some authorities have recommended as an effective germicidal agent; but quite apart from the difficulty of getting rid of the poisonous crystals of corrosive sublimate which remained attached to various parts of the room, Prof. Maschek was not able to obtain satisfactory results, although every precaution was taken to ensure success. In this respect his experiments differ from those of König, who confidently recommended its use for disinfection purposes. The effect of chlorine gas was next tested and applied both in the dry and damp state. The results were, however, far from encouraging, for even when employed in the damp state the spores were not destroyed. In connection with these experiments a very instructive instance is given of the signal failure which accompanied the use of chlorine in the Alexander Hospital in St. Petersburg, which was designed for receiving different infectious illnesses. Suspicion as to its efficacy was first aroused after its use in the disinfection of a ward in which diphtheria patients had been treated. This ward was afterwards used for scarlet fever cases, and subsequently complications with diphtheria made their appearance, in consequence of which the ward was closed and disinfected with chlorine. (A ward of 900 cubic metres capacity being subjected to the chlorine gas evolved in treating 50 kilos. of chloride of lime with 65 kilos. of hydrochloric acid.) After the disinfection was completed, the ward was thoroughly cleansed and ventilated, and allowed to remain empty for seven months. On its being re-opened for the reception of measles cases complications with diphtheria again arose, although the patients when taken into the ward were wholly free from diphtheria. The measles patients were therefore removed, and the ward was again disinfected with chlorine, only this time a much larger quantity was employed (135 kilos. of chloride of lime with 148·5 kilos. of hydrochloric acid) after which it stood empty for another seven months. Later on cases of smallpox were received into this ward, but diphtheria again appeared, the physician, two nurses, and an attendant being amongst those attacked, whilst complications with diphtheria again occurred amongst the patients. In consequence of this the unfortunate ward was once more closed and thoroughly disinfected with chlorine, and was reopened for typhoid fever patients; but all children's cases were rigorously excluded, in consequence of their particular susceptibility to diphtheria. After the adoption of this special precaution no further attacks of diphtheria were met with. It might, however, be urged that as regards the infection of patients suffering from measles with diphtheria, the disease was possibly introduced from outside, and did not necessarily arise in the ward itself, were it not for the fact that there were three other wards in the hospital in which cases of measles were being treated at the same time, and no single attack of diphtheria occurred. Krupin, who is the authority for these facts, confirming the valuelessness of chlorine for disinfecting purposes, found that the spores of anthrax were not destroyed in a hospital ward after being exposed to the action of this gas for more than 40 hours.

A large number of experiments were made with a view to determining the number of micro-organisms present on the walls of a room. For this purpose a small sterilized bit of sponge cut in the shape of a cube (of about half-inch side) was used to rub down a measured portion (about 4 square inches) of the wall. The sponge was afterwards placed in a tube containing sterile melted gelatine and rotated gently, so as to disengage all the organisms on its surface. The gelatine was then allowed to congeal on the sides of the tube, and after suitable incubation the colonies made their appearance, and were estimated in due course. It was found that the numbers present on the walls and ceiling respectively varied considerably. Near the floor the number was much greater than on the middle of the wall, whilst here again they were more abundant than on the ceiling. For example, on one of the walls, at a distance of rather more than an inch from the ground, as many as 2,871 microbes were found, whilst on the ceiling over a similar area only 85 were discovered. It was also noticed that those portions of the wall or ceiling which were exposed to currents of air from either the window or door exhibited generally a smaller number of bacteria than did places which were shielded from such draughts. Prof. Maschek further found that one rubbing was wholly insufficient to remove all the organisms from a given surface, and it was only after the process had been repeated five times that all bacterial life could be banished with certainty. Although the figures thus obtained are of interest by way of comparison, yet it is difficult to believe that they represent the *actual* numbers present. The accuracy of this method, originally devised by Esmarch, rests on the assumption that on placing the sponge in the tube of melted gelatine and rotating it gently (for if this were done violently the gelatine would froth, and the surface become covered with small bubbles, which would greatly interfere later with the counting of the colonies) all the organisms attached to the surface of the sponge would be removed. Now the sponge being left in the tube must necessarily obscure part of the gelatine surface; moreover, the interstices becoming soaked with gelatine, colonies would certainly develop within the sponge itself and escape detection, whilst it is quite inconceivable that gentle rotation would suffice to detach even all those organisms which are adherent even to the surface of the sponge.

Wall surfaces deprived of micro-organisms in the manner described above were subsequently sprayed with distilled water infected with different pathogenic bacteria, and after sufficient time had elapsed for these surfaces to dry, the effect of various disinfectants was tried. Numerous investigations are also recorded of the use of creolin, carbolic acid, and mixtures of the latter with solutions of corrosive sublimate. The effect of exposure to high temperatures, in apparatus specially constructed for the purpose, has also been tried, whilst the disinfection of sewage matters with lime is also carefully considered, and a large number of experiments recorded with the typhoid and cholera organisms.

The following interesting account is given as an illustration of the success which can be achieved in disinfection on a large scale. An epidemic of diphtheria broke out in a small village in Germany and proved particularly fatal amongst the children, indeed so alarming was its progress, that the Burgomaster was led to suggest the disinfection of the whole village. A public meeting was held and the inhabitants were instructed as to the nature of the epidemic, and the possibility of checking it by the combined action of every household. Public funds were devoted to the purchase and distribution of the requisite disinfectants, and during three days the whole place is described as smelling of carbolic, whilst in all directions windows and doors were to be seen wide open, a very unusual sight in the country, and more especially in the month of February when this occurred. The work of disinfection was carried on most systematically, every article which could not be either washed or baked was treated with a 5 per cent. solution of carbolic acid. In short, no efforts were spared to thoroughly disinfect everything, and the result was that although the epidemic before the commencement of this disinfecting crusade was steadily gaining ground, it suddenly stopped. This must be considered as a tribute to the sagacity and energy of the inhabitants; for, as Prof. Maschek points out, experience teaches us to expect a gradual decline, due to the possible weakening of the virus, so that towards the end of an epidemic the number of bad cases is lessened and recoveries are more frequent.

In conclusion the words of M. Duclaux may be appropriately quoted: "Les études sur les antiseptiques n'ont gagné que de s'encombrer de résultats qui se contredisent les uns les autres, et entre lesquels on ne peut faire un choix, précisément parcequ'ils ont été souvent obtenus en dehors des conditions d'une étude précise. Il faut donc abandonner cette méthode, scruter avec de plus en plus de soin la phénomène, faire de la science, en un mot." This "*faire de la science*" is precisely the spirit in which Prof. Maschek has carried out his experiments; the immense care with which they have been conducted, the ungrudging labour bestowed upon them should render his results a most valuable contribution to the subject of disinfection. It is only to be regretted that they are not published in a form in which they would be more likely to become known and appreciated.

GRACE C. FRANKLAND.

AN ETHNOGRAPHICAL SURVEY OF THE UNITED KINGDOM.

A CIRCULAR letter, which we have been asked to print, has just been issued on behalf of the Committee appointed by the British Association to organize an ethnographical survey of the United Kingdom. The Committee consists of Francis Galton, F.R.S., J. G. Garson, M.D., and E. W. Brabrook, F.S.A., representing the Anthropological Institute; Edward Clodd, G. L. Gomme, F.S.A., and Joseph Jacobs, M.A., representing the Folk-lore Society; H. S. Milman, Director S.A., George Payne, F.S.A., and General Pitt-Rivers, F.R.S., representing the Society of Antiquaries of London; Joseph Anderson, LL.D., Secretary of the Society of Antiquaries of Scotland; and A. C. Haddon, M.A., Professor of Zoology at the Royal College of Science of Dublin. The following is the circular letter:—

SIR,—The above-named Committee, in pursuance of the object for which they have been delegated by the Society of Antiquaries of London, the Folk-lore Society, and the Anthropological Institute, and appointed by the British Association, propose to record for certain typical villages and the neighbouring districts—

(1) Physical Types of the Inhabitants.
(2) Current Traditions and Beliefs.
(3) Peculiarities of Dialect.
(4) Monuments and other Remains of Ancient Culture; and
(5) Historical Evidence as to Continuity of Race.

As a first step, the Committee desire to form a list of such villages in the United Kingdom as appear especially to deserve ethnographic study, out of which a selection might afterwards be made for the Survey. The villages suitable for entry on the list are such as contain not less than a hundred adults, the large majority of whose forefathers have lived there so far back as can be traced, and of whom the desired physical measurements, with photographs, might be obtained.

It is believed by the Committee that such villages may exist in the districts with which you are acquainted, and, as you are eminently capable of affording help in this preliminary search, we have to request that you will do so by kindly furnishing the names of any that may occur to you, with a brief account of their several characteristics; mentioning at the same time the addresses of such of their residents as would be likely to support the Committee in pursuing their inquiry.

They would also be glad to be favoured with the names of any persons known to you in other districts to whom this circular letter might with propriety be addressed.

We are, Sir,
Yours faithfully,
FRANCIS GALTON, *Chairman*.
E. W. BRABROOK, *Secretary*.

All communications should be addressed to "The Secretary of the Ethnographic Survey, British Association, Burlington House, London, W."

NOTES.

THE Board of Trinity College, Dublin, on October 22 elected Dr. Arthur A. Rambaut, M.A., Royal Astronomer of Ireland, on the foundation of Dr. Francis Andrews. The election was made under the provisions of Letter Patent 32 George III., dated in 1792. The new Professor of Astronomy in the University of Dublin, graduated in 1881 as a Senior Moderator and Gold Medallist in Mathematics, since which period he has acted until now as Assistant at the Observatory at Dunsink

He is the author of several astronomical papers published in the Transactions of the Royal Irish Academy and of the Royal Dublin Society.

IT is proposed that a portrait medal of M. Hermite, the eminent mathematician, shall be struck in commemoration of his approaching seventieth birthday. The circular asking for subscriptions is signed by a number of well-known mathematicians.

THE following nominations have been made for the Council of the London Mathematical Society for the session 1892-3. The ballot will be taken on November 10. For President, A. B. Kempe, F.R.S.; Vice-Presidents, A. B. Basset, F.R.S., E. B. Elliott, F.R.S., Prof. Greenhill, F.R.S.; Treasurer, Dr. J. Larmor; Hon. Secs., Messrs. M. Jenkins and R. Tucker; other members, Mr. H. F. Baker, Dr. Forsyth, F.R.S., Dr. Glaisher, F.R.S., Mr. J. Hammond, Prof. M. J. M. Hill, Dr. Hobson, Mr. A. E. H. Love, Major Macmahon, F.R.S., and Mr. J. J. Walker, F.R.S. After the election of the Council Prof. Greenhill will read his Presidential Address.

IN consequence of the alterations in the rooms of the Chemical Society, the first ordinary meeting of the Society will be held on Thursday, November 17, at 8 p.m.

THE late Dr. C. A. Dohrn left his magnificent entomological collections, with the library connected with them, in trust to his son, Dr. H. Dohrn, who was directed to use them as the nucleus for the formation of a natural history museum in Stettin. Dr. H. Dohrn has now not only carried out his father's wishes, but has presented to his native town his own conchological collections and library.

THE Geologists' Association will hold a conversazione on Friday, November 4, in the Library of University College, Gower Street. Among the exhibits will be a series of photographs of the recent eruption of Mount Etna. These will be shown by Mr. F. W. Rudler.

MR. M. C. POTTER has been appointed to the Chair of Botany at the College of Science, Newcastle-on-Tyne.

THE annual meeting and conversazione of the Postal Microscopical Society took place at the Holborn Restaurant on the 20th inst. There was a good attendance, and many microscopical specimens were displayed. An address on polarized light was delivered by Mr. G. H. Bryan, the president.

THE following lectures will be given at the Royal Victoria Hall on Tuesday evenings during the coming month:—Nov. 1, Prof. A. H. Green, "Coal, what it is and how it was made;" Nov. 8, W. D. Halliburton, M.D., F.R.S., "The history of some famous epidemics;" Nov. 15, Hermann H. Hoffert, D.Sc., "Electric sparks and lightning flashes;" Nov. 22, Prof. Hall Griffin, "Among the hills of Asolo: an illustrated account of the poem 'Pippa Passes.'"

NATURALISTS who visit the Zoological Society's Gardens should not fail to go to the Insect House and see the Pratincole, which has lately been received, and is kept in a cage in this building. So far as we know, it is the first example of this curious form of plover that has ever been seen in captivity. The specimen in question does not, however, belong to the Pratincole of the south of Europe (*Glareola torquata*), which has sometimes occurred in this country, but to an allied African species—the Madagascar Pratincole (*Glareola ocularis*). The bird was obtained near Mombasa, in Eastern Africa, and presented to the society by Mr. R. MacAllister. It was carefully brought home, along with many other interesting specimens, from Zanzibar and the adjoining mainland by Mr. Frank Finn, F.Z.S., on his return from his recent expedition to that country.

A CORRESPONDENT from Tangier writes that during the recent mission to Fez of Sir Euan Smith, Mr. Walter H. Harris and Mr. Carleton, the interpreter, were informed by a cherif from Tafilelt, cousin of the Sultan, and Governor over an extensive district, that there is no question as to the existence of dwarf tribes down the Dra, where they are very numerous. Sir Euan Smith was told of this statement, and probably had a talk with him. Mr. Harris intended to have taken a trip down the Dra to Akka, but was convinced from what he heard that such a trip would be an act of suicide. He however believes that he can get full information as to the dwarfs, and perhaps photographs, without going so far, and he has just left for a trip to the interior for two months. Herr E. G. Dönnenberg, who has been for some years engaged in pushing German trade in Marocco, and every year visits the principal cities, says that a year ago he saw in Marocco city from half a dozen to a dozen dwarfs, one of whom was accompanied by a dwarf wife. They were about 4 ft. high, and robust and well made, and were certainly not Moors who had been dwarfed by rickets, as they differed from the ordinary population of Marocco in appearance. Herr Dönnenberg's address is Tangier, and he states that he is ready to answer any queries that may be sent to him, but that he cannot add anything to what is here stated, as he did not ask any questions as to the dwarfs, not knowing that they were of interest. He goes to Marocco city before long, and will make it a point to find out all he can respecting them.

DURING the latter part of last week a depression lay over the North Sea, which spread both in size and intensity, causing strong northerly winds all over this country, with heavy gales and snowfall in Scotland and the east of England, while in the southern districts the weather was fine and bright. The temperature was unusually low for the time of year, the mean temperature having in fact been considerably below the average on each day since the beginning of the month. The daily maxima have varied from 40° in the north to 52° in the south, with sharp frosts at night. On Sunday night the grass thermometer in London fell to 20°, while 25° in the shade were registered the next night in the north and west. During the early part of the present week, the area of high pressure in the west gave place to a depression, which arrived from off the Atlantic, causing cold easterly winds in the south with very heavy rains in the south-west of England; the weather over Scotland improved, although some snow showers continued to fall on the east coast. The *Weekly Weather Report*, issued on the 22nd instant, showed that the temperature of that week was much below the mean, the deficit ranging from 5° to 7°. Rainfall exceeded the mean in the east and north-east of England, but in all other districts there was a deficit. In the south-west of England there was still a deficit of about eight inches since the beginning of the year.

WE recently drew attention to a new meteorological journal published in Paris; we now note the appearance of a similar publication at Vilafranca del Panadés, in Spain. It is published on the 15th of each month, and contains a series of short elementary articles and notes, occupying only twelve small octavo pages. We hardly expect it to find many readers in this country, but hope it may awaken more interest in the subject in Spain, where practical meteorology is not at present on the same level as in other European countries.

THE Director of the Lyons Observatory, M. C. André, has published, under the title, "Relations des Phénomènes Météorologiques déduites de leurs Variations Diurnes et Annuelles," the results of the meteorological observations taken there for ten years ending 1890. The text and plates together occupy one hundred and sixty-eight large octavo pages, and, this volume will be found to be full of interest and instruction, to any one wishing either to take observations or to work up the results. The title is well chosen, for the work treats of the relations which connect the different phenomena; it also gives all necessary precautions for ensuring the accuracy of the observations. Particular attention is paid to the important subject of diurnal and annual variations of the different elements, and to the various points to be noted, while the different theories of atmospherical electricity are explained at considerable length.

A BEAUTIFUL and instructive lecture experiment, illustrative of the conditions of the heated atmosphere which give rise to the mirage, is described by MM. J. Macé de Lépinay and A. Perot, in their "Etude du Mirage," which appears in the *Annales de Chimie et de Physique*. Water is poured into a long rectangular trough with glass slides, and covered with a layer of alcohol about 2 cm. thick, containing a trace of fluorescene. After a few hours, during which the alcohol diffuses slowly through the water, a flat beam of light is sent through the mixture at a very slight inclination to the horizon. Under these conditions a kind of garland of light is seen to traverse the liquid, due to a series of curvilinear deflections or "mirages" in the less highly refractive water below and total reflections at the upper surface of the alcohol.

PROF. W. CROOKES and Prof. W. Odling, in their report on the London Water Supply for the month of September, are able to give an excellent account of the 182 samples which they analyzed. All were found to be perfectly clear, bright, and well filtered. In respect to the smallness of the proportion of organic matter present, the character of the water furnished by the seven companies continued to be entirely satisfactory, the mean amount of organic carbon in the Thames-derived supply, for example, being ·118 part, and the maximum amount in any single sample examined being but ·145 part, in 100,000 parts of the water—numbers practically identical with those of the previous month, or ·115 part for the mean, and 1·52 part for the maximum, amount. The average of the past six months, in the case of the Thames-derived supply, has amounted only to ·116 part of organic carbon in 100,000 parts of the water, with a maximum, twice met with, of ·152 part in any individual sample. The authors of the report do not expect that with the coming on of autumn and winter this low average will be much longer sustained. They note that the water supply to London is habitually at its best during the hot season, when a high quality of the supply is more especially called for.

AN interesting report on the Congress of the Library Association of Great Britain, held at Paris last month, was read on Tuesday before the Salford Royal Museum and Free Libraries' Committee. It was prepared by Mr. Alderman W. H. Bailey, who had naturally a good deal to say about the Paris Free Libraries. The governing bodies of almost all these institutions consider that there are many reasons why the libraries should be closed in the daytime when respectable artizans are engaged in earning their living. Books are therefore given out for two hours every evening of week days, generally from eight to ten o'clock, and also for two hours every Sunday morning. Mr. Bailey and the other members of the Congress were delighted with the Paris Libraries of Industrial Art, to which they devoted much attention. These Libraries—which, like the Free Libraries, are under municipal control—are in the artizan districts of Paris. Books, patterns, prints, drawings, and photographs are lent out. "Not only do house decorators," says Mr. Bailey, "find designs and books relating to work, but fan painters, porcelain modellers, designers of iron and bronze gates, medieval metal workers, cabinet makers, builders, and all workers in the constructive as well as the decorative arts may here find stimulus and draw inspiration from the wealth of examples on the shelves and walls." Free lectures are delivered in the winter on industrial art and science, and on the designs, books, and models in the Libraries.

VARIOUS experiments which are being made in France with a view to the improvement of the potato have attracted a good deal of attention in Australia. According to a statement recorded in the *Agricultural Gazette of New South Wales*, no fewer than 110 growers have obtained from a variety known as "Richter's Imperator," from twelve to twenty tons per acre, while the average is over fourteen tons to the acre. The Minister of Agriculture in New South Wales has approved of one hundredweight each of this and any other three sorts highly reputed in France being imported for experimental purposes.

AT a recent meeting of a society of French agriculturists, it was stated by Baron Bertrand-Geslin, that ten or twelve years ago a disease appeared among the chestnut trees in central and north-western France, and destroyed them in great numbers. The wood, moreover, could not be utilized for heating purposes. At this juncture an enterprising person appeared, who bought up large quantities of this dead wood and sent it by canal to Nantes, where he had works established for utilizing it in the tanning of leather. Chestnut wood contains, in fact, 5 to 6 per cent. of tannic principles, whereas oak contains only 3 or 4. By the means adopted in these works the principles are concentrated in a sirupy liquid of great strength. This establishment has become very important; it absorbs annually thirty to thirty-five million kilogrammes of wood of these dead chestnuts from three departments traversed by the canal from Nantes to Brest, and expends about 120,000 francs per annum, a considerable reduction of the loss sustained by the landowners. It was mentioned, however, by M. Paul Becquerel, in reply to a question as to competition of the new extracts with bark, that those extracts, which are products allied to tan, do not give the same results, or leather of such good quality, and many tanners who have used them have returned to the old methods of tanning.

DR. R. MUNRO contributed to the *Times* of Monday a long and most interesting account of the recent discovery of an ancient lake-village in Somersetshire. The site is about a mile north of Glastonbury. Before excavations were begun, there were sixty or seventy low mounds, rising from one to two feet above the surrounding soil and measuring from twenty to thirty feet across. That the mounds were of archæological interest was first suspected by Mr. Arthur Bulleid, who began to excavate some of them during the present summer, and was soon rewarded by making striking discoveries. Woodwork corresponding to that of the crannogs of Scotland and Ireland has been exposed, and among the objects which have been recovered are some of bronze, a few of iron, and various specimens of pottery. Mr. Bulleid has also dug out "a splendid canoe neatly formed out of the trunk of a tree." This was found about a quarter of a mile from the settlement. It would seem that the inhabitants, after a period of long occupancy, indicated by a succession of superimposed hearths, were flooded out of their homes, for an accumulation of flood soil now covers the whole meadow to the extent of 12 inches to 18 inches in depth. The surrounding district is richly cultivated, but, in looking over an old map of the date of 1668, Dr. Munro found that it contained a lake called the "Meare Poole," into which three streams debouched, and from which the site of the present discovery could not be far distant. He suggests that this lake had larger dimensions in earlier times, and that when the settlement was founded the locality was a shallow lake or marsh. The old map represents the district lying immediately on the north-west borders of the "Meare Poole" as inhabited by the Belgæ. Dr. Munro is strongly inclined to think that the settlement belongs to the so-called Late Celtic period. This he would simply call the Celtic period, for there is no evidence, he believes, of earlier Celtic remains in Britain than those known as Late Celtic. "The style of art," he says, "which controlled the manufacture of Late Celtic objects involves such an enormous advance in metallurgical skill over that of the Bronze Age, that it is impossible to suppose the two are connected by any evolutionary stages in this country. From the standpoint of archæological research this interval, or rather *hiatus*, can only be bridged over by the supposition that the people who owned Late Celtic remains were newcomers and conquerors in Britain." Much light will no doubt be thrown on the question by the further exploration of these remarkable mounds.

A LIVELY correspondence on the subject of birds *versus* insects has been going on in the Malta papers. According to the *Mediterranean Naturalist*, the enormous increase of insectiferous pests during the last few years has caused the agricultural industries to decline to an alarming extent, and it is urged that the evil has now increased so much as to call for legislation. In the Maltese Islands there are no laws for the protection of birds, and, the lower classes of the Maltese being keen sportsmen, no opportunities are allowed to either the migratory or the indigenous species of increasing.

IT was observed by Prof. Voit that when dogs were fed exclusively on bread they daily lost albumen, though not weight; the body becoming more watery and the hæmoglobin of the blood diminishing. This matter has been recently further investigated in his laboratory by Herr Tsuboi. Of three rabbits, one was fed with milk, rolls, and some hay; another with much hay; the third with potatoes. The last had more water in muscles and blood, and less hæmoglobin than the first. In another experiment (with like results) one of two cats was fed with meal and fat, another with bread and some meat extract. Again, three rabbits were fed with potatoes, the first with iron added, the second with serum, the third with blood. The last was found to have most solid matters in muscles and blood, and most hæmoglobin. It is not (the author points out) the amount of food by itself alone that determines the result, otherwise, in the fasting state, the hæmoglobin would be least, whereas it is the same as with good feeding. It is rather the insufficient composition of the food, the too small amount of albumen, with excess of starch-flour that has the injurious effect.

THE phosphoroscope of Becquerel is a well-known instrument, enabling one to observe the phosphorescence of some substance when the exciting light is gone. It is designed to be used with sunlight. M. Lenard has devised an instrument (*La Nature*) for use with the electric spark. To the armature of a Foucault interrupter in an induction coil, is attached a light wooden rod, having at its end a piece of blackened pasteboard, which is thus driven up and down before a spark-interval between two brass knobs connected with the coil and a condenser (added to intensify the spark). The body to be examined is placed close behind the interval, so that it is uncovered very quickly after the spark passes. Some curious phenomena are observed. The short duration of the spark makes the screen seem at rest, and some thousandths of a second after one sees a luminous body behind where it was; so that at first sight one might think the screen opaque to the spark, but transparent for the phosphorescent light, an illusion due to the persistence of luminous impressions. Some bodies, such as various carbonates of lime, behave very much alike in this apparatus and in Becquerel's; some are favoured in the latter, and on the other hand, crystals of arragonite, which are invisible after solar illumination, give a faint reddish light after the spark. Various experiments are described. The most curious results are furnished by the remarkable substance, asaron. In a Crookes tube this gives a bright light, it gives also a distinct glow in the ultraviolet spectrum of the spark; but in the phosphoroscope it is absolutely dark. The vibratory movement ceases immediately with the excitation.

THE new number of the *Internationales Archiv für Ethnographie* (Band v., Heft 4) consists mainly of the first part of what promises to be an elaborate paper (in German) on the inhabitants of the Nicobar Islands, by Dr. W. Svoboda. In October, 1886, while the German corvette, *Aurora*, lay in the harbour of Nangcauri, Dr. Svoboda had many opportunities of seeing the natives, and Mr. E. H. Man gave him facilities for the thorough study of a splendid collection of ethnographical objects from various parts of the group. Afterwards he extended his knowledge of the subject by reading books which dealt with it, and by visiting the ethnographical museums of Berlin and Vienna. The results he is now bringing together, and those of them embodied in the present contribution show that he is not only a good observer but that he knows how to state facts clearly and concisely. The paper is illustrated with coloured plates and woodcuts.

THE British Institute of Public Health has now an official quarterly journal, called *The Journal of State Medicine*. It is published by Charles Griffin and Co. The second number has appeared, and contains original papers on the following subjects:—lead in articles of food, by Prof. William R. Smith; points in the ætiology of typhoid fever, by Edmond J. McWeeney; chemical bacteriology of sewage, by W. E. Adeney; and new method of sewage purification, by W. Kaye Parry.

A NEW and revised edition of the late Prof. Moseley's well-known "Notes by a Naturalist on H.M.S. *Challenger*," has been issued by Mr. John Murray. It includes an excellent portrait, which vividly reminds us of the great loss inflicted on science by his premature death.

MESSRS. WHITTAKER AND CO. have published the first part of a work entitled "Dissections Illustrated: A Graphic Handbook for Students of Human Anatomy," by C. Gordon Brodie. The plates are drawn and lithographed by Percy Highley. The work will be completed in four parts. The present part deals with the upper limb, and includes seventeen coloured plates.

A SECOND edition of "A Short Manual of Inorganic Chemistry," by Dr. A. Dupré and Dr. H. W. Hake (Charles Griffin and Co.), has been issued. The authors have endeavoured to bring the statement of facts up to date without increasing the bulk of the work, and to remove those errors to which their attention has been drawn.

A RE-DETERMINATION of the mechanical equivalent of heat has been made by M. C. Miculescu at the Sorbonne. An account of the method appears in the *Annales de Chimie et de Physique* for October. The method was that of water friction at constant temperature. The liquid was enclosed in a cylindrical vessel with three envelopes. Water was kept circulating round the innermost one at such a rate that the difference of temperature of the water at entrance and exit was constant as measured by a thermopile. The heat thus derived from the water inside could be estimated by the quantity of water passed through. The water inside was stirred by vanes mounted on an axial shaft kept rotating by a gramme machine of 1 horse-power running at 1200 revolutions per minute. The expenditure of work was measured by making the whole apparatus its own dynamometer. It was suspended so as to turn round the common axis of the stirrer and the motor. The resistance met with by the former tended to turn the apparatus in the direction of revolution of the latter. It was kept stationary by a weight attached to an arm exerting a measurable couple. The mean of 31 values ranging from 426·21 to 427·12 was 426·70 in kilogram-metres per calorie, or $4 \cdot 1857 \times 10^7$ ergs. For the normal scale of the hydrogen thermometer this would be 426·84.

A NEW and very convenient method of preparing acetylene gas is described by M. Maquenne in the current number of the *Comptes Rendus*. A short time ago the same chemist succeeded in preparing a comparatively stable compound of carbon with the metal barium, BaC_2, by heating powdered retort-charcoal with barium amalgam in a current of hydrogen. Upon bringing this compound in contact with water a violent action was found to occur with evolution of almost pure acetylene gas. On account, however, of the troublesome nature of the operations of procuring barium amalgam and preparing from it the new compound, together with the very small quantities of the latter eventually obtained, this mode of preparing acetylene was only of theoretical interest, and not suitable as a laboratory method of preparation. M. Maquenne now describes a new process for preparing barium carbide, by means of which large quantities may very readily be procured in a few minutes, and from which correspondingly large volumes of acetylene may be derived. The principle of the method consists in reducing barium carbonate by metallic magnesium in presence of carbon. An intimate mixture is first made of barium carbonate prepared by precipitation, powdered metallic magnesium, and calcined retort-carbon. Convenient amounts are twenty-six grams of barium carbonate, ten and a half grams of magnesium, and four grams of charcoal. This mixture is then introduced into an iron bottle of about seven hundred cubic centimetres capacity, furnished with a tube, also of iron, thirty centimetres long and two centimetres internal diameter. The iron bottle is then heated in a gas furnace which has previously been raised to a red heat. At the expiration of about four minutes an energetic reaction occurs, accompanied by the projection of brilliant sparks from the mouth of the tube. The apparatus should then at once be removed from the furnace, the end of the tube stopped, and the bottle and contents rapidly cooled by the external application of cold water. The product may then be extracted, when it is found to consist of a mixture of magnesia with 38 per cent. of carbide of barium, a little excess of carbon, and a trace of cyanide formed at the expense of the atmospheric nitrogen. The reaction accords very closely with the equation :—

$$BaCO_3 + 3Mg + C = BaC_2 + 3MgO.$$

Carbide of barium may be preserved for an indefinite time in a dry atmosphere. It is a grey, porous, and very friable substance. When heated to redness in the air it burns with a vivid incandescence. It is also capable of combustion in chlorine, hydrochloric acid gas, and vapour of sulphur. In order to prepare acetylene from it the powder is most conveniently placed in a small flask fitted with a doubly-bored caoutchouc stopper, carrying a dropping funnel containing water, and a delivery tube. The moment water is allowed to drop the equivalent quantity of acetylene gas is evolved in accordance with the equation :—

$$BaC_2 + 2H_2O = Ba(OH)_2 + C_2H_2.$$

The delivery of the acetylene may be regulated with great nicety by suitable adjustment of the stopcock of the dropping funnel. The acetylene thus prepared possesses the further advantage of being remarkably pure, containing 98 per cent. of C_2H_2. It is interesting to learn that by allowing a stream of this pure acetylene to pass through a long heated glass tube for a few hours several grams of synthetical benzene have been accumulated by M. Maquenne.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♀) from India, presented by Mr. W. F. Faulding; a Buffon's Touracou (*Corythaix buffoni*) from West Africa, presented by Mr. A. L. Jones; two Double-banded Sand Grouse (*Pterocles bicinctus* ♂ ♀) from Senegal, presented by Mr. H. H. Sharland, F.Z.S.; a Gannet (*Sula bassana*), British, presented by Dr. Davis; a Roseate Cockatoo (*Cacatua roseicapilla*), a King Parrakeet (*Aprosmictus scapulatus* ♀) from Australia, presented by Mrs. Addiscott; four Alligators (*Alligator mississippiensis*) from the Mississippi, presented by Mr. John Terry; two Thick-billed Seed-eaters (*Oryzoborus crassirostris*), a Tropical Seed Finch (*Oryzoborus torridus*), a Saffron Finch (*Scyzalis flaveola*), a Bluish Finch (*Spermophila cærulescens*) from South America, a Puff Adder (*Vipera arietans*) from West Africa, deposited.

OUR ASTRONOMICAL COLUMN.

COMET BARNARD (OCTOBER 12).—An *Astronomische Nachrichten* circular note gives the following elements and ephemeris, computed from observations made on the 16th, 17th, and 18th of this month :—

Elements.

T = 1892 Nov. 12·745 Berlin M.T.

$$\omega = 168°\ 49'$$
$$\Omega = 220\ 50$$
$$i = 21\ 39$$
$$\log. q = 0{\cdot}03669$$

Ephemeris Berlin Midnight.

1892.	R.A. h. m.	Decl. ° ′	Log Δ.	Br.
Oct. 25	20 6·6	+7 47		
27	13·5	6 51	9·6825	1·46
29	21·5	5 52		
31	29·8	4 51	9·6609	1·66
Nov. 2	38·7	3 47		
4	48·2	2 40	9·6377	1·87
6	20 58·3	1 29		

As the brightness at the time of discovery is taken as unity, it will be noticed that the comet is quickly gaining in intensity, the value for November 8 being 2·08 Br. Its position on the 31st lies in the southernmost part of the constellation of the Dolphin, forming very nearly an equilateral triangle with α Aquilæ and β Delphini.

DISCOVERY OF THREE NEW PLANETS BY PHOTOGRAPHY.—M. Perrotin has communicated to the French Academy an account of the discovery of three small planets by M. Charlois, of the Nice Observatory, by the aid of photography. The apparatus employed consisted of an Hermagis portrait lens of 15 cm. aperture and 80 cm. focal length, mounted provisionally on M. Loewy's *equatorial coudé*. The instrument was being employed for the photography of the region of the ecliptic. With exposures ranging from two hours and a half to three hours, the eight negatives obtained since September 12 cover a region 80° long and 10° broad, and show all the stars visible through the 38 cm. refractor. A careful examination of the plates reveals the presence of three unknown and eight known planets. The former, now known under the names 1892, D, E, and F, are all of about the twelfth magnitude.

RUTHERFURD MEASURES OF STARS ABOUT β CYGNI.—Mr. Harold Jacoby, in No. 4 of the *Contributions from the Observatory of Columbia College, New York*, presents us with the reduced results of the measures of the plates containing the group of stars surrounding β Cygni. The method of measurement was exactly the same as that employed in the case of the Pleiades plates, but that of reduction has received some slight modification. For instance, the measures of the eastern and western impressions have not been separately dealt with, but their mean has been taken, and the reduction continued, using this mean as a single observation. As the accuracy of these measurements depend on the exactitude of the scale value determinations to a very considerable extent, it is satisfactory to hear that this value has remained materially the same for a very long period. The largest and smallest values recorded in the Pleiades plates were 28″·0167 and 28″·0066, the mean value amounting to 28″·0124, and it is his last-mentioned value that has been used in the above reductions. The probable error of these determinations is then $\pm 0''\cdot00071$, which corresponds to $\pm 0''\cdot025$ per 1000″. But Mr. Jacoby does not think that the average uncertainty of the final places exceeds $0''\cdot15$ on account of scale value. While comparing the Rutherfurd stars with those of Argelander, he found that four stars from the latter were lacking, while they were recorded on the original negatives of the former. Observations made this year showed that three were visible, while the fourth (No. 28), which was quite close to No. 27 on the Rutherfurd negatives, was this year "only a sort of elongation of No. 27." On the other hand, the following of Argelander's stars were absent from the plates:—

B.D.	+ 27·3395	Mag.	8·8
	+ 27·3414	,,	9·0
	+ 27·3417	,,	9·0
and perhaps			
	+ 27·3435	,,	8·5
	+ 28·3343	,,	9·0

A NEW VARIABLE STAR.—In *Astronomische Nachrichten*, No. 3124, Prof. Pickering announces the discovery of a new variable star in Aries by Prof. Schaeberle. The fact of this star being a variable was first noted when, on an examination of two plates taken December 18 and January 24, 1891, it was found that on the former it appeared of the 9·5 magnitude, while on the latter it was absent altogether. Recent visual observations have shown, however, a star of the eleventh magnitude in the exact position of the suspected variable, and this has been confirmed by means of photographs. From photographs of the same region, taken since October 31, 1890, the magnitudes recorded have been 9·6, 10·2, 11·0, less than 11·7, 10·1, 10·0, 10·4, 10·3, and 10·9. The star's position for 1900 is given as

R.A. 3h. 5·5m. Decl. + 14°24′.

JUPITER'S FIFTH SATELLITE.—It hardly ever happens that, after a discovery of any importance has been made, there are not a few "claimants" who wish to annex it as their own. This is the case with Prof. Barnard's discovery of the fifth moon to Jupiter, but the advantage he possesses over these said "claimants" is, we might say, infinite, for it is only with such an instrument as that at the Lick Observatory that this "mite" of a satellite can be observed with success. One of the despatches in which one "claimant's" views were put forth, had the audacity to insinuate that Prof. Barnard was directly inspired to this discovery by information contained in a letter sent to the Observatory. We are glad to see that Prof. Barnard deals with these "claimants" as they deserve, and we hope it may be a lesson to others who wish to assert their priority without good and sufficient reasons for doing so.

As an illustration of the difficulty of observing this satellite, we may mention that Prof. Young, in a letter to Prof. Barnard, says that although he has used a 23-inch Clark, which is an instrument as nearly perfect as can be made, he was not rewarded with success.

THE SPECTRUM OF NOVA AURIGÆ.—Herr E. von Gothard, of the Observatory at Herény, has taken a very successful photograph of the Nova spectrum, the results of which he communicates to *Astronomische Nachrichten*, No. 3122. The instrument used was a 10½-inch reflector with a 10-inch objective prism, and the exposure given amounted to 45 minutes. The spectrum shows six lines, and a comparison with the spectrum of the ring nebula and the Wolf-Rayet stars presented a remarkable concordance, the first failing only in the second Nova line, and the second differing only with regard to the intensity of the individual lines. The following table shows this somewhat more clearly:—

	I.	II.	III.	IV.	V.	VI.	VII.
Nova ...	6	1	10	5	3	4	—
G. C. 4964 ...	8	2	10	6	6	8	—
Ring nebula ...	8	—	5	2	7	6	10

The wave-lengths of the lines are, we are sorry to say, not inserted.

"JUPITER AND HIS SYSTEM" is the title of a small book recently published by Mr. Stanford, and written by Miss E. M. Clarke. The authoress has brought this book out at a time when this planet is receiving most attention, for was it not in opposition, shining with exceeding brightness, on the 12th of this month? One great point about this little monograph is that facts throughout have been strictly adhered to, so that the reader is presented with the true state of the planet as we know it. The information is well up to date, as for example the mention of the new satellite, and the book is written in a popular yet accurate style. One thing that calls for attention is the price (one shilling), which could doubtless have been halved.

GEOGRAPHICAL NOTES.

MR. J. Y. BUCHANAN, F.R.S., is this term delivering a course of lectures on Oceanography in Cambridge University. It is satisfactory to know that the lectures are better attended than has been the case since the foundation of the Geography lectureship, and that the greater number of those present this term are undergraduates.

MR. JOSEPH THOMSON has submitted to the British South Africa Company the report of his journey to the Lake Bangweola region, made last year, which ill-health has prevented him from preparing sooner. He speaks of Northern Zambesia generally as a region of great possibilities. It is a plateau rarely less than 3500 feet high, with a climate in which Europeans should find no difficulty in living for several years at a time. It is well suited for cattle-rearing and for planting, and there is an appearance of mineral wealth. Like the rest of tropical Africa, the land must be occupied and cultivated, and the natives must be trained to industry before commercial results of any importance can be obtained.

THE special meeting of the Royal Geographical Society to hear Captain Lugard's paper on Uganda will be held on Thursday, Nov. 3, at 8.30 p.m. On account of the great popular interest at present being manifested in the region of the Equatorial lakes, no extra tickets can be issued by the Society, as the attendance of Fellows and their friends will probably more than fill the hall.

THE new number of *Petermann's Mitteilungen* contains some articles of considerable interest. Dr. W. Ruge, son of the well-known geographer, Dr. Sophus Ruge, contributes a short but learned treatise on the geography of Asia Minor, which combines literary research with personal exploration. Dr. Ernst H. L. Krause produces an interesting map of North Germany, showing the distribution of forests and the most common species of trees during the Middle Ages. This work is accomplished mainly by the consultation of old records, and the examination of the remains of old forests and very ancient trees. The study of history is greatly helped by such a map, and the influence of increasing density of population and extending cultivation of farm crops is brought out strikingly by comparison with a map of the vegetation at the present day. Dr. Karl Sapper's description of Lake Yzabal in Guatemala is also worthy of note.

GEIKIELITE AND BADDELEYITE, TWO NEW MINERAL SPECIES.

VARIOUS pebbles were lately brought to this country by Mr. Joseph Baddeley, who has been acting as manager of a Gem and Mining Company in Ceylon. They had been picked up by him in the neighbourhood of Rakwana (Rackwanné) at various times, and had then attracted his special attention by reason of their high specific gravity. Their real nature not being evident on inspection, Mr. Baddeley, when invalided, brought them home to England for identification.

One kind of pebble, kindly analyzed for him by Mr. Claudet, was found to be essentially a tantalate of yttrium.

Pebbles of another kind were taken to the Museum of Practical Geology in Jermyn Street for examination. The external characters being found by Mr. Pringle insufficient for the determination of the species, the pebbles were handed over to Mr. Allan Dick for chemical investigation. Quantitative analysis proved the mineral to be essentially magnesium titanate ($MgTiO_3$) and chemically analogous to Perofskite, calcium titanate ($CaTiO_3$). To this interesting new species Mr. Dick, in a paper read before the Mineralogical Society in June, gave the name Geikielite, in honour of Sir Archibald Geikie, F.R.S., Director-General of the Geological Survey, in whose laboratory the analysis had been made.

As described by Mr. Dick, Geikielite has a specific gravity

3·98: its hardness (6·5) is between that of quartz and felspar. It has a perfect cleavage, with a splendent metallic lustre, and an imperfect cleavage nearly at right angles to the former. The pebbles themselves show no remains of crystal-faces, are bluish-black in colour, and opaque; but thin cleavage-flakes, when seen in the microscope, have a peculiar purplish red tint, and in convergent polarized light show a uniaxal figure, of which the axis is just outside the field of vision. When digested with hot strong hydrochloric acid the finely powdered mineral is slowly decomposed, and the titanic acid separates out. In strong hydrofluoric acid complete solution takes place in a few hours. The mineral is infusible with the blowpipe: fused with microcosmic salt it gives the characteristic reaction of titanic acid, notwithstanding the presence of a small proportion of oxide of iron.

Shortly after Mr. Dick's paper had been read, Mr. Baddeley courteously offered to allow me to select a single pebble for the British Museum Collection out of his small store of the mineral, the remaining ones being required by him for sending as samples to be used by searchers in Ceylon. But this store, small though it was, consisted of more than one kind of pebble, the close similarity of aspect being due to friction against a bit of graphite which was with them. On this heterogeneity being pointed out, Mr. Baddeley allowed me to take not only the promised pebble of Geikielite, but also those three pebbles which, not being Geikielite, were useless as samples of that mineral. One of the three fragments proved to be garnet, a second was ilmenite—both of them common minerals—but the third, a fragment of a crystal still retaining some of its faces, presented characters which give it unusual interest.

The fragment, which weighs just over three grams, is black and opaque, and has the general aspect of columbite; its extremely high specific gravity (6·02) and its hardness (6·5) are also suggestive of that mineral. In microscopic fragments it transmits light and is dichroic, changing from a greenish yellow to brown with the plane of polarization of the light; the fragments, when examined in convergent polarized light, show a biaxal figure, the apparent axial angle being large (near 70°); the character of the double refraction is negative. There is only one well-developed zone of crystal-faces remaining on the fragment; it consists of two rectangular pairs of parallel faces (pinakoids) and of four prism faces (*m*), the faces of one pinakoid (*a*) being much larger than those of the other (*b*); the angle *am*, as determined by means of reflection, is about 44°, but the images of the signal are multiple and wanting in definition; the dispersion of the optic axes indicates that the system of crystallization is mono-symmetric. Two other faces form a re-entrant edge parallel to the larger pinakoid, and inclined to the edges of the well-developed zone, but whether this is really due to twinning or not is far from evident.

The above set of external characters suggested that the fragment does not belong to any of the known species, and it became necessary to determine its chemical behaviour, but on account of the necessity of preserving the natural faces of what might possibly be an unique fragment, this was a process demanding great caution; fortunately, the behaviour was such that it was practicable to determine the precise chemical nature of the mineral without interference with the crystal faces, or, indeed, any appreciable destruction of material. It will be sufficient to state here the result, namely, that the material is no other than crystallized zirconia; the technical details relative to both this mineral and Geikielite will be given in the next number of the *Mineralogical Magazine*. It is remarkable that, notwithstanding the wide prevalence of zircon itself (silicate of zirconium), the natural occurrence of the oxide of zirconium has not previously been noticed. For this new species I beg to suggest the name Baddeleyite, in recognition of the services of Mr. Baddeley to mineralogical science; but for his close scrutiny of the mineral products of Rakwana, the existence of the above remarkable species would doubtless have long remained unknown.

L. FLETCHER.

NEW BRITISH EARTHWORMS.

THE additions which I have been able to make to our list of indigenous Annelids during the past two years fall naturally into two groups. There are, first, two species which are new to science, and are therefore at present known only as British species. In addition to these there are several species which, while they have been recorded for various Continental stations, have never been found in England till I discovered them among the gleanings which I have passed under review from nearly every part of the country. I shall first of all give a description of the new species.

1. *Lumbricus rubescens*, sp. nov.

This is a genuine Lumbricus in the strictest sense of the word, as it is understood by all those who adopt Eisen's analysis of this group of worms published in 1873. The lip forms a perfect "mortise and tenon," with the first ring or peristomium, and the girdle consists of six segments, four of which bear the *tubercula pubertatis*. I first discovered it in Yorkshire in 1891, and have since then taken it myself at Hornsey in Middlesex, Tunbridge Wells, and Dallington in Sussex, while more recently I have received it from Avonmouth in Gloucestershire.

In general appearance it resembles the common earthworm (*L. terrestris*, L.), as recently defined and differentiated. It is slightly smaller in size, but frequents similar haunts, and might in most respects easily be mistaken for the type. It has the male pores on segment 15 on raised, pale papillæ; but the girdle invariably commences on segment 34, and extends to the 39th, while the band which forms the *tubercula pubertatis* extends over 35 to 38. Its general form and appearance will

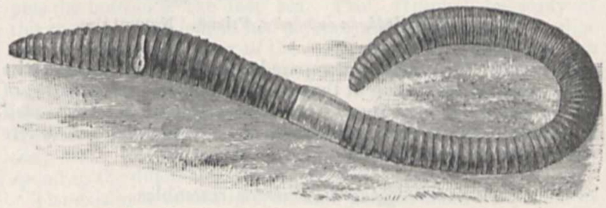


FIG. 1.—*Lumbricus rubescens*, Friend. Natural size.

be best understoood by the study of the woodcut (Fig. 1). Internally it does not differ from the other Lumbrici, but the dorsal pores commence between $\frac{5}{6}$. This makes the fourth true Lumbricus found in the British Isles, and it may be a convenience to collectors if I append a tabular statement of the features by which each is distinguished from the other.

Chart of the Genus Lumbricus.

Lumbricus	Segments occupied by the					Average length.	No. of segments.
	Girdle.	Tubercula.	First dorsal pore.	Papillæ.	Spermatophores		
Terrestris, Linn...	32—37	33—36	$\frac{8}{9}$	15, 26	?[1]	5 inches	150—200
Rubescens, Friend	34—39	35—38	$\frac{5}{6}$	15. 28	32/33	4 inches	120—150
Rubellus, Hoffm.	27—32	28—31	$\frac{7}{8}$	none	?	3 inches	110—140
Purpureus, Eisen	28—33	29—32	$\frac{6}{7}$	10 (11)	?[1]	2 inches	100—120

It will be seen that there is now a regular series in relation to the first dorsal pore, $\frac{5}{6}$, $\frac{6}{7}$, $\frac{7}{8}$, $\frac{8}{9}$, as well as in the matter of length from 2 to 5 inches and upwards, and number of segments from 100 to 200 or thereabouts. These points are worthy of note in the study of the evolution of worms.

2. *Allolobophora cambrica*, sp. nov.

This species, which I have since found in several parts of England, first came to my notice as a new species from Wales. Hence the specific name. I had previously assigned it to one or other of the related species, but eventually found on dissection that it was quite distinct from every other worm of which I have been able to obtain any description.

At first sight *A. cambrica* has all the appearance of the mucous worm (*A. mucosa*, Eisen). Its average length in spirits is about 2 inches, but when living, and moderately extended, it measures three inches. It is of a fleshy colour, with a somewhat transparent skin, so that the blood-vessels can be well observed between the girdle and the head. The dorsal pores are conspicuous in specimens which have been placed in methylated spirits, the first occurring between segments 4 and 5. The

[1] Vejdovsky and others mention the occurrence of Spermatophores on these species, but do not state the position. The point is one which should not be ignored.

setæ are in four couples, the individuals of which are near each other. The girdle covers segments 29 to 37, while 31 : 33 : 35 bear each a pair of tubercules (Fig. 2) as in the green worm

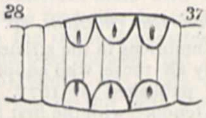


FIG. 2.—Diagram of girdle of *A. cambrica*, Friend, showing tubercula on ventral surface.

(*A. chlorotica*). There are two pairs of spermathecæ in segments 10 and 11, opening anteriorly; the male pore on segment 15 is borne on prominent papillæ, which cause the adjoining segments to appear swollen (Fig. 3). It is a very clean worm,

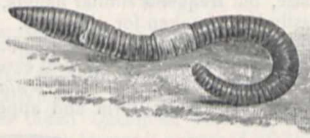


FIG. 3.—*Allolobophora cambrica*, Friend. Natural size.

exudes but little mucus as compared with the green worm; the tail is much longer than in that species, which, in the matter of girdle and tubercules, it most nearly resembles. It will be well to tabulate the points in which this worm resembles and differs from its nearest allies.

Allolobophora cambrica resembles

Allo. chlorotica	*Allo. mucosa*
in position and appearance of male pore, girdle, and *tubercula pubertatis*.	in colour, shape, size, activity, position of first dorsal pore, and appearance of male pore.

It differs

in mucus, transparency, length and shape of tail, and number of spermathecæ.	in position and shape of girdle, position of *tubercula pubertatis*, and general outline.

Tabular View.

Allolobophora	Segments occupied by the				General observations.
	Girdle.	Tubercula.	First dorsal pore.	Spermathecæ.	
Chlorotica	29—36	31 : 33 : 35	$\frac{4}{5}$	9 : 10 : 11	Dirty green, opaque, sluggish, and grub-like, exudes much mucus
Mucosa .	26—32	29 : 30 : 31	$\frac{4}{5}$	10 : 11	Flesh-coloured, active, with transparent epidermis, little mucus
Cambrica	29—37	31 : 33 : 35	$\frac{4}{5}$	10 : 11	Closely resembling *A. mucosa* in general features

When our knowledge of the hybridity of worms is more perfect, it is possible that some new light will be thrown upon such coincidences as these. I have received the worm from, or collected it in, Nottinghamshire, Hertfordshire, Yorkshire, and Montgomeryshire. I believe I have also found it in Westmorland and elsewhere, but entered it either under one or the other of the two species which it so closely resembles.

Next, we have to note the worms which are new to Britain, though not new to science. These all fall under the genus Allolobophora, and several of them are so well marked that I have, in some recent articles on this subject, revived Eisen's subgeneric term Dendrobæna, and placed under it about half-a-dozen species of tree-worms which are more or less widely distributed in this country.

The tree-worms are small, hardy, and active; the lip is usually very delicate, and appears to be used, not only as a sucker and boring agent, but also as a tissue dissolver, probably by the use of a special saliva. The setæ are usually in eight almost equidistant rows, and the lip cuts more or less deeply into the first ring. The type of this group is *Dendrobæna Boeckii*, Eisen, which has been the subject of endless confusion. The true species, following the diagnosis of Eisen, is very rare in England, and I have found it nowhere but in Airedale and Wharfdale, Yorkshire. I believe all the other records which have been given by other writers should be assigned to the much more common and widely distributed species known as *Allolobophora subrubicunda*, Eisen. This worm belongs to the same group, but lives among vegetable *débris*, as well as beneath the bark of decaying trees. Another species (*A. arborea*, Eisen) is found only in dead timber. I have specimens from Cumberland, Gloucestershire, Yorks, and Sussex. It is one of the prettiest and neatest worms indigenous to this country. Nearly related to this is another (*A. celtica*, Rosa), which, while it prefers trees, will thrive among decaying vegetable matter. I first found it at Langholm, N.B., some two years ago, but since then I have taken it plentifully in Carlisle, Morecambe, and Tunbridge Wells, besides receiving it from Sussex, Devonshire, Gloucestershire, Northants, and elsewhere. It bears spermatophores during the spring months.

When I was in the south of England in the early months of this year, I discovered a couple of specimens of a new British tree-worm (*A. constricta*, Rosa). This species seems to me to belong to the south, just as *D. Boeckii* belongs to the north. I am making notes on the distribution of these species in order if possible to ascertain their limits. A very anomalous worm (*Lumbricus Eiseni*, Levinsen) belongs to this group, though it has certain Lumbricus affinities. It is far from being a true Lumbricus, since it possesses neither *tubercula pubertatis* nor spermathecæ. Its girdle, too, is abnormal, for, whereas in the genuine Lumbricus the girdle invariably covers six segments, in this worm it extends over eight or nine. At present it does not fit in to any known genus, and should probably be made the type of a new genus. I have found it in Carlisle, Gloucestershire, and Sussex. Rosa has obtained it in Italy, and Levinsen in Copenhagen; so that it appears to be very widely distributed. On the Continent one or two further species belonging to this group are on record. On account of their habits, size, and affinities I place them in the subgenus Dendrobæna, which may be presented in tabular form as follows:—

Tabular View of Subgenus Dendrobæna.

Dendrobæna	Segments occupied by the			Setæ.	Prostomium.	Colour.
	Girdle.	Tubercula.	First dorsal pore.			
Boeckii, Eisen ...	29—33	31 : 32 : 33	—	8 equidistant	Cuts $\frac{3}{4}$ peristomium	Dark brown
Subrubicunda, Eis.	26—31	28 : 29 : 30	$\frac{5}{6}$	4 wide pairs	Cuts one half	Rose red, fleshy
Arborea, Eisen ...	27—31	29 : 30	$\frac{5}{6}$	4 wide pairs	Cuts one half	Red brown, iridescent
Eiseni, Levinsen...	24—32	0	$\frac{5}{6}$	4 close pairs	Cuts the whole	Violaceous, iridescent
Constricta, Rosa...	26—31	0	$\frac{5}{6}$	4 pairs	Cuts one half	Rose red, fleshy
Celtica, Rosa ...	30—36	33 : 34	—	4 wide pairs	Cuts one half	Violaceous, ruddy

Another group of worms belonging to the genus Allolobophora, with features more or less similar to those of the typical earthworm, has recently been enlarged by the addition of two or three species. The first (*A. profuga*, Rosa) seems to be generally distributed throughout England, as I have received it from several localities. Its synonymy, however, is at present somewhat uncertain. The long worm (*A. longa*, Ude) is the most ubiquitous of all our native species, and has for years past been confused with the common earthworm. The other species must for the present be entered as *A. complanata* (Dugès). The Continental authorities differ in their judgment respecting the identity and synonymy of this worm, and I have hitherto been unable to disentangle the complications. Certain it is that we have a species which corresponds in part with the worm described imperfectly by Dugès, and I hope in a little time to be able to determine its exact relationships.

I append a list of all those species of British earthworms which I have personally collected, examined, and identified; in each instance referring to the original memoir, and collating the worm with the author's description.

A List of Known British Earthworms.

	Author.	Date.	Memoir.
LUMBRICUS.			
1. Terrestris	Linnæus	1758	"Syst. Nat.," ed. x., tom. i., 647.
2 Rubellus	Hoffmeister	1845	"Familie der Regenwürmer."
3. Purpureus	Eisen	1870	*Öfversigt af K. Vet.-Akad.*
4. Rubescens	Friend	1891	Linnean Society, 1892.
ALLOLOBOPHORA.			
§ 1. Lumbricoidea.			
5. Longa	Ude	1886	*Zeitschrift f. Wiss. Zool.*
6. Profuga	Rosa	1884	"I Lumbricidi del Piemonte."
7. Complanata... ...	Dugès	1837	*Ann. des Sc. Nat.*, 2nd ser., viii.
§ 2. Mucida.			
8. Chlorotica	Savigny	1826	Cuv., "Hist. des. Prog. Sc. Nat.," ii.
9. Trapezoidea... ...	Dugès	1837	*Ann. des Sc. Nat.*, 2nd ser., viii.
10. Turgida	Eisen	1873	*Öfversigt af K. Vet.-Akad.*
11. Fœtida	Savigny	1828	Cuv., "Hist. Pr. Sc. Nat.," tom. iv.
12. Mucosa	Eisen	1873	*Öfversigt af K. Vet.-Akad.*
13. Cambrica	Friend	1892	NATURE, current issue.
§ 3. Dendrobæna.			
14. Boeckii	Eisen	1873	*Öfversigt af K. Vet.-Akad.*
15. Subrubicunda ...	Eisen	1873	,, ,, ,,
16. Arborea	Eisen	1873	,, ,, ,,
17. Eiseni	Levinsen	1883	"Syst. Geogr. Overs. over de Nord. An."
18. Constricta	Rosa	1884	"I Lumbricidi del Piemonte."
19. Celtica	Rosa	1886	*Bolletino dei Musei di Zoo. ed Anat.*
ALLURUS.			
20. Tetraedrus	Savigny	1828	Cuvier, "Hist. des. Prog.," tom. iv., p. 17.
21. Luteus	Eisen	1870	*Öfversigt af K. Vet.-Akad.*

When Darwin wrote his work on "Vegetable Mould," he assumed the existence of eight or ten species of earthworm in Great Britain. We now find a score of well-defined species, to which I have no doubt we shall be able to add a few others when the montane and out-of-the-way habitats have been explored. I shall be happy to receive consignments of living worms from any part of the kingdom, packed in tin boxes lightly filled with soft moss, and addressed The Grove, Idle, Bradford.

HILDERIC FRIEND.

THE PROBLEM OF MARINE BIOLOGY.[1]

IN common with the other branches of biological science, the study of marine life has made wonderful advances in the past half century, and we now begin to get a proper conception of the vastness and importance of this realm of nature.

The study of marine life has been compassed by serious difficulties; on shipboard it is impossible to examine in the living condition the enormous quantity and endless variety of forms brought up at a single haul of the net or dredge; and the old method of merely dropping the specimens into vials of alcohol resulted in vials of wrath to the naturalist who later studied the creatures in hopes of gaining from the distorted relics some knowledge of the normal appearance and anatomy. Now all this is changed, and by aid of certain chemical reagents most animals can be killed and preserved in a manner very satisfactory for study of their gross and microscopical anatomy, and hence the material collected can be examined at leisure in permanent laboratories with results corresponding to the better facilities. There has, too, been a great lack of suitable and accurate collecting apparatus. The early method was to scoop up a quantity of sea water and then tediously examine it in small quantities under the microscope. In 1845 Johannes Müller, the great pioneer of marine biology, conceived the idea of condensing into a small volume of water the forms which would be found in a very great area. This resulted in the invention of the "Müller Net," a small gauze net which is drawn through the water, entangling in its meshes the very minute and delicate organisms. For a long time Müller and his students pursued the study of marine forms, and at length came the discovery that the marine fauna and flora was directly comparable to the terrestrial.

Yet little is known of the laws of the distribution of marine life. The laws of the distribution of the terrestrial fauna and flora have been formulated for animals in the classical works of Wallace and for plants by Griesbach. The famous *Challenger* expedition (1873–1876), under the direction of Sir Wyville Thompson and Dr. John Murray, has given us the largest conception of the wealth of marine life, and has laid the foundations for the study of the marine forms both at the surface and in the depths of the ocean. Dr. Murray in his preliminary report called particular attention to the enormous wealth of organic life not only at the surface, but also many hundred fathoms below. He says that when living forms were scarce on the surface the tow net usually disclosed very numerous forms below, even to a depth of 1000 fathoms or more. In the North Pacific Ocean, the discovery was made that zones of definite depth are characterized by animals and plants peculiar to them. The tow nets sunk to 500, 1000, or 2000 fathoms brought up forms never found within 100 fathoms of the surface. The animals characteristic of these different depths are, for the most part, of the class of Radiolarians, those microscopic organisms whose silicous skeletons form much of the soft ooze which carpets the bottom of the deep sea. Prof. Haeckel, by study of this material, was led, in his monumental work on the Radiolaria, which forms a part of the "Report of the Challenger," to the recognition of three groups, (*a*) pelagic, swimming at the surface of the calm sea; (*b*) zonary, swimming in definite zones of depth (to a depth of more than 20,000 feet); (*c*) profound (or abyssal) animals swimming immediately over the bottom of the deep sea. In general the different characteristic forms correspond to the different zones (up to 27,000 feet).

The existence of this intermediate pelagic fauna was called in question by Alexander Agassiz, on the ground of the liability of error in using the ordinary open net instead of one which could be closed at a definite depth and then drawn up; and more particularly upon the ground of his own experiments made in 1878 on the *Blake* expedition. He believes that the great bulk of the ocean contains no organic life at all, that the surface fauna of the sea is limited to a relatively thin layer, and that there is no intermediate layer, so to speak, of animal life between the fauna of the bottom of the deep sea and of the surface.

Agassiz's results are contradicted by those of Chierchia on the Italian corvette *Vettor Pisani*. With the closable net invented by Palumko he brought up an astonishing quantity and variety of forms of life from different depths, even up to 4000 metres. Prof. Carl Chun, with an improved closable net, studied the marine fauna and flora of the Gulf of Naples. He formulates his results as follows: (1) That part of the Mediterranean investigated shows a rich pelagic life even to a depth of 1400 metres, as well as at the surface. (2) Pelagic animals, which during the winter and spring appear at the surface, at the beginning of summer seek the depths. (3) At greater depths pelagic animals occur, which hitherto have seldom or not at all been observed at the surface. (4) A number of pelagic animals during the summer remain at the surface and never go into the depths. From his observations upon the vertical distribution of marine life he was led to remark that the surface fauna was apparently only the advance guard of the vast army below. His conclusions were confirmed by observations made during a trip to the Canary Islands, and agree with those made by Prof. Haeckel twenty years before.

Prof. Hensen, of Kiel, has for several years past been studying the phenomena of pelagic life with a view of ascertaining its relations to the fisheries question. He has proposed the term Plankton (from πλάνομαι, to wander) to designate this world of marine life. Prof. Haeckel agrees with this and adds Planktology, that branch of biology which deals with the study of the Plankton. Prof. Hensen hopes to gain valuable information upon the phenomena of marine life by a careful mathematical estimation of the number of individuals in a given bulk of water. Presumably from this and other data some knowledge may be gained of the quantity of life which any definite area of the sea is capable of sustaining.

Prof. Ernst Haeckel, of Jena, has lately published an admirable *résumé* of our knowledge of pelagic life, and has made a very distinct advance by formulating some of the laws which govern its distribution. He has probably done more than any

[1] Reprinted from the *American Naturalist* for October, 1892.

one man to advance our knowledge on this line. Ever since 1854, when, as he tells us, he accompanied the great Johannes Müller to Heligoland and was there introduced by his master to the marine wonderland, he has almost continuously pursued the study of the Plankton. He believes that aquatic life in its broadest features shows conditions of distribution similar to those of terrestrial life, and that we may for the former as well as for the latter distinguish five great geographical provinces, each represented by characteristic forms of animals and plants. (1) the Arctic Ocean; (2) the Atlantic; (3) the Indian; (4) the Pacific; (5) the Antarctic.

All aquatic organic forms fall into two great divisions. (1) Those which live free in the water, either swimming actively or passively floating at the mercy of currents and winds. These compose the Plankton. The Plankton thus includes the widest range of organic size and form, from the minutest microscopic organisms to the gigantic cetaceans. (2) Those forms which live upon the sea bottom, either fixed or creeping about. To these the term Benthos (*τὸ βένθος*, the bottom of the ocean) is applied. The variety of forms living near the shore is known to vary with the depth, while the forms characteristic of the comparatively shallow waters of the coasts are widely different from those which inhabit the bottom of the deep sea.

The number and the kind of forms composing the Plankton are found to differ with the quality of the water, *i.e.* fresh or salt. In the ocean there is a marked difference which is conditioned by the distance from the shores, either of continents or islands. There are many species of animals, particularly certain cœlenterates, echinoderms, and worms, which pass only part of their life as free-swimming animals; for the remainder, they are bottom dwellers. Such species are not usually found far from the coast, and hence the true oceanic Plankton is made up of forms which pass their entire life as free-swimming organisms. By the presence or absence of these bottom-dwelling species the Planktologist can determine approximately the region where the forms were captured.

A mere list of the genera, not to mention the species, of plants and animals up to the present found to take part in the constitution of the Plankton would be very formidable. The range in size is enormous; from the exceedingly minute unicellular algæ $\frac{1}{25000}$ of an inch in diameter to the huge bulk of many fishes and cetaceans. The microscopic forms constitute the fundamental food supply in the cycle of marine life. They are capable of exceedingly rapid multiplication, and furnish nourishment for the myriads of large animals, which in time are preyed upon by the still higher forms. The inconceivable number of individuals of the smaller species is demonstrated by Prof. Hensen's determination of the number of individuals in about two cubic yards of Baltic Sea water. This was found to contain 5,700,000 distinct organisms; of these only about 150,000 were visible to the unaided eye. But very often microscopic forms become so numerous as to form a slime upon the surface of the water for a considerable area. Ships frequently sail for miles through water coloured by these microscopic organisms, *e.g.*, the so-called "black water" of the Arctic and Antarctic Seas, is a slime of diatoms, which serve as food for the shoals of minute crustacea and mollusca (Pteropods, sea butterflies, and Cephalopods, squid, cuttlefish) upon which the walrus and whales feed. In the warm regions the inconceivably enormous quantity of diatoms are replaced by another kind of algæ, the Oscillatoriæ, which often for an area many miles in extent colour the sea a dark red or yellowish brown. The Red Sea received its name from the abundance of one of these algæ, *Trichodesmium erythræum*, which, according to Ehrenberg, coloured the water along the shore a blood-red. In the warm region also are found the huge floating banks of Sargassum, or gulfweed, forming the so-called Sargasso Seas of the Atlantic and Pacific Oceans. These areas are found to have a marine fauna and flora peculiar to themselves, but approximating in character to that of the coast waters.

The simplest forms of animal life of the Plankton belong to the groups of Infusoria and Rhizopods; to the latter belong those minute animals, the Foraminifera and Radiolarians, which occur in such enormous quantities that their calcareous and siliceous shells form the "deep sea ooze" which carpets the bottom of the deep sea. It is the shells of these animals, too, which have built the vast chalk beds in various parts of the world. Among the multicellular animals which take a prominent part in this marine world are many species of medusæ (jelly fish) and the closely related Siphonophores, of which the beautiful Portuguese man-o'-war is the most familiar representative. The class of worms is represented by many free-swimming species; but in the number of individuals it is far surpassed by the molluscs, chiefly represented by the squids, the pearly and paper nautilus, and the huge cuttlefish, and by the minute and delicately beautiful sea butterflies (Pteropods), which occur in vast schools in the polar seas. Often, too, in very considerable number are found the free-swimming larvæ of Echinoderms, as also many worm larvæ, which, like the former, pass their adult life upon the bottom. Every haul of the gauze net is certain to contain some representatives of the great class of Crustacea, often great numbers of species, as well as of individuals. In distribution these seem to be subject to pretty definite laws, and a careful study of the phenomena would be of great interest. There are found also certain Tunicates, a group interesting because many investigators believe that here we find the transition from the invertebrate ancestor to the higher plane of life of which man is at present the highest representative.

The vertebrates of the Plankton embrace the great group of fishes, and in addition the marine birds, the seals and walrus, and finally the cetaceans. In this connection, too, the enormous number of fish eggs floating at the surface of the ocean, as well as the transparent, newly-hatched fry must be mentioned. Prof. Hensen hopes to get an idea of the approximate number of fish of a given species in a certain area, computing the number of eggs and fry of that species within that area.

The phenomenon of marine phosphorescence is very widely known with admiration and wonder. Its cause is chiefly or solely bound up with organic life. The majority of pelagic animals display the phosphorescent light in different degrees. In some the entire living animal is brightly luminous; in other the light is limited to special organs. But much of the phosphorescence of the ocean appears to be caused by the fragments of dead organisms, and is connected with the presence of bacteria.

Since many chlorophyll-bearing organisms are found at depths unpenetrated by sunlight, it has been suggested that the light necessary for their growth is furnished by the phosphorescent organisms.

The composition of the Plankton is exceedingly irregular, both in qualitative and in quantitative relations; its distribution in the ocean is also very irregular, both in time and in place. The variations occur near the shore as well as far out at sea. Very often the greater part of the mass of Plankton is made up of organisms belonging to a single group. Sometimes unicellular algæ make up nearly the whole bulk, at another medusæ, siphonophores or ctenophores; indeed, almost any group of marine organisms may occur in such quantities as to compose more than one-half of the total bulk of the Plankton, at that time and place. The fundamental causes of variation in the quantity and quality of the Plankton appears to be conditioned by time, climate, and currents.

Temporal Differences.—For a satisfactory determination of these more complete observations are needed. Reliable data can be furnished by the observations at the numerous marine laboratories and zoological stations now springing up in different parts of the world. The causes which underlie these yearly, monthly, daily, and hourly variations are manifold; in part meteorological, in part biological. They are comparable to the corresponding oscillations of the terrestrial fauna and flora, and depend on the one side upon climatic and meteorological conditions, and on the other upon the varying mode of life, particularly upon conditions of reproduction and development. Just as the annual development of most land plants is bound up with a definite time of year, as the time of budding and leafing, of blooming and fruiting, have in the "struggle for existence" become adapted to the meteorological conditions, the time of year, and other conditions of existence, so too the annual development of most marine animals is conditioned by definite habits, which have become fixed by heredity. The yearly variations may be compared to the good and bad fruit years. This yearly variation has been noted by many observers in case of many marine animals. Our attention is often called to an example of it in the unusual abundance or scarcity of the catch of certain food fishes.

Many marine animals, particularly certain medusæ, siphonophores, ctenophores, molluscs, and tunicates, are found at the surface only periodically, in one or a few months of the year. This is probably dependent upon conditions of reproduction and development, as well as upon the temperature of the season. The daily variations are conditioned by the weather, and particularly by the wind and rain. A shower will very quickly reduce the specific gravity of the surface water and thus drive the surface-dwelling animals below. Many animals rise to the surface only at a definite time of day, some in the morning, others at noon, and yet others only towards evening.

Climatic Difference.—Prof. Haeckel thinks that the quantity of the Plankton is very little dependent upon the climatic difference of the zones, but that the quality is greatly so, and indeed in this way, that the number of component species diminishes from the equator to the poles. These conditions, he believes, are directly referable to the influence of the sun, "the omnipotent creator," whose more direct rays bring about an acceleration in the processes which make up the cycle of life. As this is true of the terrestrial fauna and flora so it is true of the marine.

Currentic Differences.—Conspicuous differences are also brought about by the numberless currents, great and small, by the little-known deep sea oceanic currents as well as by the better-known great surface currents, the Gulf Stream, the Falkland Stream, the Guinea Stream and others. These currents play a great *rôle* in the distribution of many forms of life. More local influences are exerted by the small currents whose causes are found in the climatic and geographical conditions of the adjacent coast. The relations of Plankton life to currents is little known, and needs investigation, but first a better knowledge of the currents themselves is necessary.

Almost every one who has seen the surface of the ocean in a calm has noticed the glassy areas of irregular shape. These are found on the high seas as well as in sheltered bays and harbours, and are of very special interest to the student of marine life. So far as made out they are extremely irregular in time and place of appearance, and the conditions governing them have not been carefully studied. They are in a measure influenced by winds and currents, by the ebb and flow of the tide. Here, into a limited space, are crowded great numbers of organic forms; this space is readily distinguished from the surrounding water in which there is comparatively little life. These phenomena have been noticed by seafaring men and have many different names in different countries.

A word in conclusion as to the bearing and importance of the Plankton in human economy in the near future. When Malthus promulgated his famous doctrine he failed to consider the final element which enters into the problem of human population, the human mind. The ingenuity of the human mind has brought about a decreased efficiency in the natural checks to undue increase, and thus an artificial increase in the food supply is rendered necessary for the crowding population. This food supply is now mainly derived from the cultivation of the land. A still further increase of population will necessitate a levy upon marine life. As soon as man to any great degree becomes a factor in the Plankton conditions by drawing from it large quantities of food, particularly in the form of mature animals, the equilibrium of oceanic life will be disturbed, and must be adjusted by artificial means. But further, a study of the phenomena of marine life shows that the water as well as the land, through cultivation, is capable of producing a greatly increased food supply for man. The necessity of cultivating the marine resources is even now apparent, and many governments have already begun to cope with the question by the establishment of commissions of fisheries Of these commissions that of the United States stands in the front rank by virtue of its positive results. But in the near future individual attention must be turned to supplementing the terrestrial resources, the wheat fields, the cattle and sheep ranches, by an increasing utilization and development of the possibilities of marine farming; by fish propagation, by plantations of oysters, clams, quahaugs and scallops, by raising herds of lobsters and crabs. Improved breed of fish, of lobsters will result. The possibilities are well-nigh limitless; and by cultivation of the sea and sea bottom, as well as of the land, man will postpone indefinitely the fulfilment of the Malthusian prophecy.

But conditioning all advance in the possibilities of marine cultivation is the knowledge of the Plankton, of its distribution, and of the fundamental basis of marine life the microscopic marine organisms in the ocean.

GEORGE W. FIELD.

OPTICAL PROJECTION.[1]

THE intention of this lecture is to give a general survey of the subject of Optical Projection, which now takes its position in science, and to present examples of what may be done by this method. It would be difficult to determine which subject claims a first place. Some scientists say the microscope should have the preference, while others take a different view. For my own part, I think the microscope and polariscope stand foremost, on account of the facility with which these branches of science may be pursued for the benefit of a large number, without multiplying expensive apparatus; also because of the convenience in saving the eyes from undue strain. Indeed, to many persons, looking at objects in the table microscope is little short of a painful operation, and consequently the study of small objects becomes to them impossible. The projection method immediately brings the required relief.

For general instruction, projection methods are invaluable, such as, for instance, showing diagrams, photographs, and other slides, upon the screen; as well as for spectrum analysis. In fact, the subjects which can be illustrated by means of optical projection are innumerable; but time will allow me to present only a few examples, and I trust that, when I approach the end of my lecture, my view of the importance of this subject will be held in equal estimation by you.

Probably the only people in the world that benefit by the experience of their predecessors are those who pursue the study of science. They are free from the accusation of robbing the brains of other men, when they take up methods or apparatus already known and improve upon them or employ them for their own work. In such cases, however, it is always understood that honour should be given where honour is due, and accordingly I have no wish to represent to you any piece of apparatus as of my own devising, when in reality it belongs to another.

Few men have had a larger experience, and attained greater success in optical projection, than has Mr. Lewis Wright, who has embodied in his most recent forms of apparatus all that was good in designs existing until his time. I have, therefore, started from his models, making such modifications as I thought to be desirable. Mr. Wright does not appear—if I may say so —to have had much experience with the electric arc light as a radiant, and I found, at a very early stage, that great difficulties had to be encountered when this light was used, chiefly because the radiant approaches more nearly to what theory requires. That which was easy with the lime-light became almost impossible with the arc lamp, and these difficulties had to be conquered.

Many scientific men are dissatisfied with the projection microscope, on the ground that very high magnification does not give that resolution and that sharpness which is found in the usual methods of observation. This want I fully admit. At the same time it is scarcely right to condemn a particular method because you try to apply it to an unsuitable purpose. Hundreds of thousands of subjects may be shown with the projection microscope with far greater profit to the student than was possible in the old way. The very fact that the professor can place his pointer upon any part of the picture on the screen is invaluable to the students. I shall, therefore, attempt to show you only a series of microscopical subjects suitable for projection, and shall not employ very high magnification.

In regard to some substances very high powers may be used with advantage, but much time would be lost in getting them into the field and focussing them upon the screen. These, consequently, I omit, so that a large number of subjects may be illustrated.

It is fair to state that most of the apparatus used to-night has been constructed by Messrs. Newton, of Fleet-street, and the luminous pointer by Messrs. Steward, of the Strand. The arc lamp is a Brockie's projector. Messrs. Baker, Watson, and others have also come to my assistance.

I will first show, on the screen, a picture of the lantern carrying its various apparatus; and then a few systems of lenses, which may be employed for the projection microscope, as well as a diagram of the microscope itself.

Sub-stage condensers and objectives are, as a rule, made to suit the table microscope. When projecting, by means of an objective alone, in consequence of the screen distance being very

[1] Friday evening discourse delivered by Sir David Salomons at the Royal Institution, on February 26.

great—or, in other words, the microscope tube being exceedingly long as compared with the table instrument—the objective has to be approached very close to the slide; in fact, with the higher powers, closer than the cover-glass will allow. This close working distance renders necessary special sub-stage condensers, and in many cases a special one is required for every screen distance with each objective. This requisite would seem to be a complete stumbling-block to microscope projection work. With the lime-light the difficulty does not enter in the same degree as with the arc light, and as we are now dealing with the latter, further reference need not be made to the oxy-hydrogen light. There are two ways of surmounting the difficulty; one by the use of plano-concave lenses, introduced in such a way as to be equivalent to greatly lengthening the focus of the objective on the screen side, while it enables, as a consequence, the objective to be slightly further removed from the slide, *i.e.*, giving what is termed a greater working distance. The objection to this method is that, even when these plano-concave lenses are corrected, the result, though greatly improved, is not perfect. The second way, which is a perfect one, is that of introducing an eye-piece. In both these methods, that the best results may be obtained, the objective is made to occupy a position not very different from that which it would do if employed on the table microscope.

In the eye-piece method almost the exact conditions can be complied with for which the objective was made. I propose, therefore, to show the subjects by the eye-piece method. The only objectives which will be used are: (1) Zeiss's 35 millimetre projection objective, with a sub-stage condenser, 4 inches focal length, placed a considerable distance from the slide; (2) Newton's 1-inch projection objective, the sub-stage condenser as in the first case; and (3) Zeiss's ⅛-inch achromatic objective, the sub-stage condenser being Prof. Abbé's three-lens condenser with the front lens removed. In all three cases the eye-pieces used are Zeiss Huyghens No. 2 and No. 3.

In each instance I will mention the magnification in diameters, as well as the number of times when reckoned by area, for the appreciation of those who estimate by area; and I will also give the size to which a penny postage stamp would be increased, supposing it to be made of india-rubber, and stretchable to any extent in all directions. In presenting these figures I do not pretend that they are absolutely correct, but as they have been ascertained under conditions similar to those now existing the errors will not be very great.

In consequence of the field not being quite flat, and the sections having a certain thickness, although extremely thin in most cases, the whole of the object cannot be in focus upon the screen at the same time. By shifting the focussing screw slightly all parts may be brought into focus successively. So-called greater depth of focus is obtained by using an increased working distance; and for projection work over-correction for flatness can alone give a sharp picture all over with very considerable depth of focus; the difficulty of over-correction being that, unless extreme care is taken, certain forms of distortion may be introduced. By stopping down the objective greater flatness of field may be secured, but at the expense of light. There is thus a choice of difficulties, and the least one should be taken.

Turning now to the polariscope. Polarized light teaches us a great deal concerning the structure of matter; it is also a means of confirming the undulatory theory of light. This subject is so large that no attempt can be made to give even a general idea of the field it covers, and the experiments, which will be shown in the polariscope, may be taken simply as a few illustrations of the subject and nothing more; but they will, at any rate, be suggestive of the large field to which this method of analysis can be applied. A vast amount of mathematical proof can be illustrated graphically by various experiments with polarized light. I will show on the screen a diagram of the polariscope. (Shown.)

With reference to showing the spectrum. The method of projecting a spectrum, I think, is new, as I have not seen it described anywhere. It gives practically a direct spectrum with an ordinary prism, without turning the lantern round to an angle with the screen; and here is a diagram of the method.

The details of the apparatus, as well as those of the methods of working, I have modified in almost every instance, for five reasons:—(1) That more certain results may be ensured; (2) that rapidity may be obtained; (3) that only one operator may be needed; (4) that, as far as possible, all parts of the apparatus may be interchangeable; and (5) that loose screws and pieces may be dispensed with.

There were then shown by projection a number of slides illustrating various microscopic optical systems, and a number of microscopic slides, followed by a series of general polariscopic projections, some of them to illustrate the strains existing in many forms of matter; also a spectrum by a carbon disulphide prism, in conjunction with a reflecting prism and with a mirror, which, apart from any other result, demonstrates that the loss of light with a reflecting prism is less than with an ordinary glass mirror. Slides and other projections were also thrown upon the screen.

The details are as follows:—

The Microscope.—Screen distance, 21 feet. First 35 millimetres Zeiss projection objective, 4-inch sub-stage condenser, Zeiss Huyghens eye-piece 2; 500 diameters = 250,000 times = penny stamp stretched to cover about 147 square yards. Subjects shown: proboscis of blowfly; permanent molar displacing milk-tooth (kitten); human scalp, vertical; human scalp, surface; fossil ammonites and belemnite. Second, 1-inch Newton's projection objective, 4-inch sub-stage condenser, Zeiss Huyghen's eye-piece 2; 1,000 diameters = 1,000,000 times = stamp stretched to about 588 square yards. Objects shown: proboscis of blowfly; foot of a caterpillar; section of human skin, showing the sweat ducts; phylloxera vastatrix of the vine. Third, 1-inch Newton's projection objective, 4-inch sub-stage condenser, Zeiss Huyghens eye-piece 3; 1,300 diameters = 1,690,000 times = stamp stretched to about one-fifth of an acre. Slides shown: proboscis of blow-fly; wings of bee (showing hooklets and ridge); sting of bee (showing the two stings, sheath, and poison-sack); sting of wasp (showing same as last slide); eye of beetle (showing the facets). Fourth, ⅛-inch Zeiss's achromatic objective; Abbé's 3-lens sub-stage condenser, with top lens removed; Zeiss Huyghens eye-piece 3; 4,500 diameters = 20,250,000 times = stamp extended to nearly 2½ acres. Slides shown: proboscis of blow-fly; hair of reindeer (showing cell structure); hair of Indian bat (showing the peculiar funnel-like structure); sting of bee (showing the barbs); foot of spider; stage of the micrometer (the closest lines ruled to thousandth of an inch, which measure 4½ inches apart under this magnification); a wave length $\frac{1}{40000}$ inch, therefore, on screen measures about ⅛-inch.

The Polariscope.—Shown with parallel light: plain glass; glass under pressure; chilled glass (round, oval, and waved peripheries); Prince Rupert's drop (broken in the field); horn; selenites (over-lapped); butterfly (selenite); bunch of grapes (selenite); bi-quartz, with ¼-wave plate (the ¼-wave plate in this experiment produces the same effect upon the bi-quartz as if a column, 20 centimetres long, of a 7½ per cent. solution of cane sugar were placed between the polarizing nicol and the bi-quartz. The analyser has to be rotated about 10°); a piece of sapphire to show asterism. Shown with convergent light; hemitrope (cut in a plane, not at right angles to the axis); ruby; topaz; grape sugar (diabetic); cane sugar; quartz; superposed right and left-handed quartz (spirals); calcite and phenakite superposed (showing transition from negative to positive crystal, passing through the apopholite stage).

The Solidiscope.—New form of apparatus for showing solids, and consisting of two reflecting prisms and suitable projecting lenses. With this instrument were shown:—Barton's button, the works of a watch, a coin.

Spectrum Analysis.—Spectrum thrown by means of a disulphide prism combined with a reflecting prism; the result being that a good spectrum is thrown upon the screen direct without turning the lantern. There were shown:—The spectrum; absorption bands of chlorophyll, &c.; effects produced by passing the light through coloured gelatine films.

Projection of Slides.—Decomposition of water; expansion of a wire by means of heat; combination of colours to form white light; various diagrams, coloured photographs of a workshop, &c. As an extra experiment there was shown, in the polariscope, with a convergent light, Mitscherlisch's experiment (illustrating the changes which take place in a selenite under the influence of heat).

There are but few who would disagree with me in the opinion that the microscopic world, as regards its design and its molecular structure, is quite as wonderful as the great works around us seen with the unaided eye. A magnifying glass of low power opens up a world far larger than that which we are accustomed to see. At the present time, even with the most perfect apparatus that exist, only a small portion of the universe is known to us.

Scientific study should be pursued by all in a greater or less degree. It teaches more important lessons than the most impressive discourse ever preached. During the investigation of what is generally termed the invisible world, men should at time pause to reflect, and ask themselves such questions as these: What is the meaning of, and to what end is, creation? Is it all mere chance? Were such wonderful designs and properties created at the beginning? Was there in matter at the beginning an inherent, or implanted, power of development? Simple as these questions may seem, man in the flesh will never be able to find the true answers. The extraordinary design and structure which have existed in the unseen world for millions of years, or possibly in all past time, and even at the present day known to so few, demonstrate at least that the great Power has bestowed the same care upon what appear to us the most insignificant portions of creation, as upon what we think are the greatest works in the universe. These silent sermons must surely influence the mind, and set it thinking of the supernatural and of our duties during life.

It may now with truth be said that science gives us means, such as never before existed, of appreciating the greatness of the Supreme Spirit, by enabling us to read fresh chapters in the book of nature.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Prof. Darwin has been appointed to represent the University at the approaching tercentenary of Galileo's appointment to a chair in the University of Padua. The celebration will take place in Padua at the beginning of December.

Prof. Green, of Oxford, is appointed an Elector to the Harkness University Scholarship in Geology in the place of the late Mr. T. Roberts, assistant to the Woodwardian Professor.

The discussion in the Senate of the proposal to found a mechanical sciences tripos for engineering students was unexpectedly favourable, in marked contrast to the reception accorded to former schemes. Prof. Ewing is to be congratulated on the skill with which the new plan has been framed, and the success with which he has met and conciliated the original opposition of the more mathematical members of the Senate. The grants for the approval of the plan have been sanctioned by the Council, and it is not likely that they will now be opposed. Some fifteen students are already at work in the engineering laboratary in preparation for the new tripos, which bids fair to take a good place among the honours schools, and cannot fail to stimulate the growth of the engineering department under its present energetic head.

DUBLIN.—At the meeting of Council of the Royal College of Science, Dublin, held on the 5th inst., a letter was read from H.M. Commissioners for the Exhibition of 1851, announcing that they had been pleased to place at the disposal of the College a science scholarship of the annual value of £150 for the year 1893. These scholarships are specially instituted for the encouragement of scientific research and are tenable for two years, and one of them has already been nominated to by the Council of the College for the year 1891-92.

SCIENTIFIC SERIALS.

American Journal of Science, October.—On a colour system, by O. N. Rood.—An ottrelite-bearing phase of a metamorphic conglomerate in the Green Mountains, by C. L. Whittle.—The age-coating in incandescent lamps, by E. L. Nichols. The diminution of efficiency in incandescent lamps is due to three causes, viz., loss of vacuum, increase of re istance due to the the disintegration of the filament, and finally the deposition of disintegrated carbon upon the inner surface of the lamp-bulb. This deposition gives rise to what is called the age-coating. It appears that the rate of deposit of the coating in incandescent lamp-bulbs is greatest in the early part of the life of the lamp. For example, in the case of a lamp which lasted 800 hours, more than half the coating was deposited during the first 200 hours. The loss of brightness due to the absorbing power of the age-coating is a variable part of the total loss, being greatest in lamps of high initial efficiency. The coating does not appreciably modify the character of the light transmitted, as shown by a series of photo-spectroscopic measurements. The distribution of the coating within the bulb is nearly uniform. No marked difference between treated and untreated filaments appears to exist as regards the coating produced from them. It has been pointed out, however, that in the case of lamps exhausted without the aid of mercury the age-coating is scarcely perceptible.—Mica-peridotite from Kentucky, by J. S. Diller.—Glaciation in the Finger Lake region of New York, by D. F. Lincoln.—Certain points in the interaction of potassium permanganate and sulphuric acid, by F. A. Gooch and E. W. Danner. When these two bodies are brought into solution together there is developed a tendency towards reduction on the part of the permanganate, which is the greater as the strength of the acid is increased, as the temperature is raised, and as the duration of the action is extended. At first, the oxygen lost to the permanganate is liberated, whereas in the later stages manganese is precipitated in the form of a higher oxide or retained in solution in the form of a higher sulphate.—Crystallography of the cæsium-mercuric halides, by S. L. Penfield.—Silver hemisulphate, by M. C. Lea.—Restorations of Claosaurus and Ceratosaurus, by O. C Marsh.—Restoration of *Mastodon Americanus* (Cuvier), by the same.

THE number of the *Nuovo Giornale Botanico Italiano* for October is entirely occupied by the continuation of Sig. Nicotia's Statistics of the Flora of Sicily.

American Journal of Mathematics, vol. xiv., No. 3 (Baltimore, the John Hopkins Press, 1892).—The title of Prof. Cayley's communication, "Corrected Seminomiant tables for the Weights 11 and 12" (pp. 195-200) explains itself. It contains a better form of tables, which were given in a previous volume (vii., pp. 59-73). Weierstrass, in his memoir "Zur Funktionenlehre," called attention to certain functions, which offer special singularities. "Au lieu de présenter un nombre fini ou infini de points singuliers essentiels *isolés* elles offrent des lignes singulières essentielles ou même des *espaces lacunaires* à l'intérieur desquels elles cessent d'exister."—By request of Mr. Hermit, M. H. Poincaré discusses the subject in an article "Sur les fonctions à espaces lacunaires" (pp. 201-221).—J. C. Field, writes on "Transformation of a System of Independent Variables" (pp. 230-236).—Mansfield Merriman discusses "The deduction of final formulas for the Algebraic Solution of the Quartic Equation" (pp. 237-245), and L. S. Hulburt in remarks on "A class of new theorems on the number and arrangement of the real branches of plane Algebraic Curves" (pp. 246-250), follows up recent work, in the same direction, by Messrs. Harnack and Hilbert."—"The Symbolic notation of Aronhold and Clebsch" (pp. 251-261) has for its object the exposition of this notation, "so well adapted to the expression of functional invariants," in an English form. The same writer, W. F. Osgood, also contributes a note on "the System of two simultaneous Ternary Quadratic forms" (pp. 262-273). This, likewise, is a simplification for the benefit of English readers. It contains an account of Gordon's method, and employs the notation of the preceding article.—H. S. White communicates notes "on generating systems of Ternary and Quaternary Linear transformations" (pp. 274-282), and "a Symbolic demonstration of Hilbert's method for deriving Invariants and Covariants of given Ternary forms" (pp. 283-290). This latter paper also uses the symbolic notation of Aronhold and Clebsch in a simplified statement of recent results developed in Hilbert's notable paper "Ueber die Theorie der Algebräischen Formen" (Math.-Aca., vol. 36, pp. 524-6). The only paper, in the present number, which was read before the New York Mathematical Society is one by the President, Emory McClintock, "On the Computation of Covariants by Transvection" (pp. 222-229).

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 17.—M. Duchartre in the chair.—On Mr. Barnard's discovery of the fifth satellite of Jupiter, by M. F. Tisserand.—On the application of certain methods of successive approximation to ordinary differential equations, by M. Emile Picard.—On a reaction alleged to be peculiar to spermine, by M. Duclaux.—Observations of three new small planets discovered at the Nice observatory by means of photography, by M. Charlois; report by M. Perrotin (see Astronomical Column).—On the coexistence of dielectric power and electrolytic conductivity, by M. E. Bouty. A vindication of priority.—On the polarization of light of various colours by the atmosphere, by M. N. Piltschikoff. There is a well-marked difference between the intensity of polarization of blue light and that of red in the atmosphere The intensities are measured by means of a Cornu photo-polarimeter. The eye-end of this instrument is covered with a cobalt glass, the quantity of polarized light from the chosen point in the sky is measured, the blue glass replaced by a ruby glass, and the determination repeated for the latter. Generally, the intensity of polarization for blue light is sensibly greater than that of the red. This is not favourable to Lallemand's theory of the blue colour of the sky as a phenomenon of fluorescence. The difference of polarization is, however, not constant, but depends upon the direction of the wind. A series of observations made at Kharkoff between April and September, 1892, show a maximum difference with a south-easterly wind, diminishing symmetrically on both sides, and even becoming negative at W. N. W. The amount of polarization of the blue shows the opposite distribution, so that when the polarization of the atmosphere rises or falls, the effect is greater in the less refrangible radiations than in the others. There is also a notable relation between polarization and atmospheric moisture. The S.E. brings the greatest amount of precipitation, the northerly winds the least. It is also probable that dust and dry fogs exert a considerable influence, as shown by the circumstance that the greatest differences have been obtained in high winds, when the whole town was covered with dust.—On a new way of preparing acetylene, by M. L. Maquenne (see Notes).—On the analysis of mixtures of ammonia and methylamines, by M. H. Quantin.—On the nervous tissues of some invertebrates, by M. A. B. Griffiths.—Examination of some rocks collected by Prince Henry of Orléans on the lower Black River in Tonkin, by M. Stanislas Meunier.—Note on the miocene formations of western Algeria, by M. Jules Welsch. The miocene formations occur in normal succession near Hamman Riva, where they rest on the Cretaceous. It appears certain that the last upheaval of the Atlas did not take place at the end of the Helvetian epoch (middle miocene), as hitherto believed. It was post-Tortonian, and took place at the end of the upper miocene. For the formations of Gontas, Ben Chicao, Mascara, &c., are Tortonian; they are within the block of the Atlas Mountains, and have been lifted to heights of 800, 1000, and even 1700 metres. This result tends to confirm the general idea worked out within the last few years that the zones of folding are nearer the equator in proportion as they are more recent.

AMSTERDAM.

Royal Academy of Sciences, September 24, Prof. Van de Sande Bakhuysen in the chair.—Mr. H. A. Lorentz dealt with the reflection of light by moving bodies. In a former paper ("Arch. néerlandaises," t. xxv. p. 363) the author considered the propagation of light through a ponderable dielectric which has a movement of translation, but leaves at rest the inclosed ether. The equations then arrived at may be written in the form—

$$\text{div. } D = 0. \quad \text{div. } H = 0,$$

$$\text{curl } E = -\dot{H}, \ \text{curl}\left[H + \frac{1}{v^2}\text{ vect. }(Ep)\right]4\pi\dot{D},$$

$$4\pi V^2 D = n^2 E + \text{vect. }(Hp),$$

the vectors H, D, E, and p representing the magnetic force, the dielectric displacement, the electric force, and the velocity of the ponderable matter. The signs "div." and "curl" have the same meaning as in Heaviside's formulæ (*Phil. Mag.*, 5th ser. vol. xxii. p. 118), and Vect. (Ep) indicates the vector product. Finally, V is the velocity of light in vacuum, and n the index of refraction. At the boundary of two media, possessing a common translation, there will be continuity of the normal components of D and H, and of the tangential components of E and $\left[H + \frac{1}{v^2}\text{ vect.}(Ep)\right]$. If i and r are the angles of incidence and refraction for the relative rays ("Arch. néerlandaises," t. 21, pp. 129–134), Fresnel's expressions for the amplitude of the reflected ray—

$$\frac{\sin(i-r)}{\sin(i+r)} \text{ and } \frac{tg\,(i-r)}{tg\,(i+r)}$$

have to be multiplied by

$$1 - \frac{2p_1 \cos i}{V n_1},$$

where n_1 relates to the first medium, and p_1 is the velocity, in the direction of the normal, with which the reflecting surface recedes. This result may be shown to be consistent with the conservation of energy, provided that the pressure exerted, according to Maxwell, by the vibratory motion, be taken into account.—M. van Bemmelen made a second communication on the existence of the crystalline hydrate of Fe_2O_3. He obtained the ferrite of sodium ($Fe_2O_3Na_2O$) in different crystal forms. Under certain circumstances this form was a hexagonal plate. These crystals could be metamorphosed by the action of water in the hydrate of Fe_2O_3, without loss of their optical properties.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Student's Hand-book of Physical Geology: A. J. Jukes-Browne, 2nd Edition (Bell).—The Beauties of Nature: Sir John Lubbock (Macmillan).—Notes on Qualitative Chemical Analysis: P. L. N. Nayudu (Madras, Chetty).—Amherst Trees: J. E. Humphrey (Amherst, Mass., Carpenter).—Magnetical and Meteorological Observations made at the Government Observatory, Bombay, 1890 (Bombay).—Explosives and their Power: M. Berthelot, translated by C. N. Hake and W. Macnab (Murray). —Domestic Electric Lighting, treated from the Consumer's Point of View: E. C. de Segundo (Alabaster).—Introduction to Physiological Psychology: Dr. T. Ziehen, translated by C. C. van Liew and Dr. O. Beyer (Sonnenschein).—Notes by a Naturalist: H. N. Moseley, New Edition (Murray).—The Science and Practice of Lighting: W. H. Y. Webber (W. King).—Commercial Organic Analysis, vol. 3. Part 2, 2nd Edition: A. H. Allen (Churchill).—Comité International des Poids et Mesures. Procès Verbaux des Séances de 1891 (Paris, Gauthier-Villars).—The Reliquary, vol. 6, New Series (Bemrose).—Vergleichende Morphologie der Pilze: Dr. F. v. Tavel (Jena, Fischer).—Beiträge zur Biologie und Anatomie der Lianen: Erster Theil; Beiträge zur Biologie der Lianen: Dr. H. Schenck (Jena, Fischer). —Dissections Illustrated, Part 1, the Upper Limb: C. J. Brodie (Whittaker). —Science Instruments (Newcastle-on-Tyne, Brady and Martin).—Treatise on Thermodynamics: P. Alexander (Longmans).—Vegetable Wasps and Plant-Worms: Dr. M. C. Cooke (S.P.C.K.).—Text-book of Petrology: Dr. F. H. Hatch, 2nd Edition (Sonnenschein).—Meteorological Service Report, 1888: C. Carpmael (Ottawa, Dawson),

PAMPHLETS.—The Inaugural Robert Boyle Lecture: Sir H. W. Acland (Frowde).—Astronomical Observations made at the University Observatory, Oxford, No. 4, Researches in Stellar Parallax by the Aid of Photography, Part 2: Prof. Pritchard (Oxford, Clarendon Press).

SERIALS.—Records of the Australian Museum, vol. 2, Nos. 2 and 3 (Sydney).—Journal of State Medicine, vol. 1, No. 2 (Griffin).—Journal of the Chemical Society, October (Gurney and Jackson).—Zeitschrift für Wissenschaftliche Zoologie, 54 Band, 3 Heft (Williams and Norgate).—Journal of the Royal Microscopical Society, October (Williams and Norgate).—Journal of Anatomy and Physiology, vol. 27, New Series, vol. 7, Part 1 (Griffin).

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