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HETEROGENESIS.

Studies in Heterogenesis. By H. Charlton Bastian, M.A., M.D., F.R.S. Pp. ix+354+xxxvii; 19 plates, with 815 illustrations from photomicrographs. (London: Williams and Norgate, 1903.) Price 31*s.* 6*d.*

HETEROGENESIS means, in these studies, the *per saltum* origin of forms of life from other quite different forms, *e.g.* of a ciliated infusorian from a rotifer's egg, or of a sun-animalcule from a chlorophyll corpuscle. It is long since Dr. H. Charlton Bastian first suggested this heresy; and many years of industrious observation have resulted in this large and expensive volume describing and (with 815 figures) illustrating those cases in which the author thinks he has detected the heterogenetic process at work. One cannot but admire the doggedness with which Dr. Bastian has persisted—*contra mundum*—in maintaining his thesis; and even those who feel quite sure that he has misinterpreted what he saw may find it interesting to discover by repetition of his experiments what did actually occur and was actually photographed. Others, again, who would not turn round to look at slides supposed to demonstrate that the egg of a rotifer may resolve itself into infusorians or into one large ciliate, may be more tolerant of the suggestion that Protistan evolution is still going on, retracing some of its ancient steps, or making new ones. It may be that Proteus still frisks a little among the Protists, or that there are mutations among unicellulars just as among De Vries's evening primroses.

It is often said by biologists that biogenesis (or the origin of approximately like from like) is not so much a law as a fact. It may not have always been, it may not everywhere be, that a living creature arises only from a parent or parents like itself; but, so far as our experience goes, the biologists say, there is no exception to this rule. Here, however, we have a book which is full of such exceptions, and yet the author's papers on this subject are rejected by the Royal Society of London, the Académie des Sciences of Paris, the K. Akademie der Wissenschaften of Berlin, and the R. Accademia dei Lincei of Rome! What does this mean? Does it mean more than that the author's rejected addresses appeared to the secretaries and committees of these learned bodies as incredible, as the recent facts and theories relating to radium would have seemed not long ago? "What can hardly be distinguished from perpetual motion, which it is an axiom of science to call impossible, has," says Prof. Boys, "left every chemist and physicist in a state of bewilderment." Thus, as the question rises in our minds, whether heterogenesis may not be an unknown factor in evolution, we turn to what Dr. Bastian has really done.

(1) The author believes that he has shown the *de novo* origin of bacteria within "closed cells," *e.g.* of fruits or in a structure like a caudal seta of Cyclops. In the last case, two or three days after death, "scarcely visible motionless specks gradually appear in the structureless protoplasm," they grow into bacteria and show active swarming movements. "In such a case it is clear that we have to do with no process of infection from without, but with a *de novo* origin of bacteria from the protoplasmic contents of the spines or setæ." But this interpretation is quite unnecessary; it has been shown beyond doubt that bacteria may exist in fluids where the highest powers of the microscope fail to detect them, many organisms normally swarm with bacteria, and the possibility of infection from without also remains.

(2) Another set of experiments, which appear to us of greater value, are concerned with the "proligerous pellicle" or zooglœa that forms on the surface of organic infusions. Apart from his conclusions, which means, of course, leaving Hamlet out of the play, Dr. Bastian's study of the surface pellicle, apparently a very hotbed of life, is a very interesting contribution to microbiology. From such a pellicle, which *seems* to consist solely of aggregates of bacteria, come fungus "germs," amœbæ, flagellate monads, and even ciliated infusorians like vorticellids. Some of the transformations are described and photographed from stage to stage, and a point is made of the diversity of results obtainable from similar pellicles. But, so far as we can see, no progress in proving heterogenesis can be made along this line. From what *seems* to be a homogeneous pellicle of discrete corpuscles there arise all sorts of animalcules, and Bastian argues in favour of heterogenesis because they were not there before; while to the majority of biologists the emergence of the amœbæ and infusorians simply proves that they *were*, in minute form, there before, or *were added to* the pellicle from above or from below in the course of the transformation.

It is a familiar fact that a small sample of water from a brook may show in many representative drops no evidence of living organisms of any kind, even when examined under very high magnification. But in this sample after a week or two there are not merely microbes, but monads, flagellates, and even ciliates. The enthusiast on behalf of heterogenesis concludes that the new tenants arose from ultra-microscopic animate particles or from non-living material; the ordinary humdrum biologist concludes that he overlooked in his sample the juvenile forms of the now obvious tenants, or that his expedients to avoid infection from without were insufficient. But, prejudice apart, it seems a little like a *non possumus* argument on both sides until we inquire into the familiar control experiments of boiling or otherwise sterilising the samples, and then the advocate of heterogenesis is forced to say that such cataclysmal operations as boiling prevented the inorganic potentialities from asserting themselves. This savours strongly of the explanation of a séance failure by the presence of sceptical spirits. It may be that in both cases the objection is valid, but when a full-fledged vorticellid emerges in the sample, or when the summoned spirit reveals an acquaintance with the canards of the daily Press, we fall back into utter scepticism in regard to both heterogenesis and spiritualistic séances.

(3) Many other heterogenetic modes of origin—of fungus "germs," of amœbæ, of monads, of Actino-

phrys, of Peranemata, and of diatoms—have been observed by Dr. Bastian. Thus he describes in detail how within the closed cells of sprigs of *Nitella opaca* multitudes of Actinophrys appear; "all the smallest specimens are of just the same size as the chlorophyll corpuscles," "none are to be found smaller than these corpuscles," they have at first no rays, and they are motionless. "The myriads of chlorophyll corpuscles are converted into the myriads of Actinophrys." That is to say, the corpuscles of a vegetable cell may be suddenly transformed into well-known Protozoa with a specific cytoplasmic and nuclear structure, a *per saltum* transformation which no biologist would believe even if he seemed to see it, for it suggests a magical evolution entirely beyond credence, because so meaningless. In the same way the author describes the origin of immature diatoms as heterogenetic products due to the transformation of the cells of the alga Chlorochytrium, parasitic in the duckweed. Of course, the author discusses other interpretations, the infection hypothesis, backed by a further hypothesis of chemotaxis, and shows at length that they do not fit the facts he has observed. It may be noted that we have a very imperfect acquaintance with the complete life-histories of most unicellular organisms, that there is probably an extraordinary complexity of symbiosis and commensalism amongst them, that many are known to be very modifiable or plastic; and it may be that Dr. Bastian's work will find its reward in provoking research to make our knowledge of unicellular organisms more continuous. On the other hand, it is well known that many forms carefully studied have a very definite and specific organisation, and we would believe many things—even that Dr. Bastian's carefulness of method was not all that could be desired—rather than accept the view that one type of cytoplasmic organisation can be suddenly transformed into another. Evidence in favour of a certain amount of heterogenesis many biologists would be prepared to consider carefully, but when it comes to a chlorophyll corpuscle changing into an Actinophrys, we are in the position, absolutely inevitable, of those who would not believe in a resurrection though one rose from the dead.

(4) The climax of Dr. Bastian's book is his account of the heterogenesis of ciliated infusorians. These relatively highly organised forms may arise, he says, from the pellicle on organic infusions, from the transformation of amœbæ, from encysted euglenæ, from the eggs of Tardigrada, and from the eggs of the rotifer, Hydatina. Let us confine ourselves to the last instance. It was found that the eggs of Hydatina may give rise in a few days to young forms of Vorticella, Oxytricha, *Aspidisca costata*, or to a large ciliate known as *Otostoma carteri*. Nine stages in the transformation of a fresh egg of Hydatina into an Otostoma are described, and the author says "however improbable this transformation may seem to those who have not studied the changes for themselves, the possibilities of error are still more improbable." Against the suggestion that he mistook encysted Otostoma for the rotifer's eggs, Bastian gives seven items of evidence; against the suggestion that each egg seeming to undergo the transformation in question, was infected by an immature form of the infusorian, he gives eight items of evidence. If we take for granted that Dr. Bastian made no mistake in identifying either the Hydatina eggs or the large Otostoma, we must conclude that he witnessed a remarkable phenomenon which should be re-studied and properly figured. Different stages should be treated by the usual histological methods, carefully drawn and compared with the normal course of development. Careful attention should also be paid to the numerous parasites of rotifers, *e.g.* those described by Przesmycki. The photographic method used by Bastian has its obvious value, but the results are very far from clear or convincing.

In an exceedingly interesting and acute chapter on the general subject of discontinuous or *per saltum* variation, Dr. Bastian points out that his general position is supported by analogies in the inorganic world, *e.g.* by the fact that many substances crystallise in forms which belong to two or three different systems of crystallisation, and that the difference of crystalline form which they exhibit is associated with difference of specific gravity, hardness, colour, and other properties. Then there is the case of radium, which "may be looked upon as continuously giving rise to new elements by a process of material evolution." He discusses cases of abrupt or transilient variation in animals and plants, and combats the opposition which Weismann expressed in his early "Studies in the Theory of Descent" to the idea of "sudden transformation of the whole organism." But Weismann's views have changed not a little since 1882, and it would have been fairer to have quoted from his "Vorträge" of 1902. Dr. Bastian does not seem to have quite realised how many biologists now accept, as proved up to the hilt, the frequent occurrence of Galton's "transilient," or Bateson's "discontinuous," or De Vries's "mutational" variations. But this is not quite the same thing as accepting the observational conclusion that the chlorophyll corpuscle of Nitella may become a sun-animalcule, or a rotifer's egg a large ciliate! There are some things that one must see for oneself, and even then one would not believe them! It may be that "the lowest organisms exist at the present day because they are ever seething up anew by processes of heterogenesis"; and we should not be greatly surprised if that turned out to be a thesis "founded upon fact and consistent with reason." But such an epoch-making conclusion must be proved, not by one prejudiced in its favour, but by a man of *thätige Skepsis*, who takes every possible precaution to avoid discovering heterogenesis, who will certainly not adduce as evidence cases of a rotifer's germ-plasm demeaning itself to reincarnation as a ciliated infusorian. The author was forced, indeed, to offer the evidence that he observed, but if he had not drawn his bow quite so far as the case just cited implies, the arrow with "heterogenesis" on its feather might have penetrated further.

Very useful, it seems to us, is the author's idea of "ephemeromorphs," that is, of transitorily occurring phases among unicellulars, which may be wholly due to modificational influence, in contradistinction to the

regularly recurrent stable forms which constitute a species. We are inclined to think that this idea, extended to the study of multicellular forms, would show that many so-called species are based on transient "modificational" ephemeromorphs.

There is a dignified candour in Dr. Bastian's attitude towards sceptics. "It will doubtless be said that the facts I have brought forward are mere figments of my imagination, seeing that others observe no such phenomena, and that my experience is altogether exceptional." To this he answers (1) that many recorded phenomena, referred without proof to infection by parasites, are more simply interpretable as heterogenetic; (2) that he has seen the numerous cases he has recorded because he has diligently looked for them through many years; and (3) that, after all, his photographs of transformations have to be explained somehow. We must confess that the photographs, "engraved and printed," appear to us no more than a plethora of puzzles and futilities of delineation. The method is obviously admirable in being impersonal, but it seems to us quite ineffective in showing the transformation of the rotifer's or tardigrade's ova into infusorians. But we can only state our own impression; others may see more in them than we can detect; perhaps the eye of faith will see much.

"Some of my critics have refused to give any adequate consideration to the work because it has not been entirely done under certain impossible conditions which they would prescribe." Dr. Bastian admits that he has not uniformly isolated the organisms under process of change or placed them in a sterilised medium. Such cataclysmal interference would inevitably stop the heterogenetic progress. He declares, however, that the observations in proof of the heterogenetic origin of bacteria and their allies "have been conducted with all necessary precautions against the possibility of infection." If so, and every experimenter will agree that it is a big "if," then the bacteria did arise by heterogenesis, *or* they were present, though unseen, from the first. To the critic who asks why Dr. Bastian did not continuously watch the alleged heterogenetic changes from start to finish on the same individual organism, it is answered that the method pursued was that usually followed in embryological research—that of observing different states of change in different individuals. The method is comparable to that of palæontologists in working out a presumed series of phyletic change; it is not absolutely demonstrative, but it reveals phenomena which must be interpreted somehow; and the best and most reasonable interpretation, "as much as possible irrespective of preconceptions and *a priori* views," seems to the author that of heterogenesis. If it be urged that Dr. Bastian should have watched the heterogenetic processes he believes in with the same sort of assiduous continuity as Dallinger and Drysdale achieved in studying their plastic monads, it is answered that "compliance with such demands would not only be fruitless but would go far to render for ever impossible any knowledge of heterogenesis." Why this should be so we do not understand, unless heterogenesis be like the building of the fairies' palace which always stopped if anyone looked at it. But the fact is that "the methods employed by those who would gain a knowledge of heterogenesis cannot, from the very nature of the subject, be strict laboratory methods"—and this, we fear, will foreclose the question in the eyes of most biologists.

For our part, the suggestion of foreclosing a question like this savours of prejudice, and it should be remembered that results of great value, both theoretically and practically, have issued from the long drawn out controversy over spontaneous generation. After a careful study of Dr. Bastian's book, we venture to sum up our impressions as follows:—(1) If the idea of heterogenesis means, when generalised, that there may be marked discontinuity, or transilience, or *per saltum* change in the ceaseless process of organic variation, then we side with the author, and in this regard he will find that he has many allies. (2) In so far as the idea of heterogenesis implies that many of the lowest forms of life are very plastic creatures of circumstance, capable of passing from phase to phase of the cell-cycle under modificational stimulus, so markedly that they may be called "ephemeromorphs," we again side with the author, for we think that there are many facts which point in this direction. (3) As to the thesis that simple organisms "are ever seething up anew by processes of heterogenesis," it seems to us, in our ignorance, a quite legitimate conception which may eventually be demonstrated as true. (4) But as to the majority of the cases of heterogenesis which Dr. Bastian adduces, we cannot but reject them as inconclusive, not only because the methods employed seem to us to be fallacious, especially in depreciating the possibilities of latent germs and of infection; not only because they lead us to conclusions which we cannot harmonise with our confessedly incomplete biological system; but especially because they are so *meaningless*. If the egg of the Hydatina can, "under conditions not always easy to realise," be transformed into a large ciliated infusorian, then our *Systema Naturae* is a farce.

J. A. T.

PROF. OSTWALD'S JUBILEE.

Jubelband—Wilhelm Ostwald. Gewidmet zur Feier seiner vor fünfundzwanzig Jahren erfolgter Doktorpromotion von seinen Schülern, mit einer Einleitung von J. H. van 't Hoff. Pp. xxxi+679. (*Zeitschrift für physikalische Chemie,* Band 46.)

THIS stately volume is a fitting tribute to an eminent man who has done much to advance the progress of modern chemistry. The triumvirate, van 't Hoff, Arrhenius and Ostwald, the Dutchman, the Swede and the Russo-German, had a hard battle before their doctrines were accepted by physicists and by chemists. The communications made in the first volume of Ostwald's *Zeitschrift* by van 't Hoff (p. 481) on the *rôle* of osmotic pressure in the analogy between liquids

and gases, and by Arrhenius (p. 631) on the dissociation of substances dissolved in water, brought together the three friends in a manner which we now recognise as almost dramatic. Of Ostwald's 147 pupils, 34 of whom are now professors in universities all over the world, 34 have contributed memoirs to the "Jubelband" in honour of their teacher.

It would be impossible in the limited space of this notice to give an account of the contents of these articles, and it would be invidious to select names and tedious to mention all. Suffice it to say that the memoirs are in French, English and German; that their authors write from Germany, Russia, Finland, Sweden, Austria, Belgium, Greece, England, Scotland and Ireland; and that they are often under two names, implying that a third generation has aided in the research. The subjects of the memoirs range over a wide field; papers relating to solubility, to electric discharge, to electric conductivity, to vapour-pressures, to crystallisation, to catalysis, to capillarity, to high temperature reactions, to stereochemistry, to phase-rule phenomena, to colloids, to critical phenomena, to polarisation phenomena, all are found in this volume, and it is certain that each and all of the authors would acknowledge that their inspiration was derived in great part from their master, Ostwald.

A list is given of Ostwald's publications. The colossal labour of collecting and coordinating all known facts bearing on general chemistry is shown by the fact that the "Lehrbuch der allgemeinen Chemie," begun in 1885 and ended in 1887, required a new edition in 1891, which, indeed, is not yet quite complete; that, in addition to this *magnum opus*, a "Grundriss" was published in 1889; that volumes on "Physicochemical Measurements" (1893), "The Scientific Foundations of Analytical Chemistry" (1894), "Electrochemistry" (1896), "Outlines of Inorganic Chemistry" (1900), "Lectures on Philosophy" (1902) and "Chemical Dialogues" ("Die Schule der Chemie") (1903) have all proceeded from Ostwald's facile pen; and that translations of many of these works have appeared in English, Russian, French, Polish, Czech and Japanese. Besides these original works Ostwald has edited and annotated since 1889 selections from the works of Dalton, Wollaston, Gay-Lussac, Avogadro and Ampère, Hess, Hittorf, Wilhelmy, Bunsen and Roscoe, Berzelius, Carnot, Dulong and Petit, Davy, Scheele, Kirchhoff and Bunsen, and Berthollet, in the series of "Classics of Exact Science"; he has edited, along with van 't Hoff, the *Zeitschrift für physikalische Chemie* since 1887, of which 45 volumes have now appeared (it is to be presumed that the editorship of this, the forty-sixth, was not carried out by him); and since 1875 he has published no fewer than 120 papers and memoirs, embodying in large measure the results of his own researches; lastly, he has contributed about 3880 abstracts of papers and 890 reviews of books to the Zeitschrift which goes by his name.

One may well ask, how was it done? Those who know Ostwald will still be amazed; but they will recall to their minds that he possesses a rapidity of thought, an extraordinarily retentive memory, an astounding diligence and a pen which moves without effort; and perhaps most important of all, the power of expressing his ideas and those of others in clear language. Indeed, it may almost be said that Ostwald has imparted to German the accuracy and lucidity of French.

The volume contains an excellent portrait of Ostwald at his desk, and van 't Hoff prefaces the contents by a short biography, from which we learn that he was born in 1853 in Riga, that he was there as schoolboy, student, assistant, "privat-docent" and professor, until, in 1887, he was called to fill the chair of physical chemistry in Leipzig, a position which he still holds. Van 't Hoff also sketches Ostwald as a teacher, an investigator, an organiser and a reformer, and traces his progress in research from his earliest work on "The Mass-action of Water" to his latest work on the "Philosophy of Nature." The gap may appear a wide one, where only the two ends of the curve are given; but it is a continuous curve, and one which abundantly testifies to the "Stetigkeit," or continuity, of natural phenomena. Ostwald's missionary zeal is also portrayed.

"He is not content in gaining a view for himself; it is perhaps with him a necessity to impregnate others with his thoughts, and this has doubtless largely contributed to the present-day position of physical chemistry. The spreading of his ideas abroad runs parallel with his own activity in research and original thought."

Again:—

"In Ostwald as organiser we admire the practical man, who sees clearly what can be done, in small as well as in great things. On the small scale he is the constructor and deviser of handy apparatus, which he himself enjoys making, and the contriver of convenient methods of work. . . . On the large scale, he carries this sense of the practical to the erection of a pattern laboratory in the new institute at Leipzig, dedicated chiefly to physical chemistry, and embodying the many-sided mind of the master."

And in picturing another side of Ostwald's character, van 't Hoff writes regarding the work of Arrhenius (and though modesty forbids him to mention it, of himself):—

"How often do we see in similar cases an estrangement! With Ostwald, however, the opposite; sympathetic cooperation, in which Nernst soon joined as a partner."

Lastly, in dealing with Ostwald's many-sidedness, for example, in founding the Bunsen Society for Electrochemistry and editing the *Annalen der Naturphilosophie*:—

"The astonishing thing, when we consider Ostwald's activity, ever extending to wider and wider circles, is that neither his interest in his former sphere of work nor his mastery over it lessens."

Fortunate they who have been Ostwald's students; and happy they who possess his friendship!

JAPANESE BOTANY.

New Lessons in Elementary Botany (*Saishin Shokubutsugakkô Kwasho*). By Itô Tokutarô, Rigaku Hakushi, D.Sc., F.L.S.

OF this well got up, well illustrated, and lucidly written elementary treatise on botany the following translation of the introductory chapter or preface will give an adequate general idea.

It describes the province of botany in a manner likely to interest a young Japanese student.

"The surface of the globe we live on is covered with a varied and abundant vegetation, differing and agreeing in accordance with differences and likenesses of soil and climate. In this Japan of ours, which is a land within the temperate zone, many and beautiful are the flowers of the wild plants that blow at the various seasons of the year. In spring we have the *sakura* (wild cherry), the *yamabuki* (Kerria), the *tsutsuji* (azalea), the *fuji* (wistaria); in summer the *Ayame* (iris), the *kakitsubata* (*Iris laevigata*?), the *yuri* (lily); in autumn the *hagi* (Lespedeza), the kikyô (Platycodon), the *ominameshi* (Patrinia); in winter the *tsubaki* (Camellia), *sazankwa* (mountain tea-flower) and the *fukujyusô* (*Adonis amurensis*).

"Among cultivated plants we have the *ume* (plum), *momo* (peach), *Kaidô* (*Pyrus spectabilis*), *botan* (peony), *shakuyaku* (*Paeonia albiflora*), *asagaho* (morning glory), *fuyô* (*Hibiscus mutabilis*) and *kiku* (chrysanth).

"On the hill slopes grow the *matsu* (Pinus), *sugi* (Cryptomeria), *hinoki* (Chamæcyparis), *keyaki* (*Zelkowa acuminata, yenoki* (*Celtis sinensis*), *Kashi* (oak), *shii* (*Q. cuspidata*), and other trees. On the wastes and moors we find *sumire* (*Viola Patrinii*), *tampopo* (*Taraxacum corniculatum*), *rengesô* (*Astragalus lotoides*), &c., among spring plants; among autumn ones, in addition to those named before, *fujibakama* (*Eupatorium chinense*), *suzuki* (*Eulalia japonica*), and others, in such abundance as to form a many coloured carpet varying according to the season spread over the land.

"In the fields and paddies grow rice, wheat, Indian corn, colza and raphanus under cultivation, the scene being diversified by scattered clumps of dark green bamboo groves. Then in the neighbourhood of temples and shrines are camphor laurels and *ichô* trees (*Gingko biloba*)—the camphor laurels are found indigenous only in China and Japan, but are cultivated elsewhere. The *ichô* is fairly common with us, and therefore not considered a curiosity, but abroad (with the exception of China) no tree resembling it is found—it is unique.

"Again, in ponds, swamps, lakes, and rivers we have *kawahone* (*Nuphar japonicum*), *jyunsai* (*Brasenia peltata*), *hishi* (*Trapa bispinosa*), *ukikusa* (*Lemna minor*), &c., and in the sea *arame* (Ecklonia?), *wakame* (*Alaria pinnatifida*), *kombu* (*Laminaria japonica*), *asakusanori* (a kind of laver), &c.

"On our high mountains only grow such plants as *kokemomo* (Vaccinium sp.), *ihôme* (Blyxa sp.?), *gankôran* (*Empetrum nigrum*), &c., also such plants as *yashi* (*Cocos nucifera*, but this may be a mistake), *hego* (sp. of tree fern Cyathea), &c., of Asiatic and Malayan character, others of Mexican and American affinities, such as *saboten* (cactus), *riuzetsuran* (various parasitic orchids), &c., even Australian forms, such as Acacia and Eucalyptus (but these, of course, introduced).

"Our indigenous species of trees, shrubs and herbs, including cryptogams, are very numerous; in addition, among botanical forms we must count the innumerable microscopic organisms found in a drop of water or in mouldy rice.

"Some 140 years ago scarcely 10,000 species (of phanerogams and cryptogams?) were known to science; now more than 175,000 are known to flourish on our globe, and to be thus denizens of the province of botany."

The illustrations are extremely good, and many of them apparently original. Among the best are those of the hydrangea (*ajisai*), *Vicia faba* (*soramame*), the fruit of chestnut (*Kuri*), section of plum-fruit, wood of wild cherry and of *shuro* (Trachycarpus), the figure of a potato plant (*jagatara-imo*), dissection of iris flower, mistletoe on Celtis, &c. There are, in addition, two very finely coloured plates, both of gorges among the Nikko Hills, one—the frontispiece—showing, ingeniously enough, on its guard-fly leaf the outline figures with the names of the principal plants in the rich mass depicted in the chromo. Unfortunately, of the Japanese names given, only one or two can be identified in any books at my command. It is worth notice how large a proportion of the names of even common plants is Chinese.

Dr. Itô may be congratulated on the production of so excellent, indeed charming, an introduction to the study of that most fascinating of sciences, botany.[1]

F. VICTOR DICKINS.

OUR UNIQUE EARTH!

Man's Place in the Universe. By Alfred R. Wallace, LL.D., D.C.L., F.R.S., &c. Pp. xi+330. (London: Chapman and Hall, Ltd., 1903.) Price 12*s*. 6*d*.

A BOOK from the pen of so distinguished a man as Dr. Alfred Russel Wallace would naturally find many readers, but the present volume, dealing with a subject of such general interest, will undoubtedly be widely distributed.

This work is the outcome of an article which Dr. Wallace published some time ago, and the interest it excited spurred him on to bring together in book form in a more elaborate and detailed manner the arguments on which the subject-matter was based.

The reader, therefore, has now before him the whole of the evidence upon which the author claims certain conclusions, which have "enormous probabilities in their favour," namely, "that no other planet in the solar system than our earth is inhabited or habitable," "that the probabilities are almost as great against any other sun possessing inhabited planets," and "that the nearly central position of our sun is probably a permanent one, and has been specially favourable,

[1] I am not sure of the accuracy of the above given botanical equivalents.

perhaps absolutely essential, to life-development on the earth."

A close perusal of the subject-matter indicates, in the first place, two prominent facts. First, the masterly way in which Dr. Wallace has marshalled the available subject-matter to enforce his lines of argument, and second, the excessively clear and concise summary of the astronomical knowledge which he has employed. This latter is contained in the first six chapters, and although the author suggests that those who are fairly acquainted with modern astronomical literature might omit reading these, the account is so excellent that the advice should not be followed.

It is not the object of this review to tell our readers whether Dr. Wallace is correct or not in the conclusions at which he has arrived, for that would not be an easy matter, but to direct attention to a work which must be treated with considerable respect.

Astronomical science has, during the last thirty years, made enormous strides, but the information that is needed when considering such a problem as is dealt with by Dr. Wallace is still very sparse, and is conspicuously absent from many books which by their titles ought to contain it.

Chapters vii. to ix. deal with the problems, Are the stars infinite in number? our relation to the Milky Way; and the uniformity of matter and its laws throughout the stellar universe. In all of these the author displays a very thorough acquaintance with the recent advances in these subjects. He concludes from such evidence that the stellar universe is limited, that the solar system is nearly in a central position of the Milky Way, this position being probably a permanent one, and, lastly, that the whole material universe is one as regards physical and chemical laws and material structure.

In the next chapter he sums up the essential characters of the living organism in a remarkably clear and definite manner, and points out the intimate connection between animal and vegetable life.

The chapter which follows describes all the physical conditions essential for this organic life, and then the four subsequent ones point out how these conditions, in his opinion, exist only on one planet, our earth, in the solar system. Not only does he suggest that the earth alone is inhabited, but that the other planets of the system have never been and never will be the seat of organic life, since they never can produce the exact conditions that are considered necessary.

The next and last chapter carries the argument into the starry realm beyond the solar system, and here the author gives his reasons for concluding that only a very few of these stars may be suns with life-supporting planets.

In considering man's place in the universe it seems that the matter dealt with in chapter x., in which the author describes the essential characters of the living organism, contains the criterion on which the whole question of the habitability of other worlds turns.

It is known that protoplasm is so complex chemically that it defies analysis, and protoplasm, to use Dr. Wallace's words, "is, as it were, only the starting point or material out of which the infinitely varied structures of living beings are formed. The extreme mobility and changeability of the structure of these molecules enable the protoplasm to be continually modified both in constitution and form, and, by the substitution or addition of other elements, to serve special purposes."

May it not be that the very complex nature of protoplasm and its very property, the ease with which it may be modified, enable it to adapt itself to the various conditions, such as distance from central orb, size, &c., that exist on the different planets at those epochs in their life's history when the temperature conditions are within the prescribed limits?

Might not this element of living matter, working under somewhat different conditions, so affect the after products that they in their turn could weather the existing conditions, which to them would be natural and to us special?

To consider this earth as the only inhabited body in the stellar universe, a reversion to prehistoric ideas, may or may not be an advance, but it will require very strong arguments before man can be brought to consider that his isolation in the cosmos is indeed a fact.

The book, however, is one that should be read by all those interested in such a speculation, for speculation at the present time it can only be, and much valuable information may be learnt about the various subjects which the author has had to deal with in his broad survey.

OUR BOOK SHELF.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by W. T. Blanford. Rhynchota. Vol. ii. Part. i. (Heteroptera). By W. L. Distant. Pp. x+242. (London: Taylor and Francis, 1903.) Price 10*s*.

MR. DISTANT is making good progress with the description of the known species of Indian Rhynchota, and the editor informs us in his preface that the remainder of the volume will comprise all, or nearly all, the remaining families of the division Gymnocerata, thus leaving the bulk of the water-bugs for a third volume, which will complete the subject as far as the Heteroptera are concerned. The present instalment includes 371 species belonging to the families Lygæidæ, Pyrrhocoridæ, Tingididæ, Phymatidæ, Arœdidæ, Hebridæ, Hydrometridæ, Henicocephalidæ, and the commencement of the Reduviidæ. The letterpress is executed in the same careful manner as in the first volume, and is illustrated by 167 excellent text illustrations.

A considerable number of new species are described in the present part, and a very large proportion of the remainder have only become known to entomologists within the last few years, many of them, indeed, having been described by Mr. Distant, or others, as late as 1903. When we consider that the Hemiptera have been far from exhaustively collected at present, and that many of the families include small plant-feeding species, it will be plain that a vast amount of work still requires to be done before our knowledge of the Indian species can be considered as anything like complete. But such works as Mr. Distant's cannot but give a vast impetus to the study, while those who know its extent will not be liable to repeat the amusing error of Lich-

tenstein, who wrote in vol. vi. of the Linnean *Transactions*, about a century ago, that before he knew Fabricius personally, he thought the latter had been disrespectful to Linné and his other predecessors because he wrote that very little was known of entomology at that time, and that the study, especially as compared with botany, was still quite in its infancy.

Our own conception of present and future progress is doubtless equally imperfect, and it has been well said that no race of mankind is permitted to anticipate the prerogatives of its successors. To our grandfathers and great-grandfathers the very idea of carriages going without horses seemed ridiculous, and the mere suggestion of the wonderful discoveries of the last half-century would have been regarded a hundred years ago as the ravings of a lunatic.

A New Geometry for Junior Forms. By S. Barnard, M.A., and J. M. Child, B.A. Pp. vii+306. (London: Macmillan and Co., Ltd., 1904.) Price 2*s.* 6*d.*

THIS work is a selection from the larger work of Messrs. Barnard and Child published a few months ago. It is, of course, on the modern lines of teaching now almost universally adopted in England. There is no necessity for entering into a detailed account of the contents of the book, for the order and method of treatment are the same as those of the larger volume, which has already been highly commended in these columns. The work is simple, very thorough, and in every way suited to the requirements of junior students.

Although employing instruments and devoting much space to "practical" work at the outset, the authors never lose sight of the fundamental fact that *geometry is a science of strict logic.* Even those reformers of geometrical teaching who have done most to break with the difficult and stilted formalism of Euclid are sometimes alarmed by the methods adopted by the expounders of "practical mathematics"—methods entirely reprehensible because of their ignoring the logical foundations of science. The fact is that the teaching of modern improvements should be in the hands of skilled experts who have a commanding knowledge of scientific methods and results, and who are able to simplify matters for the student without sacrificing any portion of logical reasoning. We must take care that mere manual work, mechanical processes, and slipshod reasoning do not undermine the principles of accurate thought either in pure or in applied mathematics. So far, the works on geometry which give expression to the principles of the British and Mathematical Associations are beyond suspicion. The danger—though by no means absent from pure mathematics—is certainly greatest in physics and applied mathematics.

Fragments from Continental Journeyings. By A. R. Sennett. Pp. vi+516. (London: Whittaker and Co., 1903.) Price 4*s.* 6*d.* net.

WE have all done it; R. L. Stevenson with a prose fancy that would elevate road-metal itself to a place among the humanities; Henry James with a just delicacy, that seems to add a decorative touch to the familiar châteaux and the well-worn ways; the rest of us, in this latter time, at a long distance and in various measure, yet drawn irresistibly into print. And now Mr. (or Miss?) A. R. Sennett is moved also to attempt to give to others some of the abiding pleasure experienced on the open road.

We have doubts as to the writer's sex, mainly on account of the references to female costume at Monte Carlo; the male author, moreover, is usually more circumspect in revealing his ignorance of foreign languages. This little book is crowded with inaccuracies in French and German, in fact, even the single words printed in italics are frequently incorrect. Names, which can be found on the maps in the library of the Automobile Club, are also occasionally misspelt. Hence we can hardly treat the work as a contribution to geography. The ground covered is that dealt with by the post-chaise travellers of the early nineteenth century, when the close of the great wars again allowed of observation. The frontispiece of Grindelwald and the Wetterhorn gives sufficient clue to the scope of the book as a record of continental journeyings. We have no right in this place to deal with it from a literary point of view; nor do we think that the author would welcome the remarks which we reserve. G. A. J. C.

Recueil d'Expériences élémentaires de Physique. First part. By Henri Abraham. Pp. xii+247. (Paris: Gauthier-Villars, 1904.) Price 5 francs.

THIS volume of less than three hundred pages has been produced with the collaboration of 154 physicists from all parts of the world!

The book is the outcome of a request made primarily to the members of the French Physical Society by its secretary, with the authority of its council, that they should aid in the production of a volume describing elementary experiments in physics by forwarding an account of any special experiments forming part of their laboratory courses. M. Abraham is editing these, and this is the first part of the result—a second part is to follow.

The descriptions of the experiments are not accompanied by theory. The only incursion into the domain of theory has been to direct the reader's attention to the degree of precision possible in each measurement, and to the need or uselessness, as the case might be, of introducing corrections.

On the other hand, great attention has been paid to describing the arrangement of the experiments; for example, all necessary sizes are specified in order that they may be reproduced as easily as possible.

No attempt has been made to unify the style of the very various methods which the author selected from; on the contrary, the desire has been to present as great a variety as possible.

The first chapter consists of elementary instruction in workshop practice (including glass-blowing), and has an appendix containing many useful receipts. The second is on geometry and mechanics, the third is on hydrostatics, hydrodynamics and capillarity; the fourth chapter deals with heat.

The experiments described are, in the majority of cases, of a very simple character, less suitable for colleges than for schools, where they should be very welcome. Many of them, indeed, are arranged as they might be by an amateur at home, and the instructions are certainly simple enough for a lad with mechanical and experimental tastes to derive a large amount of useful pleasure in carrying them out without the aid of a teacher.

Cassell's Popular Science. Edited by Alexander S. Galt. Volume ii. Pp. xii+556. (London: Cassell and Co., Ltd., 1904.)

THIS attractive volume, with its numerous excellent illustrations and its clear type, is calculated to create interest in the study of science. The editor has arranged matters in such a manner that most branches of natural knowledge are drawn upon to provide interesting reading. The first six articles, for example, deal with subjects belonging to physics, biology, astronomy and geology—and the reader's attention is certainly not kept upon one subject for too long at one time.

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.]*

Cancer and Parthenogenesis.

MAY I be allowed to refer to the interesting and stimulating discoveries of Messrs. Farmer, Moore and Walker, and Drs. Bashford and Murray? The former have demonstrated that nuclear changes occur in cancerous tissues, by which cells of malignant growths may be justly considered homologous to active sexual elements ("gametoid"). Giant cells are suggested to be "fusion-figures" which recall normal fertilisation (*sic*) in cancer.

I write to ask if botanists or zoologists are of the opinion that "post-heterotypic" cells (homotypic) are "inclined" at all to develop without fertilisation by the spermatozoon (*i.e.* by parthenogenesis from ? chemical stimulus).

Does parthenogenesis occur in the embryosac of flowering plants or in the prothallium of the higher cryptogams under any and what conditions?

On what known states does parthenogenesis in the eggs of the honey bee, in ascaris, in artemisia, &c., depend?

This sexual character of the cells of cancer explains partly its parasitic and invading nature; the wonderful power of mimicry of the tissues from which they originate suggests that metastases commence as cells self-fertilised and maturating. A knowledge of the (? chemical) causes underlying both these changes might afford a clue to prevention.

F. BUSHNELL.

S. Devon Hospital and Public Dispensary, Plymouth.

IN reply to the queries contained in the letter of Dr. Bushnell, it may at once be said that parthenogenesis is known to follow the application of certain stimuli in the case of a few animals and plants, Loeb's experiments on sea-urchins and Nathansohn's observations on Marsilea furnishing instances to the point.

Parthenogenesis occurs in the embryosac of species of Alchemilla, perhaps also in some species of figs, but the underlying conditions are not yet understood.

In other examples of parthenogenesis, as noted in animals, it arises in consequence of the lack of separation of the second polar body from the egg, or follows on the re-fusion of it with the egg. This represents, perhaps, a modified kind of fertilisation. Apogamy as occurring in ferns is a more remote event, but is apparently possessed of a similar significance.

I quite agree with Dr. Bushnell as to the importance of reaching an understanding of the chemical and other agencies that produce the change in cells previously normal, and the concluding paragraph of the article to which he refers emphasises this side of the subject.

J. B. FARMER.

Magdalen College, Oxford, February 13.

On a Dynamical System illustrating the Spectrum Lines and the Phenomena of Radio-activity.

BY the study of a system of particles, which is similar to a Saturnian system, I was led to the discussion of disturbances which propagate in the system, having close analogy with the band and line spectra while illustrating the phenomena of radio-activity. The system consists of a large number of particles of equal mass arranged in a circle at equal angular intervals, and repelling each other with forces inversely proportional to the square of distance between the particles; at the centre of the circle is placed a large particle attracting the other particles forming the ring according to the same law of force. If the repelling particles be revolving about the attracting centre, the system will generally remain stable for small oscillations, which consist of the transversal vibration perpendicular to the plane of the orbit, together with the radial and angular disturbances representing the rarefaction and condensation in the distribution of the particles. Small oscillations of this kind have already been treated by Maxwell in his essay on the stability of Saturn's rings; the system will be the same if the repelling particles of the present system be substituted by the attracting satellites. Evidently the system here considered will be approximately realised if we place negative electrons in the ring and a positive charge at the centre. Such an ideal atom will not be contradictory to the results of recent experiments on kathode rays, radio-activity, and other allied phenomena.

The frequency of the transversal vibration is given by

$$n = \omega - am^2 + bm^4 + \ldots,$$

where ω is the principal term and m the whole number. Plotting the lines of frequency, we find the crowding of lines when the value of m is small and when it is large. Generally the coefficient $a > 0$, so that with increasing m the frequency decreases, and the interval between the lines becomes wider. The distribution of lines resembles that of a band spectrum proceeding from violet towards the red. Taking the converging point of the lines for large values of m as the beginning, it is convenient to count the lines from the point, which I suppose to correspond to $m = m_0$. Then putting

$$m = m_0 - m'$$

we obtain, remembering that $\delta n = 0$ for $m = m_0$,

$$n = \omega' + a'm'^2 + b'm'^3 + \ldots$$

n increases with m', and the distribution resembles the band spectrum of carbon type, the interval between the lines gradually widening from red towards the violet. In fact, the above equation is an extension of Deslandres's formula.

If we suppose that the particles are negative electrons, we can easily prove that the transversal vibration will not be sensibly affected by the external magnetic field. This is another characteristic of the band spectrum.

The radial and angular waves propagating round the ring have frequencies given by

$$n = \frac{C}{\sqrt{1 - Am^2 + Bm^4 + \ldots}}$$

The distribution of lines is such that they crowd together for tolerably large values of m towards a region of high frequency, and is in its general aspect similar to a band spectrum, with the difference that the interval between the successive lines is about nine times wider than in the band spectrum above described. This we may identify with the line spectrum, although m is not the same as in the formula of Kayser and Runge, or of Rydberg. The supposition that the particles are electrons leads to the conclusion that a single line is separated into doublets, circularly polarised in opposite senses.

The ring here considered is quasi-stable. It may be set to disturbances the radial and angular components of which are nearly proportional to

$$e^{\kappa\nu t},$$

where κ is a constant, ν the number of particles in a ring, and t the time. If the disturbance continues for a sufficiently long time, the ring will be torn asunder and the system will fly off with great velocity. If the particles are electrons, those in the ring will give rise to β rays, and the central positive charges will form the α rays.

The ideal atom here considered will have high atomic weight when ν is large; consequently the instability is easier to produce when the atom is massive. Where there are several series of regular spectra we shall have to consider different rings of particles giving rise to these different sets. The complexity of spectrum is by no means a guarantee for the heaviness of atom; on the contrary, if high atomic weight is accompanied with comparatively simple spectral structure, we may consider that the system of rings is less complex, and ν may be quite a large quantity. This probably accounts for the remarkable radio-active property of radium, which, in spite of its high atomic weight, presents only a certain number of characteristic spectrum lines.

The kinetics of the system here considered may be extended to investigations which have analogies with the flutings of spectrum lines. Considered as electrons, the phenomena of actino-electricity, the ionisation of flames, the change of resistance of semi-insulators by exposure to light, the problem of coherer, the phenomena of fluorescence and

phosphorescence, and many allied subjects will probably be accounted for by the discussion of resonance and forced oscillations, to which the system is susceptible.

The above results were communicated to the Physico-mathematical Society of Tokyo in December last; the details of calculation will probably appear in the *Philosophical Magazine* in the near future. H. NAGAOKA.

Physical Laboratory, Tokyo University, January 18.

Science in the Navy.

IN view of the important articles which appeared in NATURE last year on the question of science in the navy, it seems desirable to inquire into the amount of encouragement which is now given to young lieutenants to adopt either of the more scientific branches of their profession.

Apart from zeal for the service and the love of knowledge, the most potent incentive to their doing so lies in the promise of early promotion to commander. Now, of the thirty-five lieutenants promoted on January 1 last, the following analysis will show that the more scientific officer has no advantage over his fellow as regards promotion. The periods between promotion to lieutenant and to commander were:—

	12	Lieutenants of the general service	...	10·8 years.
Lieutenants of special attainments	8	,, Gunnery officers	...	10·9 ,,
	6	,, Torpedo ,,	...	10·8 ,,
	9	,, Navigating ,,	...	11·9 ,,

From the above it is evident that no advantage accrued to those who had the ability to attain the scientific knowledge required for their respective branches, whilst the future of those who selected navigation was marred by having to wait a year longer than any other officer.

Lastly, it may be remarked that it argues well for a service in which science is courted by so many in spite of the small encouragement given in this matter of promotion.

N. G. T.

Organisms and Meteorites.

I SHOULD be glad to know whether anyone has ever attempted to test the hypothesis of Helmholtz and Lord Kelvin that meteorites are possibly the carriers of organised matter. By pulverising a portion taken from the interior of a meteorite it would, I should suppose, be easy to dissolve out and detect any organic matter that was there. The result in any particular case would probably be negative; still, wilder experiments have been tried before now. JAMES WARD.

Trinity College, Cambridge, February 15.

The Gordiidæ in Folk-lore.

THE sudden appearance of the Gordiidæ or hair worms in puddles of water or similar situations has caused the primitive peoples of many countries to evolve a theory of their seemingly mysterious origin. In parts of Scotland they are believed to be the intermediate stage in the development of a horse-hair into an eel; in Iceland and the Færöes, and also in some of the Malayan islands, they are thought to come down with the rain; in the Malay Peninsula they are said to be the offspring of an unnatural union between an earthworm and a female mantis, and to turn into a fern (Lygodium sp.), the creeping rhizome of which some of them (for example, *Chorodes montoni*, Camer.) closely resemble. (I found that a very large proportion of the true Mantidæ were infested by them in the Malay States.) In the same country, by an application of the principle of the doctrine of signatures, they are used in the manufacture of a hair-wash. I have thought that it might be interesting to trace out the beliefs held about them among different races, but I find references to them extremely scanty in ethnographical or general literature. If any of your correspondents could furnish information of the kind I would be extremely grateful, for I believe that an interesting contribution to the biological philosophy of savages might be made by collecting and analysing the different theories held by primitive peoples regarding a small and easily recognised group of animals like the Gordiidæ. NELSON ANNANDALE.

34 Charlotte Square, Edinburgh.

THE ANTARCTIC EXPEDITIONS.

MORE or less detailed accounts have now been published of all the three expeditions—German, Swedish, and Scottish—which, following the lead of the British party in the *Discovery*, have during the past two years striven to extend the bounds of knowledge in the far southern regions. Some idea can therefore be gained of the scientific results obtained in various directions. It is a remarkable illustration of the independence of climatic conditions on mere latitude that, while each of the expeditions wintered outside the Antarctic circle, the rigours experienced have hardly been exceeded in the case of expeditions which have wintered more than 10° nearer the pole in both hemispheres.

To begin with the work of the Swedish party under Dr. Nordenskjöld, of which summaries have been given both in the *Times* and in the *Geographical Journal*, it is mainly of the contributions to meteorology and geology that it is yet possible to speak, though when the magnetic observations have been worked out, results of no less importance may be expected. The value both of the meteorological and magnetic work has been greatly enhanced by the enforced detention during two winters, a much more effective basis of comparison with the observations of other expeditions and stations being thus supplied. Some useful work from a purely geographical point of view has also been accomplished, our knowledge of the contours of the land masses to the south of South America having received welcome additions, mainly as the result of two separate sledge expeditions undertaken during the two winters. The winter station, it will be remembered, was established on the eastern side of Louis Philippe Land, the northern extremity of the mass known further south as Graham Land. It was itself on an island lying to the east of the main mass, but although this appears to be fringed on this side by a regular archipelago of islands separated by wide channels, it was demonstrated—and this is one of the chief geographical results of the expedition—that the larger mass runs continuously southward from Louis Philippe Land to King Oscar Land. It is formed by a high range of mountain peaks separated by large glaciers, and further inland passing into a level ice-covered plateau. Within the outer limit of the archipelago an ice-sheet extended, bounded by a formidable ice barrier running from east to west in the neighbourhood of Christensen Island (an extinct volcano). The conditions of this ice-sheet recalled those of Ross's great ice-barrier on the opposite side of the Antarctic, and, as was found by Captain Scott and his companions on their great southern sledge journey, it was separated from the land by wide, deep, and impassable crevasses. This was ascertained during the first winter expedition, which lasted from September 30 to November 7, 1902, and had its furthest point in 66° S., 62° W. During the second winter the leader, with one companion only, explored the channels leading north behind the islands towards Erebus Gulf. The scenery here was found to be of the grandest kind; on one side was the magnificent range of King Oscar Land, on the other a large archipelago forming a remarkable contrast to the former, and made up of tufaceous volcanic rocks, with sounds, glaciers, and promontories, all dominated by the shining blue-white prominent peak of Mount Haddington, probably formed by a mighty crater. It was during this expedition that Dr. Nordenskjöld luckily fell in with Dr. Andersson and Lieut. Duse, who had left the *Antarctic* before the disaster which befel it, and had spent the winter in that inhospitable region with only a summer outfit.

Throughout the time spent in the far south, the

climatic conditions were generally adverse, the violent gales and great cold experienced during the first winter equalling, if not surpassing, those which so hampered the work of the Newnes Expedition to Victoria Land. During a whole fortnight in May and June the velocity of the wind averaged 45 miles per hour, and, worse than all, it was these south-westerly gales which brought with them the lowest temperatures. Thus the stormiest day (mean velocity 63 miles) was also one of the coldest (mean −24° F.). The mean temperature for the year was about 10·2° F., the same as in Hudson Strait or at Yakutsk, the two coldest places in the north, while the summer showed the exceptionally low mean of 28·2° F., the coldest so far known. In the summer, however, the gales became very much more moderate, being insufficient, in fact, during the first year, to break up the ice—the reason for the failure of the *Antarctic* to reach the winter station; and whereas in winter the snow was all blown away by the gales, in summer a great accumulation of snow was observed on the ice at sea-level. During the whole two years not a single aurora was observed. From a geological point of view the most interesting discovery was that of numerous fossil bones of vertebrate animals, some of great size, while abundant remains of plants were also found, proving that, as in the far north, the climate was once mild, and that there existed large forests of leaf-bearing trees where birds sang and strange large animals fed on the herbage. The fossils in the islands round the station were all of Mesozoic or Tertiary age, but Dr. Andersson had discovered, in the neighbourhood of his winter quarters, a rich fossil flora of a very different type, belonging to an older geological epoch.

Mr. Bruce likewise had much to contend against in the climatic conditions, which seem to have been exceptionally unfavourable during 1903. The results of the work of his party consist mainly—in addition to the full records of magnetic and meteorological observations kept up throughout the winter—of a series of soundings and other scientific observations carried out during a cruise of more than 5000 miles in seas never before visited by a scientific expedition, and of observations on the zoology and botany of the South Orkneys. The result of the soundings was to confirm the conclusion derived from Ross's single sounding further east, showing that between 60° and 71° there is a deep sea with a more or less uniform depth of 2500 fathoms. During this cruise the heaviness of the pack—the ice being real Polar ice, sometimes 15 to 20 feet thick—proved a serious obstacle, and it was only by working eastward along the outer edge of the pack, sometimes north, sometimes south of 60°, that it was at last possible to make a clear run to the south, which took the ship to 70° 21′ S., 17° W., where a sounding of 2543 fathoms was obtained. This was towards the end of February, after which winter quarters were sought in the South Orkneys, the position chosen being a bay on the south coast of Laurie Island. Here the ship remained frozen in for eight months, a fact, Mr. Bruce says, "perhaps one of the most remarkable in the history of Polar exploration—that in an oceanic island in so low a latitude as 60°–61° it was possible to be ice-bound for so long a period." It was probably due to the continuous ice-sheet which formed between the islands and Graham's Land, which had the same effect, temporarily, as the vicinity of a continent. Eventually the ice broke up and cleared out in a single day (November 23). At the winter station a solidly built stone dwelling house was erected and a special magnetic observatory (named after Prof. Copeland), the observations at which, as also the meteorological work, were carried on by Mr. Mossman. Survey work, soundings and tidal observations were also carried on by Mr. Bruce, Mr. Wilton, and the ship's crew. During the spring, foggy and cloudy weather was very prevalent, causing many hindrances, while the rapid variations in temperature—sometimes as much as 40°–60° F. in a single day—were also very trying. All the land is described as very precipitous, rising sheer out of the water, but in spite of this the penguins manage somehow to ascend. Among the zoological facts collected, it was ascertained that the shag which inhabits Antarctic islands is the blue-eyed shag. It is hoped the work of the expedition may be continued for another year.

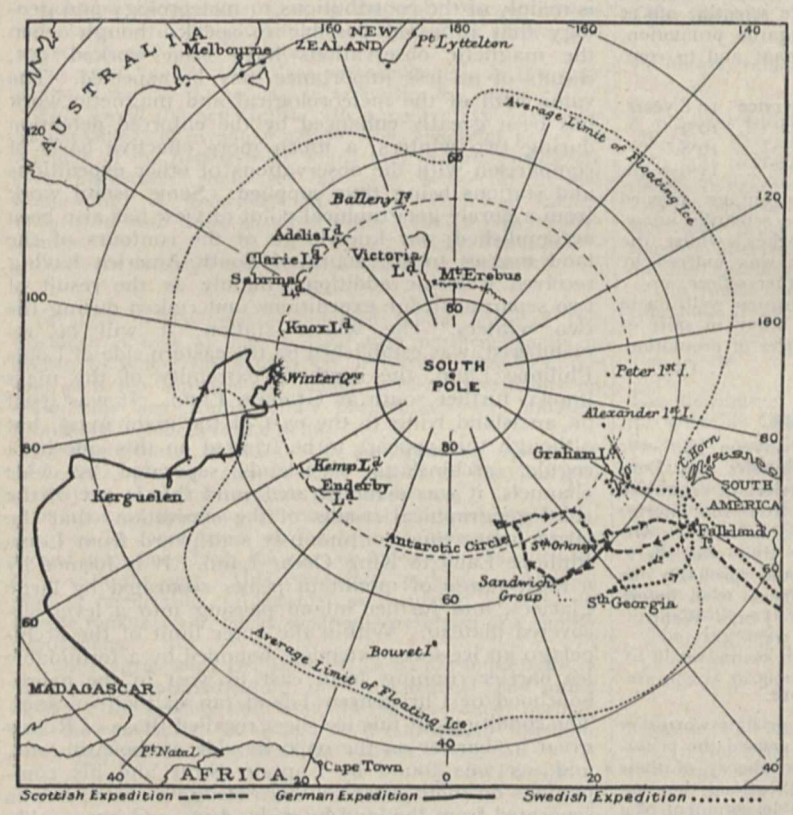


FIG. 1.—Routes of Scottish, German and Swedish Antarctic Expeditions.

As regards the German expedition, Dr. Drygalski's preliminary report issued last summer has been supplemented by the publication of the first instalment of the scientific results, while a general account of the expedition has also been given before the Berlin Geographical Society and printed in the *Zeitschrift* of that body (1904, No. 1). It is again in the field of meteorology that some of the most important work has been achieved. The climatic conditions at the winter station of the *Gauss* showed clearly that the zone of the west winds had been left behind and a new climatic

area approached, marked by east winds blowing from a continental region of high pressure in the south. The storms so characteristic of the south polar region were here experienced in their full force. Although the only land actually inspected was the solitary peak of the "Gaussberg," the whole character of the neighbourhood, with its vast sheet of "inland-ice," was such as to argue the existence of a continental mass stretching southward from the Antarctic circle. The ancient crystalline character of the rocks and the sudden fall towards a deep sea in the north point in the same direction. Valuable observations of the ice-conditions, both of the sea and land areas, were made, and the paper in the *Zeitschrift* is accompanied by excellent photographic representations, one showing the stratified formation of an iceberg being especially noteworthy.

THE "FISH HYPOTHESIS" AND THE TRANSMISSION OF LEPROSY.

LEPROSY is a disease that has been known from the earliest times, and in the British Isles was very prevalent in the twelfth and thirteenth centuries. At the present time, though unknown in many countries, it is impossible to traverse any large tract in any continent without meeting with cases, Norway, the Mediterranean littoral, India, China, certain of the Pacific islands and various parts of America and Africa being preeminently the seats of the disease. A bacillus having a strong resemblance to the tubercle bacillus is present in enormous numbers in the leprous tissues, and is regarded as the specific virus, though it is non-inoculable into animals, and, with doubtful exceptions, has never been cultivated.

The transmission of the disease is generally regarded as being due to personal contagion, and there are many facts in support of this view. Segregation of the lepers is believed to be eradicating the disease in Norway; the introduction of a case of leprosy into a place previously free has been followed by a great spread of the disease, as in the Loyalty Islands, and many instances are on record of persons contracting the disease after associating in some way with the sick, whose secretions swarm with the bacilli.

For some months past, Mr. Jonathan Hutchinson, F.R.S., has been strenuously maintaining his "fish hypothesis" of the origin and transmission of leprosy with an ardour and with a wealth of facts and figures that must strike all with admiration. Moreover, Mr. Hutchinson has recently undertaken two journeys, to India and to the Cape, in order to collect data in support of his hypothesis, no light undertakings for a man of his years! Briefly stated in his own words, "the fish hypothesis assumes that in all ages and in all countries, leprosy has been and still is due in the main to the consumption as food of decomposing or imperfectly cured fish. It is thought probable that the disease is a modification of tuberculosis, and that it receives modification in connection with some specific virus (toxin or bacillus) which is occasionally, but by no means frequently, developed in connection with such fish. It assumes that, if the virus be present, a very small quantity of fish may suffice to produce the disease in its full vigour, whilst, if it be absent, large quantities may be habitually consumed without any result. It is a specific poisoning which occurs, and by no means merely a form of ill-health due to unwholesome diet. It has no degrees of less or more, and is either contracted in its totality or wholly escaped. Thus, all who eat fish in bad condition are supposed to run some risk; and those who eat it habitually and largely encounter that risk more frequently than others. It is, however, the quality and not the quantity with which chiefly we are concerned—the presence or absence of the specific virus. For the present the existence of such a virus is a matter of hypothesis, for it has never been isolated from any specimen of fish. Thus the evidence is circumstantial, not demonstrative."

Mr. Hutchinson has directed attention to the incidence of leprosy among Roman Catholic communities; this he attributes to the use of fish during the fasts ordained by that Church. Believing, as he does, that personal contagion plays little or no part in the spread of the disease, he advocates the abolition of leper asylums or at least a great mitigation in the severity of the laws as regards segregation, especially in Cape Colony.

Mr. Hutchinson's hypothesis is doubtless supported by many facts, and there is a remarkable coincidence between fish-eating and leprous districts. Thus in India generally the incidence of leprosy is about three or four cases per 10,000 of the population, but in the island of Minicoy, devoted to fishing, it rises to 150, and in Kaligoan, a fish-curing centre, to 500. The decline of leprosy in the British Isles he would attribute to the improvement in the food of the people and to the introduction of the reformed faith, whereby fasting was abolished. There are, however, grave difficulties in the way of accepting the fish hypothesis as proved. It is almost certain that leprosy is met with among peoples who rarely or never touch fish, *e.g.* the Basutos, as pointed out by Dr. Turner. Mr. Hutchinson has controverted this statement, alleging that Dr. Turner's witnesses were not to be believed, but surely the same argument may be applied to much of Mr. Hutchinson's own evidence. Mr. Hutchinson states that on several occasions he has by cross-examination obtained an admission of fish-eating that had previously been denied. But the cross-examination of an ignorant and perhaps terror-stricken native by a casual visitor is hardly calculated to elicit the truth, and must be carried out with the greatest circumspection or the examinee will infallibly admit that which he believes is required of him. On this ground much of Mr. Hutchinson's evidence must be regarded as untrustworthy. Then there is the difficulty as to why fish in bad condition conveys the disease, whereas good fish, fresh or dried, is innocuous. Why is the virus present in bad fish and not in fresh fish, where does it come from, and how does it get there? These are questions that require an answer, for it is admitted that the leprosy bacillus has never been met with apart from the leprous person; there is absolutely no proof, or even suspicion, that fish harbour the leprosy bacillus. Orkney and Shetland formerly suffered greatly from leprosy, but Mr. Traill Skae, in a letter to the *British Medical Journal*, entirely denies that the food of the people has much improved and asserts that enormous quantities of bad fish are still consumed. It would seem much more likely that the civilisation of a people that will eat bad fish is low and that promiscuous intercourse of all kinds is, therefore, habitual, leading more readily to personal contagion; this would explain the connection, if there be one, between the consumption of bad fish and leprosy.

As regards segregation being useless, Dr. Ehlers states that in Iceland, during the five years after the opening of the asylum in 1899, the number of lepers, which had previously been increasing, diminished by one-fourth. The statement that segregation is useless is against all experience, though there is, doubtless, much to be said for a modified form of segregation and for a revision of the leprosy enactments in Cape Colony.

With regard to the remarkable waxing and waning of leprosy in many countries, this is seen in nearly every

infective disease. A disease introduced into virgin soil is apt to spread rapidly; where the soil is not virgin there is frequently a periodicity which at present cannot altogether be explained. Thus the ordinary "zymotic" diseases in the British Isles, diphtheria, scarlet fever, &c., have a seasonal and an epidemic periodicity; other diseases, notably influenza and plague, may for years be almost unknown, and then an epidemic prevalence may become established over such large areas that the disease becomes pandemic. The same unknown causes may have much to do with the extinction of leprosy in the British Isles and elsewhere. R. T. HEWLETT.

NOTES.

THE Russian Imperial Geographical Society has conferred the Lütke gold medal—its highest distinction—on Sir John Murray, K.C.B., F.R.S., for his oceanographical and limnological researches. The medal has only once before been conferred on a foreigner, namely, Prof. Suess, of Vienna, the eminent geologist.

MR. JAMES HORNELL, who acted as Prof. Herdman's assistant during the Ceylon pearl oyster investigation, has been appointed marine biologist to the Government of Ceylon, and inspector of the pearl banks. Mr. Hornell is now preparing for an inspection by means of dredges in place of divers, with the view of carrying out the changes recommended in Prof. Herdman's report. The appointment is of interest as showing how in the recognition of science some of our colonies are in advance of the mother country. We have no "marine biologist to the Government" here.

DR. J. E. MARR, F.R.S., was elected president of the Geological Society at the anniversary meeting held last Friday. Sir Archibald Geikie delivered the anniversary address, his subject being continental elevation and subsidence. The medals and funds at the disposal of the society were presented as already announced (p. 255).

THE death is announced of Prof. Callandreau, professor of astronomy in the Paris École polytechnique, and member of the Paris Academy of Sciences.

AN astronomical society has been formed at Newcastle-upon-Tyne under the presidency of the Rev. T. E. Espin, who will give the first lecture, at the Literary and Philosophical Society's rooms, on Friday, March 11, on "The Work of an Amateur Observatory." The hon. secretary of the society is Mr. J. D. Hastings, Warkworth House, Tynemouth.

A BILL for rendering compulsory the use of the metric system of weights and measures in the United Kingdom was read a second time in the House of Lords on Tuesday and referred to a select committee. The Bill provides that the metric system shall become compulsory on April 5, 1906, or at such later date as may be directed by His Majesty by Order in Council. It is, therefore, left to the discretion of the Government to fix the date for inaugurating the compulsory adoption of the system. In moving the second reading of the Bill, Lord Belhaven referred to the recommendations of the Select Committee of the House of Commons in 1895, and pointed out the educational and commercial advantages which would follow the adoption of the metric system in the place of our present irrational standards. Lord Kelvin, speaking in support of the Bill, remarked that in Germany, France, and Italy, no inconvenience had resulted from the introduction of the metric system. He said it was of interest to know that the decimal system originated in England. In a letter dated November 14, 1783, James Watt laid down a plan which was in all respects the system adopted by the French philosophers seven years later, which they suggested to the King of England as a system that might be adopted by international agreement. James Watt's objects were to secure uniformity and to establish a mode of division which should be convenient as long as decimal arithmetic lasted. Speeches in favour of the Bill were made by Lord Wolverton, the Marquis of Lansdowne, and the Earl of Rosebery.

THE Reale Accademia dei Georgofili, of Florence, offers a prize, a diploma, and a silver medal for the best essay on the fiscal policy in Italy in relation to that of other countries from the introduction of the 1887 tariff to the end of 1903. The competition closes on June 30, 1905. The Olympic Academy of Venice offers a prize, the subject being Italian emigration in South America, and the last day being December 31, 1906.

THE *Revue générale des Sciences* contains an account, by M. A. de Lapparent, of the life and work of M. Munier Chalmas, who died at Aix les Bains on August 8, 1903, scarcely three months after his election into the Académie des Sciences. M. Munier Chalmas was born in the Beaujolais district in 1843, and at the age of fourteen his interest in geology was aroused by his meeting a geological party of students near Paris, conducted by M. Hébert. At nineteen he had studied under Cordier and D'Orbigny. On the death of M. Hébert in 1890 a movement was set on foot to appoint him to the chair thus vacated at the Sorbonne. M Munier Chalmas's contributions to palæontology were numerous and varied, and dealt with the calcareous algal remains previously regarded as Foraminifera, the dimorphism of Nummulites and Miliolidæ, the classification of echinids, the morphology of brachiopods, and the embryonic development of ammonites. The present state of our knowledge of the geology of the Paris basin is largely due to his researches. He rendered valuable services in the preparation of the geological map of France, and his investigations extended also to Dalmatia and Hungary.

THE death is announced of Prof. Arthur W. Palmer, head of the department of chemistry of the University of Illinois. Prof. Palmer, says *Science*, graduated from the University of Illinois in 1883, and was for two years assistant in the department of chemistry. In 1890, after studying for two years at Harvard University and one year in Germany, he was appointed professor of chemistry, and has since served continuously in that capacity. As member of the Chemical and Biological Survey, he had lately completed an important report on the water supply of the State of Illinois, and was the author of many papers embodying the results of chemical investigation.

AT the annual general meeting of the Institution of Mechanical Engineers on February 19, the annual report of the council for the year 1903 was presented, and contains the following announcements among others. The sixth report of the Alloys Research Committee has been completed. It deals with the experiments made, under the late Sir William Roberts-Austen's direction, on the tempering and annealing of steel, by Mr. William H. Merrett and by others. At the request of the committee the report was completed by Prof. Gowland. The first report to the Steam-Engine Research Committee, by Prof. D. S. Capper, has been received, and will shortly be presented. Prof. Burstall reports that the 100 B.H.P. gas engine which has been designed for experimental work in connection with

the Gas-Engine Research Committee is now ready to be tested at the works. Prof. T. Hudson Beare, the reporter to the Committee on the Value of the Steam Jacket, carried out during the summer and autumn a number of experiments with the experimental jacketed vessel; the results obtained are now being worked out, and further experiments are in progress. New, and it is hoped more satisfactory, valve arrangements for admitting the steam to and exhausting it from the experimental vessels are now being designed. A cordial invitation from the American Society of Mechanical Engineers to hold a joint meeting in Chicago, with the view of visiting afterwards the St. Louis Exhibition, has been accepted by the council on behalf of the members.

PROF. F. G. BAILY, in a short article in the *Electrician*, gives the results of some tests on the efficiency and colour of the new osmium lamps. He finds that the consumption of power at the correct running voltage is about 1·9 watts per candle, and that the colour of the light at this efficiency is practically the same as that of a carbon lamp running at 2·1 watts per candle. From this it seems that the osmium filament is slightly superior to a carbon filament as a radiator, though the main cause of the higher efficiency of the lamp is the higher temperature which the osmium filament can stand. The only trustworthy life tests yet published are those made by Prof. Wedding, who found an average life of 1900 hours from a test on eighteen lamps starting at an efficiency of 1·7 watts per candle; at the end of the life the candle-power had fallen off about 20 per cent., and the efficiency was 2·1 watts per candle. According to Prof. Baily's tests, the osmium lamp is not quite so sensitive to voltage variations as a carbon lamp; at the same time the difficulty of producing a high voltage lamp does not seem to have been overcome, the highest P.D. for which lamps are manufactured being 55 volts. This cannot fail to act as a great drawback to the introduction of the lamp into commercial use.

MR. H. C. RUSSELL, Government Astronomer of New South Wales, has sent us a copy of the results of rain, river and evaporation observations made in that colony during the year 1900; the tables are illustrated by maps and diagrams. Mr. Russell states that the year's rainfall is a little better than that of the five preceding years, but it was nevertheless much below the average fall. Our knowledge of the distribution of rain over New South Wales is almost entirely due to Mr. Russell's persistent exertions; when he first undertook the systematic collection of rainfall statistics in the colony, in the year 1870, he found only five rain gauges in use; at the present time (1900) the number of recording stations has increased to 1703. Mr. Russell's study of the periods of floods and droughts has led him to the conclusion that these periods have followed each other with regularity, and he predicts that in 1904 and 1905 the rainfall will be abundant. In support of this he states that he has discovered, to his own satisfaction, that the rainfall is controlled by the moon, and he gives a diagram showing that when the moon's course is to the southward, in the southern hemisphere, more rain falls than when the moon moves to the northwards.

Symons's Meteorological Magazine for this month contains the very interesting summary of the climate of the British Empire during the year 1902, in the same form that it has appeared for many years. Several new stations have been added, but, as pointed out by Dr. Mill, it is still far from being fully representative of all the varying climates of the Empire. Two of the new stations take a place among the "records" for the year:—(1) Madras shows the highest mean annual temperature yet quoted in these tables (83°·2), the lowest being Winnipeg (37°·6); (2) Coolgardie (W. Australia) has the greatest mean daily range (25°·5), the least being Hong Kong (8°·6). Coolgardie owes its great range to high maxima, whereas Winnipeg, which held the place for sixteen years, owed it to low minima. The highest shade temperature was 111°·4 at Adelaide in February, and the lowest −36°·1 at Winnipeg in January. The driest station was Adelaide, mean humidity 59, and the dampest was Trinidad, 82. The latter station had the highest temperature in the sun, 177°·0. The greatest rainfall was at Colombo, 117 inches, and the least at Coolgardie, 14·7 inches. The greatest amount of cloud was at London (6·6), and the least at Grenada (2·9). The returns from Dawson were incomplete; the absolute minimum temperatures for November to January varied from −48° to −51°.

MESSRS. LUCIEN ALLÈGRE AND CO. have opened an exhibition at 99 Regent Street of work done upon the "Luna" printing-out paper, for which they are the agents. This paper has been considerably used on the Continent for three or four years, and is now being introduced into this country. It differs from other silver papers in that the sensitive salts are not carried in a film or layer of medium, but permeate the substance of the paper itself. It is prepared by soaking the paper, or other material, in an aqueous liquid that contains the sensitive salts. The picture may therefore be printed on either side of the paper so far as its sensitiveness is concerned. The platinum toning bath recommended gives a wide range of colours from reds, through browns and violets to black, according to the time that it is allowed to act. A partially exposed print may be developed by an acid developer, and in this way more contrast is obtained. Similar paper is made for the production of transparencies for decorative purposes or for the reproduction of negatives. The advantages of retaining the actual surface of the paper instead of coating it with a film are obvious to those interested in the matter, especially as the brilliancy of the resulting image does not appear to suffer. The exhibition will remain open for a few months.

No. 4 of the first volume of the Indiana University *Bulletin* contains valuable lists of certain sections of the local fauna and flora.

TWENTY years having elapsed since the publication of Mr. G. T. Porritt's well-known "List of Yorkshire Lepidoptera," the author has been well advised in issuing a new and enlarged edition, containing not only additions to the number of species, but likewise recording fuller information with regard to habitat, and including notes on variation. The new issue forms part xxx. of the *Transactions* of the Yorkshire Naturalists' Union.

IN the course of a note on a specimen of a killer-whale recently stranded on the coast of Maine, Mr. F. W. True (*Proc.* U.S. Nat. Mus., xxvii. p. 297) comes to the conclusion that there are probably several distinct forms of these cetaceans, but that there is not yet sufficient material for properly defining them. The typical species, commonly known as *Orca gladiator*, apparently ranges right across the Atlantic.

WE have received a copy of the sixth instalment (from the *Biological Bulletin*) of an essay on the eyes of the blind vertebrates of North America, the author, Mr. E. F. Muhse, discussing in this instance those of a Cuban blind snake (*Typhlops lumbricalis*). Hitherto the structure of the eye

in this genus has been known only in two Old World species, and the author institutes comparisons between this organ in the two latter and in the American form.

To the *Bulletin* of the American Museum Dr. J. E. Duerden communicates an article on certain small sea-anemones infesting West Indian sponges. In the dead state they are white, and look not unlike small serpulæ. Although many species and at least two genera have been founded for their reception, they all appear referable to three species of the one genus Parazoanthus, and their range extends from the Bermudas and Bahamas to the Lesser Antilles.

Among our weekly budget are two faunistic papers, the one, by Messrs. Snodgrass and Heller, dealing with the birds collected during the Hopkins-Stanford Expedition, and the other, by Messrs. Eigenmann and Kennedy, with a collection of fishes from Paraguay. Several new forms are described in the latter paper, which is from the *Proceedings* of the Philadelphia Academy, but in the former, which is published in the *Proceedings* of the Washington Academy, all the novelties appear to have been previously named in preliminary notices.

Prof. L. Errera, of the Royal Academy of Brussels, has favoured us with a copy of the second edition of his brochure entitled "Une Leçon Élémentaire sur le Darwinisme," which is published at Brussels, and is considerably larger than its predecessor. The main arguments in favour of evolution—and more especially Darwinism—are treated in a popular style, emphasis being laid on the importance of the evidence afforded by the phenomena of hybridism and variation, as well as on that derived from the geographical distribution of organisms.

We have received a copy of the reports of the Ulster Fisheries and Biology Association for 1903—the first working year of that body. It is satisfactory to learn that, under the able management of the hon. director, Prof. G. Wilson, and the hon. secretary, Mr. R. Patterson, the association is starting on its career under the best auspices, and has already done good work. The hon. secretary requests us to state that the laboratory at Larne Harbour, which is provided with a steam-launch and dredging outfit, and has a resident naturalist, is now in working order. The resources of the establishment are at the disposal of any working naturalist, with the proviso that the results of any investigations undertaken should be published through the association. The secretary adds that this is the first opportunity afforded to British naturalists of working with comparative ease and comfort on marine biology in Ireland, and a wide field of labour lies before them.

A very complete list of Irish hepatics, with their geographical distribution, has been published by Mr. D. McArdle in the *Proceedings* of the Royal Irish Academy. The writer has taken up the work which was begun by the late Dr. More, who issued a report of Irish hepatics in 1876. The botanical district of Kerry and south Cork is particularly rich in rare species which have been collected in the Killarney district and in the Dingle Peninsula.

A leaflet has been issued by the Board of Agriculture having reference to the pine beetle, *Hylesinus piniperda*, which infests all varieties of pine trees, but rarely attacks other soft-timber trees. The damage is mainly caused by the destruction of the young shoots, into which the beetles bore in June or July, with the result that in the autumn many of these break off. The most effectual remedy is to destroy the larvæ which are found under the bark in May.

Of the numerous additions to the botanical department of the Natural History Museum which are recorded in Dr. G. Murray's report for 1902, the most important are the late Mr. Comber's collection of diatoms, including microscopical preparations, lantern slides and photographs, which was presented by his widow, and the herbarium of hepatics which was purchased from Mr. W. H. Pearson. Besides this report, there appears in the *Journal of Botany* (February) a list of Leicestershire lichens, compiled by Mr. Horwood, which is supplementary to that contained in the flora of the county.

Mr. Horace Cox has published a fourth edition of Mr. W. B. Tegetmeier's "Pheasants: their Natural History and Practical Management." The new edition has been enlarged.

A second edition of Mr. A. T. Warren's "Experimental and Theoretical Course of Geometry" has been published at the Clarendon Press, Oxford. The propositions required, according to the most recent changes in the syllabus of the universities, for pass examinations at Oxford and Cambridge, have been included in the new edition.

A copy of the "Year-Book of the Royal Society of London" for 1904 has been received. It contains, in addition to other information, a list of the fellows of the society; particulars of the standing, occasional, and sectional committees; the statutes of the society; the standing orders of the council; the regulations for administering the Government grant for scientific investigations; the report of the council; and the president's anniversary address.

The publication of a series of monographs on scientific subjects has been commenced by the firm of Vieweg and Son, Brunswick. The first volume, which has just appeared, is a translation into German of Mme. Curie's thesis on radio-active substances, by Herr W. Kaufmann. A list of papers on radio-activity, brought up to October, 1903, is given at the end of the volume.

The Smithsonian Institution has just published an index to the literature of thorium from 1817 to 1902. The compilation has been carried out by Dr. C. H. Joüet, of Columbia University, and 1123 scientific papers dealing with the chemistry of thorium are indexed in the publication.

In the January number of the *Proceedings* of the American Academy of Arts and Sciences, Mr. W. E. McElfresh describes experiments on the influence of occluded hydrogen on the electrical resistance of palladium. The resistance increases with the quantity of hydrogen occluded, but the two factors are not strictly proportional. By the occlusion of 1030 volumes of hydrogen, which represents the maximum absorption, the electrical resistance is increased by about 68 per cent.

The reaction between potassium iodide and hydrogen peroxide in neutral aqueous solution has been the subject of frequent investigation. According to experiments of Walton, published in the current number of the *Zeitschrift für physikalische Chemie*, it appears to be established that the decomposition of the hydrogen peroxide with the evolution of oxygen is due to a catalytic action of the iodine ions. The production of small quantities of iodine and alkali makes it probable that hypoiodite is formed as an intermediate product, the chief reaction taking place according to the equations

$$KI+H_2O_2=KIO+H_2O_2$$
$$KIO+H_2O_2=KI+H_2O+O_2$$

The second reaction takes place with very great velocity in comparison with the first.

THE *Comptes rendus* for January 25 contains an account of the experiments recently made by Profs. Dewar and Curie on the gas "occluded or liberated" by radium bromide. Three series of experiments are described. In the first series a glass tube containing 0·4 g. of the salt was exhausted by means of the mercury pump, and was found to liberate gas to the extent of about 1 c.c. per month; this gas, examined spectroscopically, gave only the hydrogen and mercury spectra. The salt was then taken to the Royal Institution, transferred to a quartz tube, connected to the mercury pump, and heated to the melting point of the salt; the gas liberated was passed through three U-tubes cooled with liquid air to condense the emanation and the less volatile gases, and collected over mercury. The gas, which had a volume of 2·6 c.c. at atmospheric pressure, was intensely luminous, and three days' exposure in a quartz spectroscope showed the presence of the three chief bands of the nitrogen spectrum. During this time the glass tube had become violet in colour, and the volume of the gas had been spontaneously reduced to one-half of its original volume. A small sample of the gas was transferred to a Geissler tube, and again exhibited the nitrogen bands. Finally, the nitrogen in the Geissler tube was frozen out by means of liquid hydrogen, when a very high vacuum was produced, but the spark spectrum again indicated the presence of nitrogen and no other gas. The quartz tube containing the fused radium bromide was sealed off whilst still vacuous by means of the oxyhydrogen blowpipe and taken back to Paris. It was there examined, twenty days later, by M. Deslandres, who covered the ends of the tube with tinfoil and illuminated the gas by means of a Ruhmkorff coil; three hours' exposure in a quartz spectroscope revealed a complete helium spectrum, but the light emitted spontaneously by the tube gave a continuous spectrum free from light or dark bands.

THE additions to the Zoological Society's Gardens during the past week include two Ring-necked Pheasants (*Phasianus torquatus*) from China, presented by Mr. Eardley Wilmot Holt; an Undulated Grass Parrakeet (*Melopsittacus undulatus*) from Australia, presented by Mrs. Clement Shorter; a Bullfinch (*Pyrrhula europoea*), European, presented by Mr. R. F. Hearnshaw; an Indian Python (*Python molurus*) from India, presented by Mr. W. A. Harding; a Citron-crested Cockatoo (*Cacatua citrino-cristata*) from Timor Laut, deposited; an Arctic Fox (*Canis lagopus*) from the Arctic regions, purchased.

OUR ASTRONOMICAL COLUMN.

OBSERVED CHANGES ON THE SURFACE OF MARS.—During his observations of the Martian surface on April 19, 1903, Mr. Lowell, of Flagstaff, was surprised to see that the colour of the Mare Erythræum was a decided "chocolate-brown," whilst the neighbouring Syrtis was of the normal "blue-green." Although the sea was similarly situated for observation on March 22, this peculiarity was not seen then, therefore the change must have taken place somewhere between these two dates.

When this region was again favourably placed for observation, viz. on May 26, the Mare Erythræum had lost the brown colour except in the southern regions, and the remaining colour slowly disappeared southwards, until on May 29 only a small region near to Hellas was affected, and this became normal on May 30. During the next presentation (June 30–July 7) there was no suspicion of any chocolate coloration. Taking the time of maximum brightness of the brown colour as the time of minimum for the "blue-green" which it supplants, Mr. Lowell finds that this minimum coincides, in point of time, with the minimum visibility of the canals, and, further, that the minima also coincide in latitude, travelling southwards in each case as the number of days since the summer solstice increases. This is plainly shown by the curves and tables in which Mr. Lowell displays the results of his observations of the respective phenomena.

From these data he argues that the normal blue-green colour is due to vegetation, which, owing to the absence of large bodies of water on the planet's surface, can only thrive when fed by the water which fills the canals at the melting of the polar snows. He also suggests that the brown colour, which accompanied the minimum visibility of the canals, is due to the exposure of the bare soil which probably covers the beds of such "seas" as the Mare Erythræum (Lowell Observatory *Bulletin*, No. 7).

THE GEOGRAPHICAL DISTRIBUTION OF METEORITES.—In an article contributed to the February number of the *Popular Science Monthly*, Dr. O. C. Farrington, of the Field Columbian Museum (U.S.A.), discusses the distribution of the meteorites which have been discovered on the earth's surface. He points out that, according to Prof. Berworth, of Vienna, about 900 meteorites reach the earth annually, but from various causes the number likely to be observed is only about 55 per annum, or 5500 per century. As a matter of fact, there have only been about 350 recorded falls since the fifteenth century, yet there have been 50 well authenticated falls in France during the last 100 years.

Dr. Farrington explains the apparent discrepancy by pointing out that on a map of the world, on which he has marked the places where meteorites have been found, these places are mostly in civilised and thickly populated countries, and it may therefore be surmised that the residue are either not seen or else not recorded. Another very interesting point illustrated by the map is the comparatively large proportion of meteorites which have fallen in mountainous regions (*e.g.* the Himalayas, the Alps, the Appalachian Mountains, &c.), and to explain this Dr. Farrington suggests either increased gravitational effects near to these mountainous ranges or else the actual mechanical arrestation of the meteorites by the projecting mountains.

An analysis of the types of known meteorites discloses curious "grouping"; for instance, including both "falls" and "finds," it is seen that of the 256 meteorites known in the western hemisphere, 182 are "irons" and only 74 are "stones," whilst of the 378 known in the eastern hemisphere, 299 are "stones" and 79 are "irons." Prof. Berworth has suggested that the dry air of the large desert areas of the New World has caused the preservation of the irons, whilst the moist atmosphere of the Old World has caused their disintegration, but Dr. Farrington points out that quite a fair proportion of the "irons" found in America have come from the region surrounding the Appalachians, where a comparatively moist atmosphere obtains. Several other apparent localisations of particular types are discussed by Dr. Farrington in his interesting article.

AN ATLAS OF SOLAR PHOTOGRAPHS.—At the meeting of the Paris Académie des Sciences held on February 1, Prof. Janssen presented an atlas of photographs of the sun's disc which have been taken regularly at the Meudon Observatory since 1876. These photographs have been chosen, from more than 6000 plates obtained between 1876 and 1903, in order to show the finest examples of the various solar phenomena, and they display a fairly complete history of the solar changes during that period.

The photographs were taken with an especially constructed camera which produces a nearly monochromatic image, using the exceedingly actinic light in the violet region about HH′. An exposure of 1/3000 of a second was generally found sufficient, and therefore the resulting pictures show all the finer details of the solar surface beautifully defined.

In presenting the atlas Prof. Janssen directed attention to the great importance of obtaining such a record at several widely separated observatories, because, in the light of their inter-relation with meteorological and magnetic phenomena, it is obviously desirable to have a *complete* record of the changes which occur on the sun's surface, and such a record cannot be secured if only one or two observatories are taking photographs. Recognising the importance of this record to meteorologists and physicists, it is intended to prepare a large edition of the atlas, on a smaller scale, for wide distribution (*Comptes rendus*, No. 5).

CONCERNING GIRAFFES.

THE recent acquisition by the British Museum of specimens from East Central Africa and elsewhere has brought into prominence the question of how best to designate the various forms of giraffe to be met with in different regions of Ethiopian Africa, that is to say, whether they should be regarded as distinct species, local races of a single species, or mere, so to say, accidental variations not worthy of systematic separation. The question has been discussed at length in a paper by the present writer read before the Zoological Society on February 2, when a number of paintings and photographs of entire specimens, skins, and skulls were exhibited.

Without entering into details, it may be mentioned, as a matter of common knowledge, that the giraffes of northern Africa—including the typical *Giraffa camelopardalis* of Linnæus—are characterised by the presence in the male of three horns, supplemented in some cases by a rudimentary pair on the occiput, and their white legs. Giraffes of this general type extend at least as far south as the neighbourhood of Lake Baringo and Mount Elgon, that is to say, considerably to the southward of the equator. The accompanying illustration (Fig. 2) exhibits the aforesaid cranial features in the giraffe of the Baringo district.

On the other hand, when the southern districts of the continent are reached, we find that the frontal horn of the adult bull giraffes has been reduced to a more or less inconspicuous irregular boss, while the legs have become spotted right down to the hoofs. Giraffes displaying these two characteristics occur as far north as the northern Transvaal, although, so far as can be judged from a single specimen, the form from that region (Fig. 1) differs decidedly in its markings and colour from the well-known giraffe of the Cape district, as it also does in certain features of the skull.

FIG. 1.—Head and neck of North Transvaal bull Giraffe, presented to the British Museum by Mr. Rowland Ward, to show Southern type.

FIG. 2.—Head and neck of old bull of Baringo Giraffe, presented to the British Museum by Sir H. H. Johnston, to show Northern type. (From "Guide to Mammalia in British Museum.")

Apparently, although our information is far from being so complete as is desirable, the nearest approach to a transition between these two extreme types is displayed by the giraffes of the Kilimanjaro district, which have the lower portion of the legs partially spotted, and tend to show less development of the third horn. Not that the known forms in any way form a complete transition between the northern and southern types. On the contrary, they display markings peculiarly their own, and quite unlike those of any of the others.

It has been already stated that there are two distinguishable forms of giraffe belonging to the southern type (and there is a third in Angola). It should be added that equally marked local differences occur in the case of the northern type, the aforesaid Baringo giraffe being strikingly different as regards markings and colour from the Nubian animal, while a giraffe brought by Major Powell-Cotton from the southward of Lado (just north of the equator) appears different from both. Then, again, there is the very strikingly coloured Somali giraffe, which, while agreeing with the northern type in cranial characters, strikes out a line altogether its own in the matter of marking and colour, although in both these respects it merely displays an ultra and bizarre development of the northern type. Nevertheless, it has been regarded as indicating a species apart from the one including all the other forms.

To discuss further the characteristic features of the foregoing and other forms of giraffe until the paper in question has been published would obviously be inadvisable. Sufficient has, however, been stated to afford a general idea of the question at issue, namely, are these various local forms of giraffe constant, and, if so, should they be regarded as species or races?

Apart from the Somali giraffe, which certainly differs in colour and marking more from all the others than do the latter *inter se*, the aforesaid tendency to a gradation (with many local side-developments) from the northern three-horned and white-stockinged to the southern two-horned and spot-legged type points to the advisability of regarding the local colour-forms as races rather than species (in the modern sense of both terms). It should be mentioned, however, that at present, at all events, there is no sign of one local form grading into another, although subsequent discoveries may prove this to exist.

Then comes the question, are these local forms constant and invariable (save for individual tendencies towards albinism or melanism)? Dealing solely with available facts, and not admitting hypothesis, the answer to this, so far as our present information goes, is in the affirmative. Of course, additional specimens of each form are desirable, but all the examples of each type at present available point to the conclusion that such types are constant locally, and it is therefore obvious that it is incumbent on those who dispute this assertion to substantiate their objections by producing specimens showing individual variation in one and the same locality.

As regards the evidence for constancy of local type, it may be mentioned that the herd of Nubian giraffes formerly in the Zoological Society's Gardens, together with the numerous specimens that have of late years been imported into Europe, are amply sufficient to demonstrate the absence of individual variation in this case. The proof of constancy of type is nearly equally strong in the case of the Cape giraffe, despite the fact that as we proceed north a change in the nature of the markings is noticeable. The Baringo and Kilimanjaro giraffes, allowing for marked differences according to age and sex, are also known by a considerable number of specimens, so that there is every probability that their respective types of coloration are fairly constant, and the evidence for such constancy is still more satisfactory in the case of the Somali giraffe. As regards the other named forms, it must be admitted that their right to separation rests on the evidence of single specimens. Still, if constancy of type occurs in the other forms, the presumption is that it also obtains in these.

If, of course, Kilimanjaro giraffes were met with among a Baringo herd, or *vice versâ*, the case for the racial distinctness of the local forms would be at once demolished, but no evidence of such an admixture of type has ever been recorded. Until this is observed, we are accordingly entitled —or rather compelled—to regard the differences in the colour and markings of giraffes from different localities as indicating local races precisely analogous to those of the bonte-quagga, or Burchell's zebra. The extent of area covered by these local forms, whether some of them may be anything more than individual variation, and whether on the borders of their respective ranges they interbreed with the neighbouring races, or, as is more probable, keep perfectly distinct, are factors in the question still awaiting definite answers.

In conclusion, reference may be made to the extremely important and valuable additions to our knowledge of these animals which have resulted from the specimens collected by Major Powell-Cotton during his recent expedition to East Central Africa. The only pity is that, by reason of the game-preservation laws, he was prevented from bringing away such a series of examples of the different local forms as would have sufficed to convince even the most sceptical of their respective constancy to a common type.

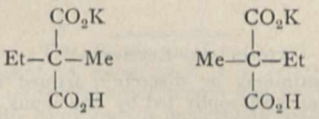
R. L.

A DIRECTED SYNTHESIS OF AN ASYMMETRIC COMPOUND.

ALL previous attempts to synthesise an optically active carbon compound have been based on one principle; they have involved the combination of an inactive compound, containing an ethylene linkage or a carbonyl group, with an optically active substance to form an ester or glucoside, and the subsequent treatment of this product in such a way as to attach two different groups to a previously ethenoid carbon atom so as to render it asymmetrical. As Prof. Japp and others have pointed out, the two possible isomerides should not necessarily be formed in equal quantities, so that on hydrolysing the new ester or glucoside one of the isomerides would preponderate, and therefore an optically active product should be obtained. Prof. Kipping reduced the bornyl ester of benzoyl formic acid to the bornyl ester of mandelic acid, hoping to obtain an optically active mandelic acid. Prof. Fischer and M. D. Slimmer added hydrogen cyanide to helicin; they then hydrolysed the nitrile and subsequently the glucoside, with the object of preparing active oxymandelic acid.

Prof. Kipping's product proved to be inactive, and it was not conclusively established that that obtained by Fischer was active.

In the last number of the *Berichte*, Prof. Marckwald, of Berlin, describes the synthesis of active *l*-valerianic acid. Methylethylmalonic acid forms two acid salts, which in the case of the potassium salt are enantiomorphously related



and will possess the same solubility, whereas the two acid salts with an optically active base, such as brucine, will in general have different solubilities. Methylethylmalonic acid loses carbon dioxide when heated, forming methylethylacetic acid, which contains an asymmetric carbon atom; it is to be supposed that from the acid brucine salts of the malonic acid the free carboxyl group will be preferentially eliminated. Led by these considerations, Prof. Marckwald crystallised the less soluble brucine salt from the mixture of the two in the expectation of obtaining a material in which presumably the one form of the asymmetric compound would preponderate. This salt was heated at 170°. The valerianic acid obtained was optically active to the extent of $-1°{\cdot}7$ per 10 c.c., which may be taken as an indication of the presence of 10 per cent. of *l*-valerianic acid.

BAROMETRIC SEESAWS.

PROF. HOFRATH JULIUS HANN has recently contributed an important paper to the Vienna Academy, an abstract of which is printed in the *Akademischen Anzeiger*, No. 1, of the Kaiserliche Akademie der Wissenschaften in Wien. This paper is entitled "Die Anomalien der Witterung auf Island in dem Leitraume 1851 bis 1900 und deren Beziehungen zu den gleichzeitigen Witterungsanomalien in Nordwest Europa." In this Prof. Hann discusses the relationship between the monthly and yearly means of the temperature, pressure and rainfall of Stykkisholm, in Iceland, for the longest time available, the temperature variations at Greenwich, Brussels and Vienna, the pressure and rainfall variations at Brussels and the pressure variations at Vienna.

The results at which he has arrived are of very great interest, for they show that there is a most intimate connection between Icelandic meteorology and that of north-west Europe. For a full account of these the reader must refer to the abstract itself, but some of the results may be briefly summarised here. In the first place, for the three winter months the pressure variations of north-west and middle Europe are for the most part simultaneously of opposite sign to those at Stykkisholm, while the same reversal occurs to a slight extent with the temperature and rainfall. Again, when the pressure variation for a month in Stykkisholm is negative, the probability for a positive temperature variation in north-east and middle Europe is 0·82, and *vice versâ* with a probability of 0·73. Again, contrasting temperature and pressure variations, the following results were obtained:—

	No. of cases	Mean variation: Pressure, Stykkisholm (mm.)	Mean variation: Temp. Greenwich Brussels (°C.)	Probability of sign of temp. variation
Winter half year ...	67	+8·6	−1·5	0·81
Summer half year...	55	+3·8	−0·5	0·65
Winter half year ...	72	−7·7	+1·4	0·90
Summer half year...	50	−5·0	+0·7	0·76

Prof. Hann shows further that the probabilities of positive temperature variations at Greenwich and negative pressure variations at Stykkisholm, and *vice versâ*, are 0·83 and 0·85 respectively. In the case of the Azores he shows that a similar reversal with Stykkisholm occurs. Interesting results are also obtained when he considers the new station at Angmagsalik, in Greenland.

THE AMERICAN ASSOCIATION.

THE annual meeting of the American Association for the Advancement of Science was held at St. Louis on December 26, 1903, to January 1. The address delivered by the president of the association, Prof. Ira Remsen, appeared in NATURE of January 28; and extracts from the addresses of presidents of some of the sections are given below.

ATOMS AND ELEMENTS.[1]

Is matter continuous or discrete? argued the opposed schools of Grecian philosophy led by Leucippus, Democritus and Epicurus, and dominated by Aristotle. Despite the clarity of the statements of the Roman Lucretius,[2] the atomic hypothesis received scant attention until the seventeenth century of the Christian era, when Galileo's experimental science assailed Aristotelian metaphysics and demanded verification of the premises of that philosophy which had governed all the schools of Europe for two thousand years.[3] While Gassendi, Boyle, Descartes, Newton, perhaps Boscovich, Lavoisier, Swedeborg, Richter, Fischer and Higgins had to do with our modern atomic theory, Dalton one hundred years ago "created a working tool of extraordinary power and usefulness" in the laws of definite and multiple proportions. As Clarke[4] remarked, "Between the atom of Lucretius and the Daltonian atom the kinship is very remote." Although the lineage is direct, the work of Berzelius, Gmelin and others; the laws of Faraday, Gay Lussac, Avogadro, Dulong and Petit; the reformations of Laurent and Gerhardt, but particularly Cannizzaro; the systematisations of de Chancourtois, Newlands, Hinrichs, Mendeléeff and Lothar Meyer; the stereochemistry of van 't Hoff and Le Bel have imperialised the ideas of the Manchester philosopher, so that the conceptions of the conservative atomists of to-day are quite different from those at the beginning of the closed century.[5]

The Daltonian ideas had scarcely reached adolescence before Prout (1815), giving heed to the figures concerned, would have all the elements compounded of hydrogen. The classical atomic mass values obtained by sympathetic Stas and the numerous investigations of those who followed him, with all the refinements human ingenuity has been able to devise, temporarily silenced such speculations, but not until Marignac had halved the unit, Dumas had quartered it, and Zängerle, as late as 1882, insisted upon the one thousandth hydrogen atom.

The notion, like Banquo's ghost, will ever up, for if one may judge from the probability calculations of Mallet (*Phil. Trans.*, clxxi., 1003, 1881) and Strutt (*Phil. Mag.*, (6), i., 311), a profound truth underlies the now crude hypothesis.

Crookes (*Chem. News*, lv., 83, 1886), from observations made during prolonged and painstaking fractionations of certain of the rare earths, supported his previously announced "provisional hypothesis" as to the genesis of the elements from a hypothetical *protyle*, which existed when the universe was without form and void. He designated those intermediate entities, like yttrium, gadolinium and didymium, "meta-elements,"[1] a species of compound radicles, as it were. *Urstoff*, fire mist, protyle, the ultragaseous form, the fourth state of matter (Crookes, Royal Societies, June 10, 1880) was condensed by a process analogous to cooling; in short, the elements were created. The rate of the cooling and irregular condensation produced "the atavism of the elements," and this caused the formation of the natural families of the periodic system. Marignac (*Archives des Sciences Physiques et Naturelles*, 17–5; *Chemical News*, lvi., 39), criticising this hypothesis, states:—"I have always admitted[2] the impossibility of accounting for the curious relations which are manifested between the atomic weights of the elements, except by the hypothesis of a general method of formation according to definite though unknown laws; even when these relations have the character of general and absolute laws."

Further, "I do not the less acknowledge that the effect of constant association of these elements is one of the strongest proofs that can be found of the community of their origin. Besides, it is not an isolated fact; we can find other examples such as the habitual association in minerals of tantalum, niobium, and titanium."

The peculiar discharge from the negative electrodes of a vacuum tube was investigated many years ago by Hittorf and Crookes, who arrived at the conclusion that it was composed of streams of charged particles. All are familiar with the very recent proposed "electrons" and "corpuscles" resulting from the beautiful physical researches of Lodge and J. J. Thomson. These appear to have caused a trembling in the belief of many in the immutability of the atom, and the complete abandonment of the atom is seriously discussed by others.

Although by chemical means, so far, we have been unable to break up the atoms, apparently electrical energy, in the form of kathode rays, for example, follows the grain of atomic structure. Some advanced thinkers look upon the atoms as disembodied charges of electricity. Ostwald has taught it. Electric charges are known only as united to matter, yet Johnstone Stoney and Larmor, have speculated on the properties of such charges isolated. "Such a charge is inertia, even though attached to no matter, and the increase of inertia of a body due to electrification has been calculated by both Thomson and Oliver Heaviside, the conception accordingly being advanced that all inertia is electrical, and that matter, as we know it, is built up of interlocked positive and negative electrons. If it were possible in any mass of matter to separate these electrons then matter would disappear and there would remain merely two enormous charges of electricity." We are aware of phenomena attributed to the negative electrons; we await anxiously the announcement of the positive electrons.

We do know, however, as A. A. Noyes says, that "there exists in the universe some thing or things other than matter which, by association with it, give rise to the changes in properties which bodies exhibit, and give them power of producing changes in the properties of other bodies."

Shall we say, as does Remsen, "An element is a substance made up of atoms of the same kind?" Can we say that it is not? Venable (the "Definition of the Element," *Am. Chemist*, 1875, 23) truly says: "An element is best defined by means of its properties." These conceits are not exclusive. The properties are the result of the action of physical forces and chemical affinity, whatever that may be. Certain of the novel atmospheric gases have so far responded but poorly to the latter, as predicted before their discovery by Flawitzsky, Julius Thomsen and de Boisbaudran in 1887.

The following simpler definition has finally served as my guide: *An element is that which has not been decomposed, so far as we are aware, into anything other than itself.* In short, it is consistent.

We have decided to define an element by its properties. The alterations produced in the properties of the most characteristic elements by the presence of small amounts of foreign substances are evident in steel. The influence of arsenic upon the conductivity of copper is well known, and Le Bon (*Compt. rend.*, cxxxi., 706, 1900) has recently shown

[1] Abridged from an address delivered before the Section of Chemistry of the American Association by Prof. C. Baskerville.

[2] "Nature reserving these as seeds of things
Permits in them no minish nor decay;
They can't be fewer and they can't be less."

Again, of compounds—

"Decay of some leaves others ree to grow
And thus the sum of things rests unimpaired."

Book ii., 79.

[3] See "The Atomic Theory," the Wilde Lecture by F. W. Clarke at Dalton Celebration, May, 1903.

[4] *Loc. cit.*

[5] While I have examined much of the original literature, Venable's "History of the Periodic Law" has been most helpful. I have, furthermore, had the privilege of reading very carefully the manuscript of a work entitled "The Study of the Atom" (in press), by Dr. Venable.

[1] Address before Chemical Section of the British Association, *Chem. News*, liv., 117, 1885.

[2] Remarks made in 1860–5 after publication of Stas's "Researches on Atomic Weights," *Archives*, ix., 102, 24–376.

that traces of magnesium (one part in 14,000) in mercury cause the latter to decompose water and to oxidise rapidly in the air at ordinary temperatures. Thorium with less than a trace of actinium produces an auto-photograph.

This point cannot be too strongly stressed in the rare earth field. One who has wrought with thorium dioxide well knows the influence a small amount of cerium has upon its solubility. The conflicting statements in the literature as to the colours of the oxides of the complexes, neodidymium and præseodidymium, cause one to wonder if different researchers have had the same hæcceity.

An appeal to the spectroscope is, of course, in the minds of all my hearers.

Grünwald, in a series of papers on his theory of spectrum analysis,[1] endeavours "to discover relations between the spectra and thus to arrive at simpler, if not fundamental "elements.'" He came to the conclusion that "all the so-called elements are compounds of the primary elements *a* and *b*" (coronium and helium). Ames (*Am. Chem. J.*, xi., 138, 1889), having directed attention to the use of uncorrected data by Grünwald, remarks: "The concave grating gives the only accurate method of determining the ultra-violet wave-lengths of the elements; and as a consequence of not using it, most of the tables of wave-lengths so far published are not of much value."

Lockyer maintained that the lines of certain brilliant substances vary not only in length and in number, but also in brilliancy and in breadth, depending upon the quantity of the substance as well as temperature (Roy. Soc. *Proc.*, lxi., 148, 183; *Chem. News*, lxxix., 145). Being unable to decompose the elements in the laboratory, he studied the spectra of the stars. The spectra of the colder stars show many more metals, but no metalloids, whereas the coldest stars show the Crookes spectrum of metalloids which are compounds; none of the metalloids are found in the spectrum of the sun. More than 100,000 visual observations and 2000 photographs were made in the researches.

Without doubt the spectroscopic criteria are the most valuable we have in judging finally the elements, and mayhap will remain so, but in my humble opinion, such have not alone sufficient authority, as yet, to usher the aspirant to a place among the elect. The contention frames itself, however, in an expression of the need for uniformity.

Whether we follow the most advanced metaphysico-chemical teachings or no, if there be any one concept upon which modern practical chemical thought depends, it is the law of definiteness of composition. There may be, and doubtless are, definite, perhaps invariable, properties of our elements other than their combining proportions, the atomic weights, if you please, yet, so far as we know, they approximate more closely than any fixed, if not permanent, ratios. Many of these values, by which we lay such store, are dependent upon data in which, I venture the assertion, too great confidence has been bestowed, or opinions to which sufficient attention has not been given.

As hinted at in the earlier portion of this unduly prolonged address, many have theorised as to the ultimate composition of matter. The logic of Larmor's (*Phil. Mag.*, December, 1897, 506) theory, involving the idea of an ionic substratum of matter, the support of J. J. Thomson's (*Phil. Mag.*, October, 1897, 312) experiments, the confirmation of Zeemann's phenomenon, the emanations of Rutherford, Martin's (*Chem. News*, lxxxv., 205, 1902) explanations, cannot fail to cause credence in the correctness of Crookes's idea of a fourth state of matter (*Phil. Trans.*, ii., 1881, 433). In the inaugural address as president of the British Association (1898), he acknowledges in the mechanical construction of the Röntgen ray tubes a suggestion by Silvanus Thompson to use for the antikathode a metal of high atomic weight. Osmium and iridium were used, thorium tried, and in 1896 Crookes obtained better results with metallic uranium than platinum.

These and the facts that most of the elements with high atomic weights, in fact all above 200 (thallium not reported on),[1] exhibit radio-active properties, are doubtless closely associated and have to do with the eventual composition of matter. I have unverified observations which go to show the existence of at least one element with a very high atomic weight. If it be confirmed, then we have them now or they are making, and probably breaking up, as shown by that marvellous class of elements in the discovery of which the Curies have been pioneers.

If our ideas that all known elements come from some primordial material be true, then it stands to reason that we are coming in time, perhaps, to that fixed thing, a frozen ether, the fifth state of matter. I may make use of dangerous analogy and liken our known elements, arranged in a perfected natural system, to the visible material spectrum, while electrons, &c., constitute the ultra-violet and *cosmyle* composes the infra-red, either one of the latter by proper conditions being convertible into perceptible elemental matter.

The Scope of Geography.[2]

The essential in geography is a relation between the elements of terrestrial environment and the items of organic response; this being only a modernised extension of Ritter's view. Everything that involves such a relationship is to that extent geographic. Anything in which such a relationship is wanting is to that extent not geographic. The location of a manufacturing village at a point where a stream affords water-power is an example of the kind of relation that is meant, and if this example is accepted, then the reasonable principle of continuity will guide us to include under geography every other example in which the way that organic forms have of doing things is conditioned by their inorganic environment. The organic part of geography must not be limited to man, because the time is now past when man is studied altogether apart from the other forms of life on the earth. The colonies of ants on our western deserts, with their burrows, their hills, their roads and their threshing floors, exhibit responses to elements of environment found in soil and climate as clearly as a manufacturing village exhibits a response to water-power. The different coloration of the dorsal and ventral parts of fish is a response to the external illumination of our non-luminous earth. The word *arrive* is a persistent memorial of the importance long ago attached to a successful crossing of the shore line that separates sea and land. It is not significant whether the relation and the elements that enter into it are of easy or difficult understanding, nor whether they are what we call important or unimportant, familiar or unfamiliar. The essential quality of geography is that it involves relations of things organic and inorganic; and the entire content of geography would include all such relations.

Thus defined, geography has two chief divisions. Everything about the earth or any inorganic part of it, considered as an element of the environment by which the organic inhabitants are conditioned, belongs under physical geography or physiography.[3] Every item in which the organic inhabitants of the earth—plant, animal or man—show a response to the elements of environment, belongs under organic geography. Geography proper involves a consideration of relations in which the things that belong under its two divisions are involved.

Geography is, therefore, not simply a description of places; it is not simply an account of the earth *and* of its inhabitants, each described independently of the other; it involves a relation of some element of physical geography to some item of organic geography, and nothing from which this relation is absent possesses the essential quality of geographical discipline. The location of a cape or of a city is an elementary fact which may be built up with other facts into a relation of full geographic meaning; but taken alone, it has about the same rank in geography that spelling has in language. A map has about the same place in geography

[1] "Über das Wasserspectrum- das Hydrogen. und Oxygenspectrum," *Phil. Mag.*, xxiv., 304, 1887. "Math. Spectralanalyse des Magnesiums und der Kohle." *Monatshefte für Chemie*, viii., 650. "Math. Spectralanalyse des Kadmiums," *Monatshefte für Chemie*, ix., 956.

[1] See the exquisite paper by Madame Curie on "Radio-active Substances," also "Radio-active Lead," Hofmann and Strauss. *Berichte* xxxiv., 3033, Pellini (*loc. cit.*) on "Radio-active Tellurium"; Strutt, *Phil. Mag.*, vi., 113, Elster and Geitel, Giesel, Marckwald, &c.

[2] Abridged from an address delivered before the Section of Geology and Geography of the American Association by Prof. W. M. Davis

[3] It should be noted that the British definition of physiography gives it a much wider meaning than is here indicated.

that a dictionary has in literature. The mean annual temperature of a given station, and the occurrence of a certain plant in a certain locality, are facts of kinds that must enter extensively into the relationships with which geography deals; but these facts, standing alone, are wanting in the essential quality of mature geographical science. Not only so; many facts of these kinds may, when treated in other relations, enter into other sciences; for it is not so much the thing that is studied as the relation in which it is studied that determines the science to which it belongs.

There can be no just complaint of narrowness in a science that has charge of all the relations among the elements of terrestrial environment and the items of organic response. Indeed, the criticism usually made upon the subject thus defined is, as has already been pointed out, that it is too broad, too vaguely limited and too much concerned with all sorts of things to have sufficient unity and coherence for a real science. Some persons, indeed, object that geography has no right to existence as a separate science; that it is chiefly a compound of parts of other sciences; but if it be defined as concerned with the relationships that have been just specified, these objections have little force. It is true, indeed, that the things with which geography must deal are dealt with in other sciences as well, but this is also the case with astronomy, physics, chemistry, geology, botany, zoology, history, economics, and other sciences. There is no subject of study the facts of which are independent of all other subjects; not only are the same things studied under different sciences, but every science employs some of the methods and results of other sciences. The individuality of a science depends not on its having to do with things that are cared for by no other science, or on its employing methods that are used in no other science, but on its studying these things and employing these methods in order to gain its own well-defined object. Chemistry, for example, is concerned with the study of material substances in relation to their constitution, but it constantly and most properly employs physical and mathematical methods in reaching its ends. Botanists and zoologists are much interested in the chemical composition and physical action of plants and animals, because the facts of composition and action enter so largely into the understanding of plants and animals considered as living beings. Overlappings of the kind thus indicated are common enough, and geography, as well as other sciences, exhibits them in abundance. It may be that geography has a greater amount of overlapping than any other science; but no valid objection to its content can be made on that ground; the maximum of overlapping must occur in one science or another—there can be no discredit to the science on that account. Geography has to do with rocks the origin of which is studied in geology; with the currents of the atmosphere, the processes of which exemplify general laws that are studied in physics; with plants and animals, the forms and manner of growth of which are the first care of the botanist and zoologist; and with man, whose actions recorded in order of time occupy the historian; but the particular point of view from which the geographer studies all these things makes them as much his own property as they are the property of anyone else.

Some Unsolved Problems of Organic Adaptation.[1]

The recent impulse which has come to biologic progress by experimental methods, and the remarkable results which have been attained thereby, may without exaggeration be said to have raised anew many an earlier doubt as well as brought to light problems apparently beyond the scope of the older explanations. It may not, therefore, be an extravagant assumption to announce the entire question of organic adaptations as open for reconsideration, in the light of which no apology will be necessary for directing attention to certain phases of the subject upon the present occasion.

Among the many problems which recent investigations and conclusions have brought into better perspective as well as sharper definition, and which might profitably be discussed, the limits of a single address preclude any very wide range of review. I have, therefore, chosen to restrict my discussion chiefly to problems of coloration among lower invertebrates, including incidental references to correlated subjects, and the probable limitations of colour as a factor in organic adaptation.

As is perfectly well known, colour in nature is due to one of two causes, or to a combination of both, namely, (1) what has been termed optical or structural conditions, such as diffraction, interference or unequal reflection of light, examples of which are familiar in the splendid hues of the rainbow, the iridescent sheen and metallic colours of the feathers of many birds, wings of insects, &c. (2) What are known as pigmentary colours, due to certain material substances lodged within the tissues of animals or plants which have the property of absorbing certain elements of light and of reflecting others, and thereby producing the sensation of colour. While the two are physically quite distinct it is not unusual to find them associated in producing some of the most exquisite colour effects of which we have knowledge. In a general way one may usually distinguish between these two sorts of colour by noting that those which are purely optical in their character produce a constantly changing impression as the relative position of object or observer may happen to vary with reference to the angle and direction of light; while, upon the other hand, colours which are due to pigments show this property very slightly or not at all, and that, moreover, pigment colours are usually more or less soluble in various reagents, such as alcohol, ether, acids, alkalies, &c., and that they often fade rapidly under the influence of strong light or in its absence, or upon the death of the organism.

The work of Krukenburg, MacMun, Macallum, M'Kendric, Hopkins, Urech, Eisig, Cunningham, and a host of others, comprising a mass of literature of enormous proportions, will be available to those interested, and may afford some faint conception of the magnitude and importance of the field to be explored, as well as an introduction to that already made available. And while as a result of this activity many and various organic pigments have been isolated and their composition in part or entirely made known, it must be recognised that the task of the chemical analysis of any such highly complex compounds as most of these are known to be is attended with extreme difficulty and no small measure of uncertainty. Still, it has been possible fairly to distinguish several classes of such pigments, differentiated physiologically as follows:—

(1) Those directly serviceable in the vital processes of the organism. Under this head may be classed such pigments as hæmoglobin, chlorophyll, zoonerythrin, chlorocruorin, and perhaps others less known. It need not be emphasised that by far the most important of these are the two first named. The others, found chiefly among the lower invertebrates, are believed to serve a function similar to the first.

(2) Waste products. Among these the several biliary products are too well known to call for special note. Guanin is a pigment of common occurrence in the skin of certain fishes, and is associated with the coloration of the species. Similarly certain colouring matters have been found in the pigments of many Lepidoptera, known as lepidotic acid, a substance closely allied to uric acid, and undoubtedly of the nature of a waste product.

(3) Reserve products. Of these there are several series, one of which, known as lipochrome pigments, is associated with the metabolism involved in the formation of fats and oils. Perhaps of similar character are such pigments as carmine, or rather cochineal, melanin, &c. It may be somewhat doubtful whether these pigments do not rather belong to the previous class, where should probably be listed such products as hæmatoxylin, indigo, &c., all of which have been claimed as resultants of destructive metabolism in process of being eliminated from the physiologically active tissues of the body of the organism. Of similar character is probably tannic acid, a substance well known among plant products and involved in the formation of many of the brownish and rusty colours of autumn foliage, particularly of the oaks and allied trees, as are the lipochromes in the formation of the reds and yellows which form so conspicuous a feature among autumn colours.

While the association of these and other pigmentary matters has long been known in connection with both animal and plant growth, and while the conception of their more or less intimate relation to the active metabolism of the various tissues is not new, comparatively little has been

[1] Abridged from an address delivered before the Section of Zoology of the American Association by Prof. C. W. Hargitt.

done toward directly investigating and elucidating the exact nature and extent of the process. This seems to be especially the case in relation to the part played by these products in the formation of those features of coloration among organisms with which we are now concerned.

From considerations of researches connected with various organisms three things seem to be more or less evident:—

(1) That in all regenerative processes a very marked degree of metabolism is involved, whether in the mere metamorphosis of old tissues into new, or in the direct regeneration of new tissues by growth processes, both of which seem to occur.

(2) That in regenerative processes there is often associated the development of pigmentary substances which seem to have no direct function in relation thereto.

(3) That in many cases there follows a more or less active excretion and elimination of portions of the pigment in question.

In the present review I have not in the least sought to ignore or discredit the value of natural selection as a factor in organic evolution. Nor would I be understood as wholly discarding colour as a factor in organic adaptation, particularly among the higher and more specialised forms, but rather to show its limits. At the same time I must submit to a growing conviction that its importance has been largely overestimated, and that other factors have been as largely lost sight of. If the present discussion may serve in even the smallest degree to direct attention to some of the latter it will have served its chief purpose.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—An examination in tropical medicine and hygiene will be held during the year 1904. The examination will begin on August 9, and extend over three days. The examination will have reference to the nature, incidence, prevention, and treatment of the epidemic and other diseases prevalent in tropical countries. Every candidate who passes the examination to the satisfaction of the examiners will receive from the university a diploma testifying to his knowledge and skill in tropical medicine and hygiene. All applications for information respecting the examination should be addressed to Mr. G. H. F. Nuttall, Pathological Laboratory, Cambridge.

THE Education Committee of the Manchester City Council has unanimously resolved to recommend that a grant of 4000*l.* be given from the city rates in aid of the University of Manchester.

IT is announced in *Science* that Prof. John Hays Hammond has added 10,000*l.* to his previous gift of 10,000*l.* for a metallurgical laboratory of Yale University, and that by the will of the late James A. Woolson Boston University will ultimately receive 120,000*l.*, Radcliffe College 60,000*l.*, and the Wesleyan Academy at Wilbraham, Mass., 60,000*l.*

MR. P. N. RUSSELL, who for many years carried on extensive engineering works in Sydney, but has latterly resided in London, has made a further donation of 50,000*l.* for an additional endowment to the School of Engineering at the University of Sydney. Mr. Russell originated this school about seven years ago by an endowment of 50,000*l.*

LORD KELVIN will distribute the prizes at the Northampton Institute, London, on Friday, February 26. The students' conversazione will be held on the same evening, and will be continued on the evening of Saturday, February 27, when the building will be thrown open to the whole of the members and students of the institute and their friends.

THE annual report of the Carnegie Trust for the universities of Scotland was submitted to the trustees at their third annual meeting, which was held in London on Friday last. The report states that the scheme of allocation for five years of an annual grant of 40,000*l.* among the four Scottish universities became operative on January 1, 1903. Of the grant for the year ended December 31, 1903, sums amounting to 20,325*l.* have been claimed and handed over. One chair has been founded and its first occupant appointed—the Burnett Fletcher chair of history and archæology in the University of Aberdeen. Of the sum of 20,000*l.* required for the endowment of this chair, donations amounting to about 12,000*l.* have been received from the Burnett trustees, Mrs. Fletcher, and others. The ordinance instituting a chair of geology in the University of Glasgow has been approved by Parliament, and it is expected that a professor will be appointed before next winter session, when the accumulations in hand of the annual grant of 2000*l.* assigned towards the endowment of this chair will be available, together with such portion of the future annual grants as may be needed to complete the endowment fund of 15,000*l.*, half of which is provided by the Bellahouston trustees and others. In the University of St. Andrews two lectureships—in French and in botany—have been established, each with an endowment of 10,000*l.* Under the scheme of endowment of post-graduate study and research the committee has made the first awards. The estimated outlay under this head for the academic year 1903–4 is 3524*l.*, of which the sum of 1828*l.* was expended within the year 1903. The committee has entered into an agreement with the Royal College of Physicians of Edinburgh by which the trust has purchased the property and laboratory of the college in Forrest Road, Edinburgh, for 10,000*l.*, on the understanding that the College of Physicians and the College of Surgeons continue their present annual contributions of 750*l.* and 200*l.* respectively to the working of the laboratory.

THE second annual report of the executive committee in connection with the fund for advanced university education and research at University College, London, was presented at the annual general meeting of the members of the college on February 24. It will be remembered that the two main purposes of the fund are:—(1) to raise the sum of 200,000*l.* to bring about the incorporation of University College in the University of London, and thus to promote the unification of university studies in London; (2) To provide the sum necessary to equip and endow University College adequately for its work as an integral part of the University of London. For this purpose it was estimated that a capital sum of 800,000*l.* was required, or an income corresponding to such capital sum. For the first of these purposes the committee has raised 141,000*l.*, leaving a balance of 59,000*l.* necessary to enable the conditions of incorporation to be fulfilled. Since August 31, 1903, a most important addition has been made to the fund owing to the munificence of an anonymous donor, who, through Prof. E. H. Starling, F.R.S., and Dr. Page May, promised the sum of 50,000*l.* This sum, together with additional subscriptions received since the date mentioned, brings the total amount raised up to 167,287*l.*, of which 141,000*l.* is available for the purpose of incorporation and the balance of 26,000*l.* for the endowment and equipment of the college. It will be seen that while considerable progress has been made, much remains to be done to realise the whole scheme. It is desirable that the remainder of the money necessary for incorporation should be raised without delay in order to make it possible for a Bill to be introduced in the House of Commons next session. The report of the council of University College presented on the same occasion contains, in addition to full financial statements for the year 1902–1903, an exhaustive list of original papers and other publications completed by members of the staff of the college during the same period, and also particulars of the post-graduate courses of lectures and laboratory work during the present session.

THE secretaries of the Royal Society have addressed a letter to the Vice-Chancellor of the University of Oxford directing attention to a resolution adopted by the president and council of the Royal Society:—"That the universities be respectfully urged to consider the desirability of taking such steps in respect of their regulations as will, as far as possible, ensure that a knowledge of science is recognised in schools and elsewhere as an essential part of general education." Enclosed with the letter was a statement regarding scientific education in schools, drawn up by a committee of the Royal Society, and both are printed in the *Oxford University Gazette*. The statement points out that "it still remains substantially true that the public schools have devised for themselves no adequate way of assimilating

into their system of education the principles and methods of science," and goes on to urge that the universities can do much to promote and encourage improvement in these matters. It is suggested that the universities might expand and improve their general tests, so as to make these correspond with the education, both literary and scientific, which a student, matriculating at the age of nineteen years, should be expected to have acquired. Commenting on these communications from the Royal Society, Prof. Case, in a letter to the *Times*, remarks "that the real contention is that while Greek is not, 'science' is, an essential part of general education." But as his letter shows, Prof. Case means by "science" some single subject such as mechanics, whereas the Royal Society is pleading for instruction in the methods of science. It may fairly be asserted that no general education can be complete in which scientific method takes no part; yet, in the past, there has been a compulsory examination in Greek and none in science. Though men of science do not ask for compulsory examinations in single subjects of science, nor advocate these as essential parts of the school curriculum, yet they urge strongly that the spirit of scientific observation and inquiry should be fostered because it promotes both the material and the intellectual progress of the nation.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 18, 1903. (Received in revised form January, 1904.)—"The Longitudinal Stability of Aërial Gliders." By G. H. **Bryan**, Sc.D., F.R.S., and W. E. **Williams**, B.Sc., University College of North Wales.

The object of the investigations was (1) to show that the longitudinal stability of aëroplane systems *can* be made the subject of mathematical calculation; (2) to direct the attention of those interested in the problem of artificial flight to the necessity of acquiring further experimental knowledge concerning the quantities on which this stability is shown to depend.

The conclusions reached were as follows:—

(1) For a glider or other body moving in a vertical plane in a resisting medium of any kind whatever, the small oscillations about a state of uniform rectilinear motion are determined by an equation of the fourth degree, so that the conditions for stable steady motion are those obtained by Routh.

(2) The coefficients in the period equation involve, in addition to the ordinary dynamical constants, nine quantities $X_u \ldots G^\theta$, which, when referred to rectangular axes fixed in the body, represent the differential coefficients of the forces and couple due to the aërial resistances with respect to its translatory and rotatory velocity components.

(3) In the case of a system of aëroplanes these nine quantities can be expressed for the separate planes in terms of $f'(\alpha)$ and $\phi'(\alpha)$, where $f(\alpha)$ and $\phi(\alpha)$ are functions determining the resultant thrust, and the position of the centre of pressure when the direction of the relative motion of the air makes an angle α with the plane. These functions have been tabulated for certain different forms of surfaces, but further data are greatly needed.

(4) *The longitudinal stability of the gliders is thus seen to be capable of mathematical investigation*, and it is of paramount importance that the present methods should be practically applied to any aërial machines that may be designed or constructed before any actual glides are attempted.

(5) The methods of calculation are exemplified by numerical determinations of the criterion of stability in the cases of a single plane lamina, and a pair of planes one behind the other. Most of the calculations have been performed for an angle of gliding of 10° with the horizon, and it has been necessary to assume arbitrary values for the moment of inertia of the lamina.

(6) The condition that any steady linear motion may be stable in all these cases assumes the form $V^2 > ka$, where a is a constant depending on the linear dimensions of the glider, and k is a constant depending on its shape, the angle of gliding and the law of aërial resistance.

(7) For a pair of narrow slats, in which the variations in the positions of the centres of pressure of each are neglected, certain coefficients of stability vanish if the slats are in the same plane. If the planes are square so that the displacements of the centres of pressure are not neglected, the system is in general less stable than a single square plane.

(8) By inclining the planes at a small angle to each other the stability is much increased. On the other hand, if they are made to slope away from each other, the glider becomes unstable.

(9) Two square planes of equal size placed one behind the other at a small angle are less stable in the examples considered than a square of the same size as one of the two, but more stable than a single square the side of which is equal to the total length of the glider formed by the pair.

(10) A pair of unequal squares of which the smaller forms a rudder are more stable, in the examples considered, when gliding with the rudder behind than with the rudder in front.

(11) In the examples considered stability is increased by decreasing the moment of inertia of the glider.

February 4.—"Cultural Experiments with 'Biologic Forms' of the Erysiphaceæ." By Ernest S. **Salmon**, F.L.S. Communicated by Prof. H. Marshall Ward, F.R.S.

The author points out that through specialisation of parasitism "biologic forms" have been evolved in the Erysiphaceæ, and that the powers of infection, characteristic of each "biologic form," are under normal conditions sharply defined and fixed. Hitherto the result of the experiments of numerous investigators—both with regard to the present group of fungi and to the Uredineæ, where the same specialisation of parasitism occurs—has been the accumulation of evidence tending to emphasise the immutability of "biologic forms."

In a series of cultural experiments with "biologic forms" of *Erysiphe Graminis*, DC., the author has discovered that under certain methods of culture, in which the vitality of the host-leaf is interfered with, the restricted powers of infection, characteristic of "biologic forms," break down.

In these cultural experiments the leaf, previous to inoculation, was injured by the removal of a minute piece of leaf-tissue, or by touching the epidermis with a red-hot knife. The experiments proved that the range of infection of a "biologic form" becomes increased when the vitality of a leaf is affected by injury, so that the conidia of certain "biologic forms" are able to infect injured leaves of host-species which are normally immune against their attacks.

Further experiments showed that the conidia of the fungus produced on a "cut" leaf are able at once to infect uninjured leaves of the same host-species.

The author suggests that injuries to leaves, caused in nature by hail, storms of wind, attacks of animals, &c., may produce the same effect as the artificial injuries described above in rendering the injured leaf susceptible to a fungus otherwise unable to infect it.

Attention is directed to the close parallel between the behaviour of the fungus in the experiments and the biological facts obtaining in the class of parasitic fungi known as "wound parasites" (Nectria, *Peziza willkommii*, &c.).

"On the Effects of Joining the Cervical Sympathetic Nerve with the Chorda Tympani." By J. N. **Langley**, F.R.S., and H. K. **Anderson**, M.D.

The experiments have been directed to determine whether the cervical sympathetic, if allowed an opportunity of becoming connected with the peripheral nerve cells in the course of the chorda tympani, will in part change their function from vaso-constrictor to vaso-dilator. The superior cervical ganglion in an anæsthetised cat was excised and the central end of the cervical sympathetic nerve was joined to the peripheral end of the lingual, which contains the chorda tympani fibres. After allowing time for union and regeneration of the nerves, the cervical sympathetic was stimulated; it caused prompt flushing of the sub-maxillary glands, and the effect was repeatedly obtained.

The experiment shows (1) that vaso-constrictor nerve fibres are capable of making connection with peripheral vaso-dilator nerve cells, and becoming vaso-dilator fibres, and (2) that whether contraction or inhibition of the un-

striated muscle of the arteries occurs on nerve stimulation depends upon the mode of nerve-ending of the post-ganglionic nerve fibre.

The cervical sympathetic gave a less scanty and more prolonged secretion than normal, so that some of its nerve fibres had become connected with the peripheral secretory nerve cells of the chorda tympani.

Geological Society, January 20.—Sir Archibald Geikie, Sec.R.S., vice-president, in the chair.—On the jaws of Ptychodus from the Chalk: Dr. A. Smith **Woodward**, F.R.S. Hitherto no traces of the cartilaginous jaws of this fish have been found in association with the dentition, but recently a specimen of *Ptychodus decurrens* has been found in the zone of *Holaster subglobosus* of the Lower Chalk at Glynde. Fragmentary remains of both jaws are seen in the specimen, each bearing characteristic teeth arranged in natural order. There are four series, and one small displaced tooth (probably belonging to the fifth series), on the left of the large median series in the lower jaw, while in the upper jaw the teeth are arranged in six paired series. The specimen proves that Ptychodus resembles the Trygonidæ in its jaws. The probable explanation of the new discovery is that in the Cretaceous period the great rays of the "families" Myliobatidæ and Trygonidæ had not become fully differentiated. Prof. Jækel has proposed to place all these fishes in one family, termed Centrobatidæ. If this arrangement be adopted, Ptychodus represents a primitive subfamily, which still awaits definition, while the Trygoninæ, Myliobatinæ, and Ceratopterinæ are equivalent subfamilies which still survive. —On the igneous rocks at Spring Cove, near Weston-super-Mare: W. S. **Boulton**. A traverse from end to end of the exposure at the locality shows that the "basalt-mass" is by no means a simple lava-flow. It may be roughly divided into three portions. Beginning at the cliff-end to the north, the rock is a pillowy basalt, with tuff and limestone; then the rock is mainly a coarse "agglomerate," with lapilli and bombs of basalt and limestone; while the remaining part is a basalt-coulée, with few small lumps of burnt limestone. The limestone below is reddened and altered, and does not contain lapilli; the limestone above contains lapilli. The pillowy basalt probably represents a river of agglomeratic material possibly ejected from a vent. The intervening tuff may present an analogy with the "volcanic sand" of the West Indian eruptions. There is no evidence of the quiet deposition of ashy material. The large fragments of limestone found mainly in the lower part of the basalt-mass have not come in from above, but seem to have been picked up from the sea-bed in which it had been accumulating, and to have been involved with and altered by the volcanic material.

February 3.—Sir Archibald Geikie, Sec.R.S., vice-president, in the chair.—On a deep-sea deposit from an artesian boring at Kilacheri, near Madras: Prof. H. Narayana **Rau**. The boring, after penetrating the upper clays and sandstones, passed through carbonaceous shales, and at a depth of about 400 feet reached a blue homogeneous rock, effervescing with acid, and showing radiolarian tests under the microscope. One or two specimens of foraminifera have also been seen. The deposit underlies beds of the Upper Gondwána stage. The author concludes that the deposit is of abysmal origin, similar to those described in the *Challenger* reports. In the discussion that followed Dr. W. T. Blanford said that he was unable to agree with the author's conclusions, and he objected to the title of the paper, because the rocks described were, in his opinion, not deep-sea deposits. The mineral evidence brought forward was quite insufficient to show that the beds were oceanic, and the presence of radiolaria was no proof by itself of deep-sea conditions.—The Rhætic beds of the South Wales direct line: Prof. S. H. **Reynolds** and A. **Vaughan**. After a reference to the literature of the subject the following exposures are described—the Stoke-Gifford and the Lilliput or Chipping-Sodbury sections.

Entomological Society, February 3.—Prof. E. B. Poulton, F.R.S., president, in the chair.—Mr. A. J. **Chitty** exhibited two specimens of *Ptinus tectus*, Boisd., taken by him in a granary in Holborn in the winter of 1892–3, also a complete series of the red Apions to show *A. sanguineum* from the late Frederick Smith's collection.—Mr. O. E. **Janson** exhibited specimens of *Papilio weiskei*, Ribbe, and *Troides meridionalis*, Rothschild, recently taken by Mr. A. S. Meek near the Aroa River in the interior of British New Guinea. —Mr. E. C. **Bedwell** exhibited the following species of Coleoptera taken by him in north Wales (on Snowdon) in the first week of August, 1903:—a fine series of *Chrysomela cerealis*, L., a pair of them being of the curiously dull form, *Anthophagus alpinus*, Payk., *Acidota crenata*, F., *Arpedium brachypterum*, Grav.; and *Quedius longicornis*, Kr., hitherto unrecorded from the Principality.—The Rev. F. D. **Morice** exhibited a series of lantern slides illustrating the structure of concealed ventral segments in males of the hymenopterous genus Colletes.—Mr. W. J. **Kaye** exhibited a Müllerian association of black and transparent species from the Potaro Road, British Guiana, consisting of Ithomiinæ, *Ithomia zarepha*, *Ithomia florula*, *Heterosais sylphis*, and Napeogenes, n.sp., Erycinidæ, *Stalachtis phaedusa*, and *Stalachtis evelina*, Hypsidæ, *Lauron partita*, Geometridæ, Hyrmina, n.sp. The whole of the specimens had been caught on one single forest road, some 170 miles inland. Mr. Kaye directed particular attention to the new species of Napeogenes, and said it was a most remarkable divergence from the usual coloration of the genus Napeogenes as a whole, where orange-yellow and black were the prevailing colours, while the present insect was black and transparent only, and conformed in a wonderful way with many true members of the genus Ithomia.—The **President** exhibited a male and female of *Papilio dardanus*, captured by Mr. Geo. F. Leigh at Durban in 1902, and examples of the offspring reared from the eggs laid by the female. The latter was of the *cenea* form, as were the great majority of the female offspring; three, however, were of the black and white *hippocoon* form. More recently, in 1903, Mr. Leigh had captured a female of the rare *trophonius* form, and had bred from the seven eggs laid by it five butterflies, of which the two females were both of the commonest *cenea* form. The female *trophonius* was also exhibited, together with the five offspring.—Captain C. E. **Williams** read a paper on the life-history and habits of *Gongylus gongyloides*, a mantis of the tribe Erupasides and a floral simulator, and exhibited a living ♀ in the nymph stage, together with coloured drawings, photographs, and lantern slides showing both the adult and immature insect in various positions. The chief features of interest in the exhibitions lay in the peculiar modifications of shape and colouring by which this mantis conceals itself and attacks its prey, which consists of Lepidoptera and Diptera.—Mr. G. A. J. Rothney communicated descriptions of new species of Cryptinæ from the Khasia Hills, Assam, and a new species of Bembex, by Peter **Cameron**.—Mr. M. **Burr** contributed systematic observations upon the Dermatoptera.—Dr. T. A. **Chapman** read a paper on a new species of Heterogynis, and exhibited specimens of this and other allied species.—Mr. R. **Trimen**, F.R.S., read a paper on some new or imperfectly known forms of South African butterflies, and exhibited, among other specimens, illustrating his remarks, typical and aberrational forms of *Acræa rahira*, *Zeritis felthami*, a new species, *Z. molome*, Trim., and *Z. damarensis*, Trim.; typical *Colias electra*, Linn., from Natal, and a remarkable melanic aberration of the same species; also *Kedestas tucusa*, a very rare and unfigured Hesperiid ♀ and ♂ from Johannesburg.

PARIS.

Academy of Sciences, February 15.—M. Mascart in the chair.—The president announced to the academy the death of M. Callandreau, member of the section of astronomy. —On the simple fundamental solution and the asymptotic expression of temperature in the problem of cooling: J. **Boussinesq**.—The action of reduced nickel in the presence of hydrogen on halogen derivatives of the fatty series: Paul **Sabatier** and Alph. **Mailhe**. It has been shown in a previous paper that in the aromatic series the halogen may be readily replaced by hydrogen by the action of reduced nickel. In the fatty series the action is quite different; the saturated hydrocarbon is not produced, but the alkyl chloride is broken up into hydrochloric acid and the corresponding olefine, these partially recombining, giving secondary and tertiary chlorides where possible. Methyl

chloride behaves in an exceptional manner, giving hydrochloric acid, hydrogen, and carbon. The behaviour of bromine and iodine derivatives is generally similar to that of the chlorine compounds, methyl iodide being exceptional, giving methane and a little ethylene.—On quasi-rational numbers, and ordinary or continued quasi-periodic arithmetical fractions: Edmond **Maillet.**—On the actinium radiation: A. **Debierne.** A detailed study of the law of disappearance of the emanation of actinium, and also of the decrease of radio-activity induced by this emanation.—The phenomenon of the transmission of the *n*-rays and its applications: Augustin **Charpentier.**—A description of a series of experiments on the conduction of the *n*-rays along copper and silver wires. A piece of string, moistened with collodion containing calcium sulphide in suspension, also conducts like a metallic wire.—On the conditions of the indifferent state: E. **Ariès.**—On the influence of complex ions in electrolysis by alternating currents: André **Brochet** and Joseph **Petit.** With alternating currents there may be the formation of complex ions, disengagement of detonating gas, solution of the electrodes, or oxidation or reduction in cases where the electrolyte is capable of oxidation or reduction.—On γ-chloroacetoacetic ester: M. **Lespieau.** This substance has been previously only obtained mixed with an isomer; by the oxidation of

$$CH_2Cl.CH(OH).CH_2.CO_2C_2H_5$$

by a mixture of potassium bichromate and dilute sulphuric acid which furnishes the ketonic ester in a pure state. It is characterised by its copper salt, which is insoluble in water, but can be crystallised from benzene.—On dichloromethylenedioxypropylbenzene and the carbonate of propylpyrocatechin: R. **Delange.** The halogen compound is obtained by the interaction of phosphorus pentachloride and dihydrosafrol, and is separated by distillation in a vacuum. It enters very readily into reactions, details of those with water, alcohol, phenol, acetic anhydride, and acetic acid being given.—On the glyoxylic ureides: allantoin and allantoic acid: L. J. **Simon.**—Some observations in the composition of potato starch: A. **Fernbach.** Phosphoric acid is an integral constituent of starch grains. Potato starch was separated by levigation into several fractions, corresponding to grains of varying size, and the amount of phosphate in each fraction determined. From the analytical figures thus obtained the conclusion is drawn that the nucleus of each grain is relatively rich in phosphorus, and upon this are gradually superposed layers of starch free from phosphorus.—On a new copal resin and kino, the first furnished by the fruit, the second by the bark of *Dipteryx odorata*: Édouard **Heckel** and Fr. **Schlagdenhauffen.**—Varieties of origin, nature and properties of the soluble active products developed in the course of a bacterial infection: A. **Charrin.**

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 25.

ROYAL SOCIETY, at 4.30.—Electromotive Phenomena in Mammalian Non-medullated Nerve: Dr. N. H. Alcock.—Further Observations on the *Rôle* of the Blood-Fluids in connection with Phagocytosis: Dr. A. E. Wright and Capt. S. R. Douglas.—On Mechanical and Electrical Response in Plants: Prof. J. C. Bose.—On the Compressibility of Solids: J. Y. Buchanan, F.R.S.—A Contribution to the Pharmacology of Indian Cobra-venom: Major R. H. Elliot.

ROYAL INSTITUTION, at 5.—Electrical Methods of Measuring Temperature: Prof. H. L. Callendar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Transatlantic Engineering Schools and Engineering: Dr. R. M. Walmsley. (Adjourned Discussion)

FRIDAY, FEBRUARY 26.

ROYAL INSTITUTION, at 9.—New Developments in Electric Railways: Alex. Siemens.

PHYSICAL SOCIETY, at 5.—A New Dilatometer: B. Bonniksen.—A Quartz-thread Vertical Force Magnetograph: Dr. W. Watson, F.R.S.—On Stresses in a Magneto-static Field: G. W. Walker.—Some Hints on the Preparation of Diagrams: Dr. W. Watson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Boiler-house Design: L. G. Crawford.

SATURDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

ESSEX FIELD CLUB, at 6.30 (at the Essex Museum of Natural History, Stratford).—A Disappearing Industry; Charcoal Burning in Essex: T. S. Dymond.—Recent Observations and Discoveries concerning London City Walls, the Walbrook and Moorfields: F. W. Reader

MONDAY, FEBRUARY 29.

SOCIETY OF ARTS, at 8.—Modern Book Printing: Charles T. Jacobi. (Cantor Lecture, II).

INSTITUTE OF ACTUARIES, at 5.—An Investigation into the Rates of Re-Marriage and Mortality amongst Widows in Receipt of Relief from the Patriotic (Russian War) Fund, 1854-1900: J. Burn and J. McDonald.

TUESDAY, MARCH 1.

ROYAL INSTITUTION, at 5.—Japanese Life and Character: E. Foxwell.

SOCIETY OF ARTS, at 4.30.—Nigeria: Lady Lugard (Miss Flora L. Shaw).

ZOOLOGICAL SOCIETY, at 8.30.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Papers to be further discussed*: The Construction of Railway-Wagons in Steel: J. D. Twinberrow.—The Construction of Iron and Steel Railway-Wagons: A. L. Shackleford.—Iron and Steel Railway-Wagons of High Capacity: J. T. Jepson.

WEDNESDAY, MARCH 2.

SOCIETY OF ARTS, at 8.—Physical Degeneration: Dr. Robert Jones.

ENTOMOLOGICAL SOCIETY, at 8.—Notes on Australian and Tasmanian Cryptocephalides, with descriptions of New Species: A. M. Lea.—A Revision of the Sub-family Pelidnotinæ of the Coleopterous family Rutelidæ, with descriptions of New Genera and Species: the late Frederick Bates, communicated by G. J. Arrow.—On some New Species of Eastern Australian and African Moths in the British Museum: Colonel C. Swinhoe.—An Entomological Excursion to Moncayo, Spain: G. C. Champion; with some Remarks on the Habits of *Xyleborus dispar.*, Fabr.: Dr. T. A. Chapman: Further Notes on Hydroptilidæ belonging to the European Fauna, with descriptions of New Species: K. J. Morton.—*Discussion*: What is a Species? Prof. E. B. Poulton, F.R.S., Mr. H. J. Elwes, F.R.S., Dr. F. A. Dixey and others.

THURSDAY, MARCH 3.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: An Inquiry into the Nature of the Relationship between Sunspot Frequency and Terrestrial Magnetism: Dr. C. Chree, F.R.S.—The Optical Properties of Vitreous Silica: J. W. Gifford and W. A. Shenstone, F.R.S.—A Radial Area Scale: R. W. K. Edwards.—The Origin of the Flutings in the Spectra of Antarian Stars: A. Fowler.

ROYAL INSTITUTION, at 5.—Electrical Methods of Measuring Temperature: Prof. H. L. Callendar, F.R.S.

RÖNTGEN SOCIETY, at 8.30.—Presidential Address: Some Laboratory Notes of the last Six Months.

LINNEAN SOCIETY, at 8.—List of the Species of Carex known to occur in Malaya: C. B. Clarke, F.R.S.—On some Species of the Genus Palæmon, Fabr., from Tahiti, Shanghai, New Guinea, and West Africa: Dr. J. G. de Man.

CHEMICAL SOCIETY, at 8.—Chemical Dynamics of the Alkyl Iodides: Miss K. A. Burke and F. G. Donnan: The Constitution of Phenolphthalein: A. G. Green and A. G. Perkin.—δ-Ketohexahydrobenzoic Acid: W. H. Perkin, junr.—Photochemically active Chlorine: C. H. Burgess and D. L. Chapman.

FRIDAY, MARCH 4.

ROYAL INSTITUTION, at 9.—Breathing in Living Things: Prof. W. Stirling.

SATURDAY, MARCH 5.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

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