THURSDAY, DECEMBER 28, 1911.

THE SYNTHETIC COLOURING MATTERS.

The Chemistry of the Coal-tar Dyes. By Prof. I. W. Fay. Pp. vi+467. (London: Constable and Co., Ltd., 1911.) Price 16*s.* net.

THE rate of progress in the dyestuff industry is admittedly far more rapid than in any other branch of applied chemistry, and the advances made during the past ten or fifteen years have effected an enormous change in the whole aspect of the subject. Very many dyestuffs of former importance have been abandoned or partially replaced, and hundreds of new dyestuffs have been introduced into commerce. New manufacturing processes have superseded older ones, and considerable improvements have been made in the methods of dyeing and printing. The majority of these advances have been directed towards securing a greater degree of fastness to washing, light, and other agencies. Thus in cotton dyeing the want of fastness of the earlier "substantive" or "salt" dyestuffs soon led to attempts to fix these colours after dyeing, by various methods, such as by diazotisation and combination with phenols, by coupling with diazo-compounds, by treatment with formaldehyde, or by fixation with salts of copper or chromium. The introduction in 1894 of Vidal black, and the enormous extension of the group of "sulphide" dyestuffs which shortly followed, provided the cotton dyer with a class of cheap colouring matters of much greater fastness than those of the "salt" class, which they therefore largely replaced. Again, more recently the newly introduced "vat" dyes of the anthracene and indigoid classes, though at present expensive and difficult to apply, bid fair eventually to supplant the "sulphide" dyestuffs for those purposes, in which the highest degree of fastness is of paramount importance, since many members of this class exhibit a resistance to light and washing surpassing that of any of the older organic dyestuffs. On the theoretical side also considerable progress must be recorded. The constitution of many dyestuffs and dyestuff groups has been elucidated, the mechanism of reactions has been rendered clearer, and our views as to the connection of chemical structure with colour and dyeing properties have been extended.

In the presence of such rapid advances, existing text-books soon become out of date, and in presenting a new work it should be the first aim of the author to render an account of the subject from the most modern point of view. This unfortunately has scarcely been accomplished in the work under review. The author has apparently drawn his material chiefly from the standard text-books, to which indeed he gives full acknowledgment. Original sources, such as the scientific and technical journals or the patent literature, do not seem to have been consulted to any considerable extent. In consequence many important dyestuffs and even entire groups of dyestuffs escape mention, whilst undue space is devoted to the description of others that are now obsolete, and for which a short historical reference would have sufficed. Thus, among the azo-dyestuffs we find no account of those derived from pyrazolone, comprising the light-resisting dyes—tartrazine, fast light yellow, &c.; nor of the more recent chrome-azo colours obtained from orthoamidophenols and orthoamidonaphthols; nor of the valuable class of substantive dyestuffs derived from the 2 : 5 : 7-amidonaphtholsulphonic acid. The very important group of anthracene vat dyestuffs, of which indanthrene blue is the typical representative, is also not mentioned; whilst thioindigo red and thioindigo scarlet are the only vat dyestuffs of the indigoid class which are described.

Even amongst the older dyes we note some curious omissions. Thus no reference is made to the thiazol class, which includes primuline, chloramine yellow, and thioflavine, though this group still retains its importance. Again, the stilbene condensation, by which curcumine yellow and the mikado oranges are produced, is only referred to in connection with the preparation of diamidostilbene disulphonic acid, whilst the reactions for the formation of this substance are represented in a manner now proved by recent investigations to be erroneous. In describing the synthetical methods for the manufacture of indigo, no reference is made to the technically important modification of Heumann's process employed by the Farbwerke Hoechst, which consists in adding sodium amide to the phenylglycine melt. Moreover, the starting point in the Sandmeyer synthesis is not chloral and hydroxylamine but diphenylurea.

In regard to the more theoretical aspects of the subject, we miss any full discussion of the relationship of constitution to colour, beyond the older views of Witt. Paraquinonoid and orthoquinonoid formulæ are frequently used indiscriminately and without explanation. Thus, whilst the paraquinonoid formula is given to Lauth's violet, its tetramethyl derivative, methylene blue, is represented on the same page by an orthoquinonoid structure. Similarly, in the general classification of the dyestuffs only paraquinonoid types are given, whilst in the general text the dyes of the azine, oxazine, and thiazine classes are mostly represented by orthoquinonoid formulæ. The structure assigned to quinoline yellow is the old quinophthalone constitution now abandoned for the indanedione formula. Chrysophenine is a diethylether of brilliant yellow, and does not contain a free hydroxyl group as formerly supposed and here represented. The fastness to alkalis of the dyestuffs of the patent-blue class cannot be due to the suggested intramolecular linkage of the ortho-sulphonic group, since a similar effect is produced by halogen atoms, or even by methyl groups when present in the same position.

Apart from the above defects, which perhaps are more serious from the point of view of the technologist than for the general chemical student, the subject is presented in an interesting and readable form, which should render the volume of utility. The printing of the text and formulæ is unusually clear, and for a work of this kind fairly free from errors.

The dedication of a whole chapter to the "seven food colours" permitted by the United States Government, appears somewhat a waste of space even for American readers.

ARTHUR G. GREEN.

CONSTRUCTIVE BIOLOGY.

Some Neglected Factors in Evolution: an Essay in Constructive Biology. By H. M. Bernard. Edited by Matilda Bernard. Pp. xxi+489. (New York and London: G. P. Putnam's Sons, 1911.) Price 12*s.* 6*d.* net.

MANY who know the late Mr. Bernard's work in other fields—notably on Madreporarian corals, the Apodidæ, the Galeodidæ, and the retina—will be interested in this essay in constructive biology. Mr. Bernard was marked by a resolute independence of thought, and this quality, strengthened by his mathematical and philosophical training, is conspicuous in the book before us, a posthumous work, very carefully edited.

The first part of the volume is an exposition of the protomitomic theory, according to which what are called "cells" are merely form-features of some deeper underlying texture, namely, a fundamental linin-chromatin network. In the retina of vertebrates the author found a continuous network with the nuclei at the nodes. He called this fundamental reticulum in living substance, "the protomitomic network." "The connecting filaments were seen to be continuations of the filaments within the nuclei, so that the latter appeared to be merely special tangles of the filamentous network." In some tissues a large amount of cytoplasmic matter is required for their activities, and this tends to obscure the essential reticular structure; in other tissues the filaments are the most obvious structural elements. According to Mr. Bernard's view, which is expounded in a temperate, scholarly, and ingenious argument, the biological unit—both morphological and physiological—is not the cell, but a node in the reticular linin-chromatin system, a stellate linin-chromatin mass from which filaments radiate. By concentration of chromidia (*i.e.* minute chromatin particles which occur in the nodes of the linin network), rearrangement of filaments, and progressive centripetal differentiation, and the like, the first cells may have arisen. They are like enlarged editions of the chromidial units, capable of a larger "life."

This is not the sort of theory that can be called right or wrong; the question is whether it is useful in the interpretation of cellular structure and function. In a series of chapters the main conception—of a continuous filamentous system with nuclei distributed as centres of functional activity—is cleverly used as a key, not only in regard to structural details of epidermis, nervous system, sense organs, and the like, but also in regard to growth, cell-division, and even heredity. We come at length to the idea that organisms differ from one another in the pattern of their protomitomic networks, which is like the morphological side of Haeckel's idea that organisms differ from one another in the rhythm of their minutest protoplasmic particles or plastidules. It is indeed a fundamental biological conception that an organism is an individualised persistence of a specific activity inseparably associated with a specific structure.

In many of the cells that we are in the habit of looking at we are bound to confess that we cannot see anything of the protomitomic system, and the descriptions given by some of the most expert cytologists are not in favour of the author's view, which is essential to his whole theory, that the filaments of the nuclear network are *continuous* with the network of the cell-body. The suggestion is made that the use of osmic acid is to blame for the modern denial of the unity of the reticulum. Apart from the idea of continuity, it is possible to find in many recent researches some corroboration of the author's emphasis on the extra-nuclear chromatin. We think, for instance, of the modern insistence, due very largely to Richard Hertwig, on the importance of the chromidial (*i.e.* extra-nuclear chromatin) apparatus in the cytoplasm. Or we recall the "plastosomes" of Meves, elementary structures in the cytoplasm, which are regarded as the foundations or primordia of ontogenetic differentiations.

The second part of the book contains the author's theory of evolution. It is very interesting, characteristically fresh and independent, but within the space at our disposal we cannot do more than allude to three of its outstanding features. The first is the idea of a cosmic rhythm, which is akin to a suggestion that Herbert Spencer made, but left undeveloped, that "life on the earth has not progressed uniformly, but in immense undulations." As Mr. Bernard expressed it: "Organic life is seen advancing out of the dim past upon a series of waves"; period succeeds period, each with a higher unit—"each evolutionary period can be described by the same formula, the processes in all cases being essentially the same, although the factors involved become increasingly complex." The first period is that of the chromidial unit, the second that of the cell unit, the third that of the gastræal unit, the fourth that of the annelidan unit, the fifth that of man. One must remember, of course, that even so far back as the Cambrian life had got a long way past the simpler expressions of the annelidan unit.

The second outstanding feature is the author's conviction that the Darwinian theory accounts for detailed adaptation rather than for great advances in *type*, and that the production of new types is describable as a kind of colony-formation. This was the lesson that the author learned from his thirteen years of work on corals. "The physical force of life" has had periodic outbursts of growth leading to the production of homogeneous aggregates, to repeated colony-formation, to "raisings of the level of life," to "altogether new organisation." Many naturalists have pondered over colony-formation, and we are not prepared to accept the statement on p. 299, that "colonies are regarded by them merely as accidental knots in the evolutionary chain, of no value to the chain." We feel sure, for instance, that the veteran zoologist of Jena will heartily agree with the thesis which his esteemed student has developed in chapter xvii., that colony-formation is an essential factor in evolution. What we miss, however, is a recognition of alternating periods of aggregation and integration.

The third distinctive feature in the etiology of this book is the recognition of "a psychic element in life." While "the assumption of a special 'vital force' is a

knot gratuitously tied in the tangled skein of physical and psychical phenomena," and while the author "would deprecate the assumption that the psyche has mixed, in any way, as an integral factor in the machinery of the building processes of the forms of life, or in their daily workings as intricate mechanisms," yet he believes that the psyche has been able to exert an influence on the working by either delaying or hastening it. In this the psyche is like Driesch's "Entelechy," which punctuates the transformations of energy within the body.

THE SENSIBILITY OF THE ALIMENTARY CANAL.

The Goulstonian Lectures on the Sensibility of the Alimentary Canal. Delivered at the Royal College of Physicians on March 14, 16, *and* 21, 1911. By Dr. Arthur F. Hertz. Pp. v+80. (London: Henry Frowde and Hodder and Stoughton, 1911.) Price 5*s.* net.

THE lectureship which was founded by the late Dr. Goulston is annually awarded to one of the newly elected fellows of the Royal College of Physicians, and so forms a channel by means of which a junior member of the medical profession may make what has often proved to be the first of a valuable series of additions to physiological and pathological progress. Dr. Hertz, however, to whom the honour was awarded this year, is already well known to his medical brethren, and has published many papers on various subjects, as well as a book on constipation. It is to him and his colleagues at Guy's Hospital that we owe the work by means of which the X-ray method has been rendered an aid in medical, as it had been previously shown to be in surgical, cases, and during recent months allusions have been made in these columns to the value of such research in elucidating the disorders of the alimentary canal.

In the present volume, in which Dr. Hertz republishes his lectures, he has, however, struck a new note, and deals with the sensations arising from this part of the body.

The martyr to dyspepsia needs no reminding how insistent such sensations may be. The man in perfect health, however, is scarcely cognisant of the existence of his internal organs. In pre-anæsthetic days, surgeons discovered that the majority of the internal structures of the body are insensitive to touch; they can be handled, and even cut or burnt without causing any sensations. Dr. Hertz not only confirms this by his careful experimental and clinical observations, but has further shown that the alimentary canal is, with the exception of the œsophagus and the anal canal, also insensitive to sensations of heat and cold. Contact with alcohol, however, applied to any part gives rise to a subjective sensation of warmth.

But, as already suggested in the mention of the dyspeptic, pain is experienced; this sensation, which is probably the most primitive of the senses, as it is so important for protective purposes in the struggle for existence can be elicited, but its only cause is tension or stretching, which in a milder degree is also the cause of the sensation of fulness. If disease spreads to, or the tension is exerted on, peritoneal structures, the pain may become excruciating. This sensibility varies in different people, and is most marked in those with an irritable nervous system, as in neurasthenia, hypochondriasis, and anæmia. But when visceral pain or discomfort is present, all people are alike in their inability to localise it accurately. It is then that the so-called "referred pains" come to the assistance of the physician. By this one means that areas of skin and subjacent muscle related to the same spinal segments that govern the viscera, are the seat of discomfort, pain, and even of tenderness. This aspect of the subject has been taken up especially by Dr. Henry Head, and it is quite possible to localise an internal disorder by a study of the referred pain. The painful, tender patch may not always be in the immediate vicinity of the affected organ, for in growth the skin area, and the internal viscus which send their messages to the same segment of the spinal cord may become widely separated; for instance, the association of liver trouble and shoulder pain is familiar even to the non-medical reader.

The alimentary canal, though destitute of any true tactile sense, is endowed with certain sensations peculiar to itself, namely, hunger and thirst. These two sensations do not run quite on all fours with each other, and of them Dr. Hertz refers to hunger only. This consists not only in a general sensation of malaise, but a local sense of abdominal emptiness. Dr. Hertz believes that the latter is produced by the motor activity of the stomach and intestines during fasting; and this affects consciousness partly because the action is excessive, and partly because the central nervous system is over-excitable in this condition.

The brochure of which we have attempted this brief and imperfect summary will amply repay careful perusal, and hearty congratulations are due to its author, not only for his accurate and well-devised experimental work and observations, but also for the lucid and interesting way in which he has presented them. W. D. H.

A NEW PRIMER OF PSYCHOLOGY.

The Essentials of Psychology. By Prof. W. B. Pillsbury. Pp. xi+362. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1911.) Price 5*s.* 6*d.* net.

THE task of writing a good elementary text-book on any science is notoriously arduous, and this is especially the case with so difficult a subject as that of psychology. The ideal writer of such a book would be one whose power of taking a broad and unbiassed view of his subject was guaranteed by a thoroughly sound previous training in mathematics, physiology, and philosophy (metaphysics, logic, ethics, &c.), every one of which sciences is absolutely essential to a competent knowledge of psychology in its full extent at the present day. A writer falling short of this ideal is likely to betray the fact by an unevenness, more or less pronounced, in his treatment of different parts

of the subject. In the case of the present book the unevenness, though not entirely absent, is scarcely apparent. It takes the form of slight inadequacy on the mathematical side, appearing in the brief and not entirely unmisleading account of the measurement of sensation intensities, and more prominently in the long and otherwise excellent chapter on "The Interrelations of Mental Function," where the important method of correlation now in general use for the measurement of these interrelations is not mentioned, and is only referred to indirectly by the quotation, in one sentence, of a research somewhat out of date and certainly not representative.

In other respects, Prof. Pillsbury has written an exceptionally useful and effective book, for which one can safely predict a high degree of popularity among students. The earlier chapters are devoted to a very interesting analysis of the general characteristics of consciousness, such as attention, retention, and association, and the descriptions of perception, memory, reasoning, &c., are all based upon this earlier account, and form the later chapters of the book. The discussions of attention, memory, and imagination, reasoning and work, fatigue and sleep, are exceptionally good, and sum up concisely a great many of the results of modern experimental work on these topics. Perception is not so well done. It is surely incorrect to say that "perceptions always involve centrally aroused sensations or memories, as well as sensations" (p. 157). Evidence from pathology and animal psychology makes dead against this view. Inherited structure of the nervous system, as Prof. Stout suggests, "explains" the function better in such cases, and even in normal human psychology these additional mental images and ideas are largely mythical and unidentifiable by introspection.

Another small point: in the chapter on cutaneous sensations no mention is made of the distinctness of sensations of warmth, coolness, and light touch from those of heat, cold, and heavy touch respectively, although this result, based upon the work of Drs. Head, Rivers, and Sherren, is now three years old and well authenticated. A reference to it would not have conflicted with the elementary character of the book. This is one instance among several of the tendency to ignore important work done by English psychologists, which is more pronounced than it might be in some American and Continental writers.

At the end of each chapter of the book there is a series of "exercises" in experimental introspection, for which one is grateful. They add considerably to its value for class-work. W. B.

NUMBER AND QUANTITY.

Grandeurs et Nombres—Arithmétique Générale. By Prof. E. Dumont. Définitions et Propriétés fondamentales des Grandeurs géométriques et de leurs Mesures; Nombres Naturels, Qualifiés, Complexes, Ternions et Quaternions. Pp. xvii+275. (Paris: A. Hermann et Fils, 1911.) Price 10 francs.

IN mathematics, as in other affairs, a great movement happens now and then which is a kind of revolution; and whenever this occurs there is sure to be a body of stalwart veterans, who refuse to budge from their old position, however untenable or worthless it may be.

M. Dumont's book is an illustration of this familiar fact. So far is he from accepting the modern view of mathematical science that it stirs him to a passionate revolt; he invokes the shades of the old masters, from Archimedes down to Hamilton, and denounces the logicians as conspiring to make mathematics a barren pastime, instead of the instrument of the natural philosopher.

In order to justify his protest, he has attempted to give a theory based on the definition of a number as the ratio of two quantities. As might be expected, he constantly begs the question, and makes a variety of tacit assumptions, far more complicated than those really necessary in applying mathematics to physical phenomena. For instance, he says (p. 7), "To multiply a quantity G by the number A_1/A is to apply to G the same treatment which, applied to A, produces A_1." What is "the same treatment"? G may be a length, and A, A_1 volumes or masses; how can "the same treatment" be defined without begging the whole question at issue? A little further on we read that "it is not always possible to multiply a quantity (*grandeur*) by a number, as we shall see in the theory of quaternions." Here our Don Quixote betrays some sense of discomfort in his antiquated armour; the reason appears subsequently. Length is defined (p. 114) as "une grandeur linéaire relative et orientée . . . qui se développe dans deux sens opposés, à partir d'une origine arbitraire, et dans une direction variable." On p. 195 we read, "the ratio of two vectors or of two angles, thus conceived, is called a quaternion or quaternary number"; after this it is not surprising to find a treatment of quaternions quite needlessly complex, with definitions stated as theorems, and formulæ of the most repellent kind; moreover, we have a separate chapter on "ternions," which are only special cases of quaternions. To make confusion worse confounded, the author writes (a, b denoting vectors) a/b as the equivalent of $b^{-1}a$, and calls it "the ratio of a and b," while $a:b$ is the equivalent of ab^{-1}, and is called "the quotient of a by b." Almost immediately before this we read: "Quant à a/b, on écrira aussi volontiers $a/b=b^{-1}a$ que $a/b=ab^{-1}$"!

M. Dumont expressly denounces the views of his distinguished countrymen Jules Tannery and M. Hadamard; they need no better justification than is unconsciously given by this attempt to prove them wrong. At the same time, some of us will partly sympathise with M. Dumont, although entirely disagreeing with his doctrine. It would indeed be lamentable if mathematics were to be entirely divorced from its physical applications, and simply cultivated as an intellectual game. Fortunately, there is no reason to fear that this will ever be the case; electrical theory alone will continue to attract many of the ablest mathematicians of the time. And however fully we may admit that arithmetical analysis is independent of measurement, we cannot ignore the fact that measurements must precede any physical theory of a mathematical kind. Moreover, the data properly belonging to any physical science are not themselves

mathematical; the business of the mathematician (as Kirchhoff and Pearson have so well pointed out) is to provide, if possible, a descriptive scheme, such, for instance, as the so-called "law" of gravitation and its mathematical consequences, which reduces a complex group of phenomena to an intelligible system. Anything beyond this is metaphysics, and outside the domain of physical science and mathematics as well.

G. B. M.

APPLICATIONS OF PHOTOGRAPHY IN SCIENCE AND TECHNICS.

Angewandte Photographie in Wissenschaft und Technik. Edited by K. W. Wolf-Czapek. In vier Teilen. Pp. xvi+100+37 plates; pp. 119+41 plates; pp. 95+42 plates; pp. 98+37 plates. (Berlin: Union Deutsche Verlagsgesellschaft Zweigniederlassung Berlin, 1911.) Price 20 marks.

THERE is scarcely a science to-day wherein photography is not employed in one form or another, and even our industries make use of it in a host of different ways. So universal has become the adoption of this form of obtaining permanent records of things living and inanimate that specialists have sprung up in all directions who are able to bring to bear a great amount of experience, not only in how to apply photography to the particular case in question, but the most appropriate apparatus and methods to be adopted to secure the best results.

If, for instance, one wishes to launch out in the domain of photomicrography the first step is to find out what has been written on the subject, and then secure a book which is recommended as containing the best methods to be followed. Or, again, the special field of photographing fast-moving objects, like rifle bullets, is one that requires a good deal of attention before satisfactory results can be obtained. It often happens that one wishes to tackle one branch of photographic work which is outside the domain of that to which one is accustomed, and hence there follows an inquiry into the methods, special apparatus, and material required.

Now the work under review is a veritable *vade mecum* in this respect, for it deals, and deals exceedingly well, with the application of photography in practically every important aspect, both in science and the technics. It is only natural that for such a volume to be of value it must necessarily be the work of numerous men, for no one man can have had experience in all the multitude of applications. Herr K. W. Wolf-Czapek has done well therefore in gathering round him a number of workers who are authorities on the branches about which they write, and the result is one that is eminently satisfactory. The book itself contains 407 pages and 159 plates, with 470 illustrations on them, so that the reader will at once gather the fact that both methods and examples are amply illustrated and described. The contents are divided into four parts under general subheads, namely (1) inorganic physical sciences, such as physics, chemistry, astronomy, &c.; (2) organic physical sciences, such as botany, zoology, &c.; (3) technical science, such as photography applied to war, engineering press, &c.; and lastly (4) social problems, as anthropology, criminal statistics, &c. The list of coworkers is too numerous to be given here, but when it is seen the reader can rest content that the text was in good hands. It is interesting to note that the volume was inspired by the International Photographic Exhibition held in Dresden in 1909, and that Herr Wolf-Czapek took the opportunity to utilise the exhibits as the groundwork for the volume.

In addition to a very carefully prepared table of contents, a subject-index and a name-register, the value of the work is considerably enhanced by the large number of references to the literature of the various subjects treated.

AGRICULTURE AND SOILS OF KENT, SURREY, AND SUSSEX.

Board of Agriculture and Fisheries: a Report on the Agriculture and Soils of Kent, Surrey, and Sussex. By A. D. Hall, F.R.S., and Dr. E. J. Russell. Pp. viii+206+56 figures. (London: H.M. Stationery Office, 1911.) Price 2*s.* 6*d.*

A BRIEF introductory account is given of the geological features of the area under consideration. This is followed by a concise account of the agriculture of the three counties as practised at the present day, chief reference being made to the cultivation of hops and fruit, for which this part of England is famous. Attention is also directed to the most important breeds of live stock found in the districts, the Southdown and Romney Marsh sheep receiving special notice.

The latter portion of the report is devoted to the authors' work upon the soils of the three counties. This section contains a valuable record of analyses—both mechanical and chemical—of the soils of the different localities. Messrs. Hall and Russell have taken the geological formations as a basis of work, and find that the analyses of the soils upon each formation exhibit certain common features which mark them off from those of other formations.

By a careful study of the results, it is seen that the mechanical analysis is, in a general way, indicative of the power of the soil to grow particular crops successfully, and a knowledge of the character and proportion of the component particles is frequently sufficient to enable the expert to predict with certainty the suitability of the soil to the cultivation of hops, fruit, roots, wheat, and other cereals. The chemical analyses in many instances also clearly indicate the need for particular fertilisers, and practical recommendations are made for the manuring of the various farm crops when grown on land situated on the different geological formations.

The authors modestly suggest that the report is incomplete and fragmentary. It is, however, one of the most valuable contributions made to the study of soils in this country, and it is to be hoped that some effort will be made to secure a continuance of similar work in other areas and on an extended scale. We should like to see the analysis of soils undertaken in conjunction with carefully planned experiments upon the actual fields from which the samples are drawn,

the experiments to be continued on the same plots for a period of not less than ten years. If this were done at, say, 500 to 1000 centres, we venture to think that a vast step forward would be made; the interpretation of the figures of soil analysis would become more precise than it is at present, and the relationship between soil texture and composition and its productive power or capacity to grow crops would be more clearly understood. J. P.

OUR BOOK SHELF.

An Account of the Crustacea of Norway. By Prof. G. O. Sars. Vols. i.–v. Vol. v., Copepoda Harpacticoida. Pp. 449+284 plates. (Bergen: Published by the Bergen Museum, 1890–1911.)

By the publication of the concluding parts of vol. v., Prof. Sars has now provided us with the first adequate account of the harpacticoid Copepoda. It was perhaps natural that pelagic Copepoda should first attract the attention of investigators, but many zoologists still appear to think that such forms constitute the principal representatives of the group. This is by no means the case, but perhaps on account of this erroneous impression, the Harpacticoida and other bottom forms have been very much neglected.

An examination of the present volume at once suggests that we still have much to learn of this interesting assemblage. The author gives descriptions of no fewer than 291 species belonging to 99 genera, but at the same time he tells us in his preface that his latest excursion in the summer of 1910 produced about forty additional species, many of them new to science, and most of them obtained in a single locality. This is sufficient evidence that a great deal yet remains to be done, and indeed it is only on the British coast, in addition to that of Scandinavia, that the true bottom forms have been seriously studied, in spite of their considerable economic importance.

It is a matter of some satisfaction that countrymen of our own are among the foremost authorities quoted by Prof. Sars, but this is primarily an indication that these particular forms have been little investigated elsewhere. The abundant large-scale drawings which illustrate each species afford in themselves a most trustworthy means of identification, and it is to be hoped that with such a convenient book of reference now available, a much more extended survey of the types living on the sea bottom will be attempted. We congratulate the veteran author on the successful completion of another volume, and the scientific public on the steady growth of this very valuable work.

W. A. CUNNINGTON.

Traité de Chimie Générale. By Prof. W. Nernst. Ouvrage traduit sur la 6e édition allemande par Prof. A. Corvisy. Deuxième Partie, "Transformations de la Matière et de l'Énergie." Pp. 422. (Paris: A. Herman et Fils, 1912.) Price 10 francs.

THE issue of the translation in two parts is to be commended, for the original has grown to such an extent in passing through its six editions that a single volume would be of inconvenient dimensions. It is only quite recently that an English version, revised in accordance with the sixth German edition, made its appearance, and was reviewed in these columns. In these circumstances, it need only be said in reference to the general character of the book that the translator's work in the second volume is of the same high standard as that attained in vol. i.

With regard to the treatment of the subject-matter, attention may be directed to the question of catalysis. In explanation of the general catalytic activity of acids it is assumed, as usual, that the active agents are the free hydrogen ions. It is true that many of the older observations relating to the catalytic activity of acids can be accounted for on this theory if certain subsidiary hypotheses are accepted, but this apparent harmony between theory and experiment vanishes as soon as we leave the domain of aqueous solutions. Recent work has indeed shown that the catalytic activity of acids in non-ionising solvents is much greater than in aqueous or other ionising media, and this important fact cannot be reconciled with the usual ionic explanation of acid catalysis. In view of the importance of the question, the lack of any reference to such observations must be regarded as a serious omission in a treatise which, in so many other respects, may be considered as efficiently revised in accordance with the progress of physico-chemical science.

In regard to the much-discussed question of the nature of crystalline liquids, the author gives an excellent short summary, but considers that none of the theories advanced can be harmonised with experimental observations.

Three short notes are added by the translator dealing respectively with (1) the direct measurement of osmotic pressure by Fouard's method; (2) the radioactive elements; and (3) the methods of measuring the number of molecules in the molecular volume.

Text-book of Mechanics. By Prof. L. A. Martin, jun. Vol. iii., "Mechanics of Materials." Pp. xiii+229. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1911.) Price 1.50 dollars net.

THE present volume forms the third of a series, the first dealing with statics and the second with kinematics and kinetics, having been reviewed in NATURE of May 16, 1907, and February 6, 1908, respectively. The author has not attempted to treat the mechanics of materials exhaustively; the matter includes simple stresses and strains; the strength and elasticity of beams; statically indeterminate beams; struts and columns; torsion; general theorems of stress and strain; compound stresses; the principle of work as used in computing deflections.

The calculus has been used freely, and the impression is given to the reader that there has been a straining after mathematical effect, instead of the mathematics employed being made subordinate to the clear expounding of the mechanical principles involved. Illustrations have been taken, not because of their practical importance, or of their service in elucidating the subject, but because "they furnish interesting applications of the calculus." We note the very scanty use made of the ellipse of stress, although by means of this method much shorter and more readily comprehended solutions may be obtained in many cases. The same straining after mathematical effect may be observed in the treatment of thin cylindrical and spherical shells under internal pressure. Methods of testing and experimental results are almost absent, an omission which helps to contribute to the air of unreality in the treatment.

Some minor blemishes occur; in finding and using a formula for the horse-power transmitted by shafting, the reader is not warned that the torque must be uniform—a state of affairs which scarcely ever occurs. The "dangerous section" of a beam is defined as that at which maximum bending moment occurs; this will be the case in some instances, but a better and more general definition would be that section which has maximum stress. The book has clear diagrams, and numerous, well-considered exercises for working out are included, a point which will recommend the volume to many students.

The Photographic Annual, 1911–12, Incorporating the Figures, Facts, and Formulae of Photography: a Guide to their Practical Use. Edited by A. D. Godbold. Seventh edition. Fourth year of publication. Pp. 293. (London: G. Routledge and Sons, Ltd., and Dawbarn and Ward, Ltd.; New York: Tennant and Ward; Melbourne: Kodak Australasia, Ltd., 1911.) Price 1*s.* net.

IN the compilation of this volume a new departure has been made embodying considerable alterations from previous issues. Thus, for example, the interesting glossary has this year been omitted, and the editor quite rightly thinks that by this means he avoids the undue repetition of matter, and that reference can easily be made to previous volumes by those who wish to look up such matters. The book opens with the usual series of articles on special topics, and in this issue they relate to the subjects of aërial, flower, and night photographs, together with picture-making by the bromoil and oil processes, and hints for home portraiture. All these contain very concise information for those who wish to take up the subject, and each is well illustrated by series of excellent plates. Mr. Griffith Brewer's fine photograph of St. Paul's Cathedral, taken from the balloon "Vivien," on May 22, 1909, is reproduced.

Following these articles is a series of coordinated data which is always valuable and ready to hand. Thus a list is given of classes for instruction in photography, bibliography, railway companies' lantern slides, federation lecturers, and lectures, &c., and the formulæ as recommended by the leading plate and paper manufacturers. Pp. 163 to 291 are devoted to the "Figures, Facts, and Formulæ," which always form the distinguishing feature of this annual; this section contains a mine of useful and up-to-date information, and should be available in every photographic studio. Those photographers who are not acquainted with this annual, and their number cannot now be many, should undoubtedly examine the book for themselves in order to form a better idea of the everyday information embodied in it.

Das Phytoplankton des Süsswassers mit besonderer Berücksichtigung des Vierwaldstättersees. By Prof. H. Bachmann. Pp. 213+xv plates. (Jena: Gustav Fischer, 1911.) Price 5 marks.

THIS volume is intended as a general summary of our present knowledge of fresh-water phytoplankton, with a passing reference to that which is found in the lake of Lucerne. The first portion of the book, which deals with the methods of collection, the apparatus used for this purpose, and the quantitative estimation of results, is exceedingly good. The remaining five-sixths of the work (about 170 pages) is devoted to a biological and systematic account of the constituents of the phytoplankton, and the treatment of the Flagellata, Peridinieæ, and Myxophyceæ, which is largely based upon the recent work of Lemmermann, is also very good. The account of *Ceratium hirundinella* deserves special comment, as it is perhaps the most complete that has so far been written.

The diatoms are dealt with in a comprehensive way, more especially the plankton-species of the genus Cyclotella, but there is a strange omission of the genus Surirella, species of which are constant plankton-units in the lakes of the British area and in the large lakes of Central Africa.

There is a brief mention of the Desmidiaceæ as plankton-constituents, but the author's synopsis of the genera is not quite accurate in detail. A fuller treatment of this group should be given in any general work dealing with fresh-water plankton, as there are probably more species and varieties of desmids exclusively confined to the plankton than can be found in any other group of green algæ. Moreover, with the exception of a few species of Surirella (omitted in this work), the plankton-desmids are almost the only known constituents which give the fresh-water plankton a definite geographical character, and thus save it from a monotonous cosmopolitanism.

In contrast to the brief treatment of the Desmidiaceæ, there is a somewhat extended treatment of many of the Protococcales, a considerable proportion of which are only casual plankton-constituents.

The text-figures are quite good, but the plates are not of a very high standard. The diatom plates are the best, but the desmids, so poorly figured on plate v., are, with three exceptions, not those usually observed even in the plankton-community of the lakes of western Europe. G. S. WEST.

Peeps at the Heavens. By the Rev. J. Baikie. Pp. 96. (London: A. and C. Black, 1911.) Price 1*s.* 6*d.* net.

MR. BAIKIE'S "Peeps" will, we have no doubt, lead many young people to long for, and to ensure getting, more than peeps into the wonderful phenomena he describes so interestingly.

The order in which the sun, the moon, the planets, and the extra-solar bodies are described is the usual one, but Mr. Baikie has introduced an originality and an attractiveness into the descriptions which are bound to appeal to all those who are children in these matters. In one or two places this has perhaps led to slightly inaccurate word-pictures. For example, on p. 58, he says, "I do not think that there is a more lovely picture to be seen in all the heavens than Saturn, with his three rings and his ten moons"; any beginner who looks at Saturn expecting to see *ten* moons will probably be considerably disappointed.

The fourteen plates in the book add greatly to its value, as do the constellation figures printed on the inside covers, while the picture of the great comet of 1910 on the front cover adds to the book's attractiveness. Many of the plates are from original drawings by Miss Constance Baikie, who must be congratulated upon the manner in which she has used colour and form to make pictures certain to attract young readers. W. E. R.

Vergleichende Physiologie. By Prof. A. Pütter. Pp. viii+721. (Jena: Gustav Fischer, 1911.) Price 17 marks.

PROF. PÜTTER'S book on "Comparative Physiology" is not of the same ambitious character as the one edited by Prof. Winterstein, which has recently been noticed in these columns. It is nevertheless an extremely useful book, and is packed full of information. It is to be thoroughly recommended as a trustworthy and up-to-date guide to those who are working at this branch of science. In tackling a subject of this nature, there are obviously two methods of dealing with it. One method is to take the various groups of the animal kingdom, and describe the functions of each; the other is to take physiological functions as the main headings and deal with the variations in each met with in the different zoological phyla. To the physiologist it is obvious that the latter method is the best, and it is the one Prof. Pütter has adopted. The chapters are therefore headed protoplasm, metabolism, nutrition, nervous activity, and so forth.

We cannot help remarking how overwhelmingly important the applications of chemistry to biological problems is becoming. Organic chemistry and physical chemistry are helping physiologists to elucidate the phenomena of life in an ever-increasing manner. The greater part of the present volume is occupied in dealing with these questions.

W. D. H.

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.]*

The Thames Valley.

IN the "Physical Geology and Geography of Great Britain," Sir A. Ramsay expressed some interesting speculation about the relation formerly existing between the valleys of the Thames and the Severn. According to his view, the Severn Valley was the older, being "one of the oldest in the lowlands of England." He considered that the secondary strata to the south-east of that river originally drained into it, and that subsequent subsidence altered their inclination to an eastward slope, causing the waters to cut a new channel through the Oolites and Chalk towards the east, the direction in which the Thames flows at present. This view, I believe, has never been favourably entertained by other geologists, owing to the absence of corroborative evidence of such a change in the dip of the beds as Ramsay postulated.

Nevertheless, I venture to ask consideration for a feature in the fauna of the Thames Valley which is difficult to reconcile with the belief that the Thames always flowed eastward. I have called it a feature; I should have said, more correctly, the absence of a faunal feature characteristic of other eastward-flowing rivers in England.

In all the rivers between the Yorkshire Ouse and the Norfolk Ouse is found that remarkable fish the burbot, or eel-pout (*Lota vulgaris*), a creature remarkable not only as being the only member of the Gadidæ, or cod family, known to inhabit fresh water (the North American *L. maculosa* can be regarded only as a geographical variant of the species), but also on account of its severely restricted distribution in Great Britain. It seems fairly safe to attribute the presence of this fish in the district indicated to the former connection of these rivers—the Trent, the Nen, the two rivers Ouse, &c.—with the great Rhine system at a time when the North Sea was a vast plain, through which these streams found their way to join the mighty river on its course to the Arctic Ocean. The burbot, I believe, abounds in the Rhine at this day; if, as is commonly assumed, the Thames was ever a tributary of the Rhine, why does it contain no burbot?

On the strength of a passage in Leonard Mascall's "Booke of Fishing with Hooke and Line" (1590), I, in common with many others, was led to believe that the burbot did once inhabit the Thames; but I think I can now prove that we have been misled by a printer's or writer's error.

"There is a kind of fish in Holand [not the kingdom of Holland, but the south-eastern district of Lincolnshire] in the fennes beside Peterborrow, which they call a poult; they be like in making and greatness to a whiting, but of the cullour of the loch [loach]; they come forth of the fenne brookes into the rivers there about, as in Wandsworth river there are many of them. . . . They are taken in welles [eel-baskets] and at waters [weirs] likewise. They are a pleasant meate, and some do thinke they would be as well in other rivers and running waters, as Huntingdon, Ware and such like, if those waters were replenished as they may be with small charge. They have such a plentie in the fenne brookes, they feed their hogges with them. If other rivers were stored with them, it would be good for the commonwealth, as the Carpe which came of late yeares into England. Thus much for the fenne poult."

Now it was easy to suppose that when Mascall wrote of the "Wandsworth river" he meant the Wandle, which joins the Thames at Wandsworth. But if the passage above quoted be read carefully it appears clear that he was treating only of rivers in the fen district, and that he referred, not to Wandsworth on the Thames, but Wansford on the Nen, a few miles west of Peterborough. This explains the difficulty of understanding how a vigorous and prolific fish, once inhabiting the waters of the Thames Valley, and not depending, like the salmon, upon free access to the sea, could have totally disappeared within 300 years. The burbot never inhabited the Thames system, a fact which seems to support Sir A. Ramsay's doctrine that the Thames formed originally part of the Severn system, with a general flow from east to west, while the basins of the Trent and Yorkshire Ouse were connected with the Rhine system.

HERBERT MAXWELL.

Monreith, Wigtownshire, December 20.

The Inheritance of Mental Characters.

SIR H. BRYAN DONKIN (December 14, p. 210) thinks that I am quibbling, and Dr. Reid (*ibid.*) thinks that I am not clear as to the situation. I cannot argue these points. Suffice it to say that my clearly defined object was and is to show, not that Prof. Pearson's statement quoted by Dr. Reid was right, but that Dr. Reid's condemnation of it was wrong and misleading.

A real difficulty appears to me to lie in the fact that different people use different names for the same thing, and the same name for different things. No so-called character is more than a potentiality in the fertilised ovum. The result of the action of the environment is to produce successive stages in the development of these potentialities. The potentialities, which are subject to variations and may be inherited, are, to me, the only true inborn characters. I gather from Dr. Reid's writings that this is substantially his view.

All the characters quoted from Prof. Pearson are mixtures of acquired and inborn elements. If the fore-arm were never used from birth, it would develop no more than it does in a case of infantile paralysis. If any two children were given precisely the same amount of exercise and of other factors in the environment which influence the development of the potentiality, the development in each would be different. The histories of those remarkable families, the Jukes and Zeros, which produced an enormous number of criminals in a few generations, are well known. Some of the criminal members did not have the same educational environment as their parents. The character dealt with in the fore-arm measurements does not include the presence or absence of the limb. It is development dependent upon a potentiality and a similar, but not identical, environment. Conscientiousness, as dealt with by Prof. Pearson, is development dependent upon the same factors. If it is contended that variations in the environment influence the character, I agree, but in the sense implied here both characters are certainly inherited in the same way.

Dr. Reid again quotes Prof. Pearson, this time as saying that the characters with which he dealt were "bred, not created." I accept Dr. Reid's statement that the meaning implied by "bred" is equivalent to inborn, and by "created" acquired. Having made this quotation, Dr. Reid asks: "Is potentiality meant here?" When I read Prof. Pearson's Huxley lecture I certainly thought that it was. "Geniality and probity and ability may be fostered, indeed . . . but . . . their origin is deeper down than these things. They are bred, not created." Not only this passage, but others, led me to believe that Prof. Pearson, in saying that these characters are inherited, implied that their origins, as distinct from acquirements, are inherited.

Leaving speculations as to Prof. Pearson's private thoughts, and as to how he intended his public statements to be interpreted, may I pursue a more profitable course in asking Dr. Reid for enlightenment as to what *he* means? Dr. Reid's last letter gives me the impression—I am very likely mistaken—that he considers educability, as regards mental characters in man at any rate, as a single potentiality for development, and that the kind of stimulus or stimuli determines which, and to what extent, characters will develop. Now, though I agree with Dr. Reid that individual characters are less certainly inherited than racial, I hold, and I think that he does so too, that the former are the material from which natural selection produces the latter. Unless each of the mental characters is dependent upon a separate potentiality, we must conclude that a change took place whereby all the mental potentialities were massed together; for it is inconceivable that the various adaptive instincts in the lower animals could have evolved otherwise than separately. We are by no means confined to pure instincts or to the lower animals. It would doubtless be possible to teach a bulldog to point, but it is certainly more difficult to teach bulldogs generally to point than it is to teach pointers to point. It is also usually more easy to bring a pointer of good ancestry to a high state of efficiency with regard to his various and

particular mental characters than one of bad ancestry, and a very high state of efficiency is common only in dogs well bred from the Field Trials point of view. These particular mental potentialities are just as much inborn characters as the shape of the dog's head; they are modified by selection in precisely the same way, and are transmitted, with variations, from parents to offspring.

If the existence of heritable variations in each particular mental potentiality be accepted, the conclusion is practically unavoidable that, as Prof. Pearson has suggested, the majority of the lowest class of the population is inferior in capacity for intellectual development to the majority of the middle and upper classes. Favourable variations which are inherited must generally result in a rise, unfavourable in a fall in social position, and a fall to the lowest class means a high mortality among the offspring. Moreover, the upper and middle classes are subjected to continual selection. A known period of selection has changed the Jews from an extraordinarily militant, quarrelsome, and bloodthirsty race to an undoubtedly peaceful, and probably the most generally intellectual race in the world. Any individual amongst them who continued to react to violence by developing a violent temperament must certainly have been eliminated, while survival depended upon a high capacity for making other mental acquirements. The comparative brevity of the period during which selection lasted suggests that mental potentialities respond, if anything, more quickly to selection than do physical potentialities.

Glasgow, December 16. CHARLES WALKER.

Theory of Complex Cartesian Coordinates.

A RECENT number of the Proceedings of the London Mathematical Society (vol. x., part iii.) contains a note of mine on a theory of complex Cartesian coordinates, in which the complex point $(a+di, b+ei, c+fi)$ is represented by the segment AB joining the real point (a, b, c) to the real point $(a+d, b+e, c+f)$. Since its publication I have learnt that the same theory has been discussed by Mr. Ellery W. Davis in the Nebraska University Studies (Lincoln, 1910).

I am writing now for two purposes. In the first place, I wish to express my regret that, not knowing of Mr. Davis's work, I made no reference to it in my paper. Secondly, the fact that two investigators have quite independently, and both after a study of v. Staudt, invented *the same* representation of complex points, affords a presumption that it is a natural one. Personally, I believe that many interesting facts will follow from further investigations in this field: it will never replace Staudt's projective theory, which is absolutely perfect so far as it goes, but it may help to make the comprehension of Staudt's work a little easier, and thus popularise one of the most splendid works of mathematical genius.

I may add that parts of Mr. Davis's paper were read before the American Mathematical Society (April and November, 1907; November, 1909) and the British Association (August, 1909). I gave a brief account of the theory myself to the Mathematical Association at a previous date; but really there is no question of priority in dispute. Probably Mr. Davis, like myself, has been in possession of the elements of the theory for a long time. G. B. MATHEWS.

10 Menai View, Bangor, December 19.

Science and Literary Form.

THE gap between the terminology of commercial science and the ordinary amenities of language seems to be hopelessly widening. The following specimens are culled at random from the account of the exhibition of the Physical Society, contained in *The Times* Engineering Supplement of December 20:—"synchroscope," "decremeter," "lumeter." The word "speedometer" is now consecrated by text-books and even by legislation. All this gives one pause to think, when it is remembered how careful the early scientific pioneers in electrical developments (Kelvin, Maxwell, &c.) were to select suitable terms. The question even persists in obtruding itself, in what relation all this stands to the view that education can be based on a purely scientific training. J. L.

Cambridge, December 20.

The Weather of 1911.

THE interesting question of Sir Edward Fry in NATURE of November 16 can be defined more precisely by the other question: Where did unusual precipitation occur in the European summer, 1911? I replied to this question, asked by the editor of *Ciel et Terre*, by pointing to the excessive rains of middle and northern China, Japan, and the Philippine Islands in the same summer, 1911. Indeed, the rains of Baguio (Luzon), July 14–17, established a record only comparable with the rains of Cherrapunji, June 12–16, 1874. Baguio received in four days 2239 mm.; Cherrapunji in five days 2598 mm. More comparisons may be found in the *Frankfurter Zeitung*, December 8, ii., and, I hope, at an early date in *Ciel et Terre*. Here I emphasise the connection of these rains, especially in Hondo and Luzon, with typhoons, proved clearly for the latter island in the preliminary communication of P. José Coronas, assistant director of the Manila Observatory: "Three typhoons, which caused heavy floods in Luzon."

In NATURE of April 11, 1907, p. 560, I published a paper, "Atmospheric Seesaw-phenomena and the Occurrence of Typhoon Storms." I applied afterwards the law there stated to the weather of the summer of 1907, being on the Atlantic side of the earth extremely cool, in a paper, "Klimaschwankungen und der thermisch-barometrische Ausgleich," in the *Meteorologische Zeitschrift*, 1909, vii., pp. 331–2. Indeed, the formation of tropical cyclones (typhoons) in that summer largely preponderated in the great Pacifical focus of such storms. The same explanation as for the cool summer of 1907 can, strange to say, be employed for the dry and hot summer of 1911. A difference is only caused by the larger development of the Azores-maximum of aërial pressure in 1911. This development made the Pacifical depressions arriving on the western side of Canada travel more northerly than usual, and therefore arrive in Europe on the more easterly coasts of Russia instead of, as in 1907, on the coasts of western and central Europe. To this also may be ascribed the occasional excesses to night frost in central Europe during June and August, 1911, July descending also to +2° C.

The development of the maximum was caused by a somewhat independent and contrary northerly precession of subtropical conditions over Europe and of tropical conditions over subtropical latitudes. These caused another strange phenomenon of aërial pressure in Europe and also in North America, namely, a retrograde motion of depressions similar to the first part of tracks of tropical cyclones, the phenomenon of "Zugstrasse VI.," as I designated it. I found this extremely rare phenomenon over Europe in May, June, and September, 1910, October and November, 1911, and over North America three times in August, 1911. Its occurrence in Europe coincided with well-developed "Hochwasses Tiefs." Conducting them quickly westwards, and preventing them from pouring out plainly their precipitations, it contributed to the relative dryness of October and November, 1911. WILHELM KREBS.

Grossflottbek (Holstein), December 9.

Nature of Light emitted by Fireflies.

IN NATURE of November 23 (vol. lxxxviii., p. 111) there is a letter from Messrs. Singh and Maulik on the nature of the light of the firefly (Luciola), in which they report the penetration of opaque substances by the rays from these insects to such an extent as to affect a photographic plate. Their results are essentially similar to those reported by Muraoka (*Wiedemann's Ann. d. Chem. u. Physik*, 1896, vol. ccxcv., pp. 773–81; Journ. Coll. Sci., Tokyo, 1897, vol. ix., pp. 129–39), an explanation of which has been given by Molisch ("Leuchtende Pflanzen," Jena, 1904; Report, Smithsonian Institution, Washington, D.C., 1905, pp. 351–62). The spectral structure of the light of Lampyridæ has been studied spectrophotographically by Ives and Coblentz (Bulletin of the Bureau of Standards, Washington, D.C., 1910, vol. vi., pp. 321–36), and also separately by Ives (*Physical Review*, 1910, vol. xxxi., pp. 637–51) and Coblentz (*Physikal. Zeitschrift*, 1911, vol. xii., pp. 917–20; also in *Canad. Entomol.*, 1911, vol. xliii., pp. 355–60).

Before attempting further work along this line Messrs. Singh and Maulik would do well to read the above papers, and to refer to Mangold's monograph "Die Produktion von Licht" (second half, vol. iii., Winterstein's "Handbuch der vergleichende Physiologie," Jena, 1910).

F. ALEX. MCDERMOTT.

Industrial Research Laboratory, Pittsburg, Pa., U.S.A., December 11.

WHAT SHORE-WHALING IS DOING FOR SCIENCE.

THERE is no group of mammals about which, in recent years, our knowledge has increased with greater rapidity than in the case of the whales. Although for centuries whales have held an important place in the commercial history of the world, until a short time ago almost the only data relating to their habits were drawn from the stories of the men who had hunted them. At best the pursuit incurred great danger and hardship, and the cruises occupied several years. It was, therefore, almost an impossibility for a naturalist to obtain first-hand knowledge of their habits.

But the dearth of accurate information extended not only to their habits, but to their physical characters. Until about twenty-five years ago, there were few naturalists who had an opportunity of seeing, in the flesh, more than a half-dozen or so whales during their entire life. These were usually carcases which had been cast upon the beach. Almost invariably these stray examples had been dead for days before they were washed ashore, or came under the notice of a trained scientific observer, and had lost much of their original proportions and colour. A whale's body begins to generate gases at an astounding rate as soon as the animal is dead, and within a very few hours is so swollen and distorted that the true proportions are almost lost. Even naturalists did not always take this fact into consideration and their descriptions and figures are notable chiefly for their inaccuracy.

It is only within a very few years that the rapidity with which cetaceans change colour when killed has been generally recognised, and it is a most usual thing to find whales described in scientific papers as "black" which are never black in life. By far the greater number of whales and dolphins have various shades of slate or grey on the upper-parts, and if exposed to the sun for a few hours these portions turn jet-black. Again, there is, in all cetaceans, great variation in colour and form among individuals of the same species, and whales from the same school or "pod," may differ widely in proportions and general colour. Some may be long and slender, others short and thick; one may have a light grey back and pure white under-parts, while a second, taken from the same herd, is dark slate above and strongly shaded below. Quite naturally when these extremes came under the notice of a man of science, who had, perhaps, seen but three or four whales in his entire life, they were at once judged to be representatives of different species and given new names. This course can scarcely be condemned, for, under existing conditions, it was almost the only one to be followed; but, although it did put on record many valuable facts concerning the history of the animals, it also resulted in multiplying names to such an extent that the work of later investigators in separating the valid from the invalid species has become a herculean task; quite false conclusions were also drawn as to the distribution of the various whales which only a vast amount of labour and study can rectify.

For many years almost all the information concerning the large cetaceans centred about three species, viz., the sperm, the "bowhead," or Greenland right whale, and its smaller relative, the North Atlantic right whale, or "Nordkapper." Other species, of less commercial value, received but comparatively little attention.

In the year 1864, however, Swend Foyn, a Norwegian, invented the harpoon-gun, which was mounted on the bow of a small steamer and fired an iron harpoon having an explosive head, or point, called the "bomb."

With the further development of the harpoon-gun, a new and great industry grew up, for it made possible the capture of whales known as "rorquals" or "finners" in sufficient number to warrant the erection of stations at certain points on the shore, near the feeding-grounds of these animals, where they could be brought in, and the huge carcases converted into commercial products. Instead of saving only the oil and baleen (the "whalebone" of commerce) as was the case with the sperm and bowhead whales, which were usually killed far out at sea, it was possible also to utilise the flesh, bones, blood, &c. Previously these whales had been little troubled by the men who hunted in a small boat, and with a hand-harpoon and lance, for the great speed of the animals in the water and their tendency to sink when killed caused them to be let alone by the early whalers; moreover, their blubber was so thin and the baleen so short and coarse, that, if these parts alone were utilised, the animals were not worth the trouble of killing.

In a very few years after the harpoon-gun was

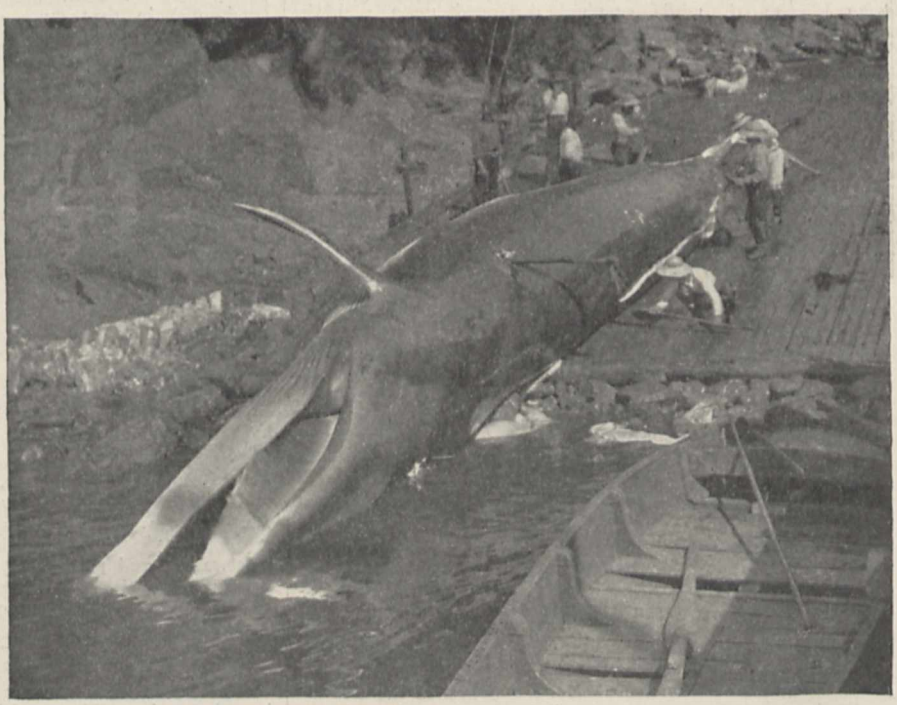

FIG. 1.—Drawing out a Finner Whale. Japan.

perfected, stations had sprung up on the coasts of Norway in every available place, and later were established on the American shores of the Atlantic. Newfoundland was the first extensive hunting-ground for American whalers,[1] and only a few years ago as many as eighteen stations were in operation upon that island and in the immediate vicinity.

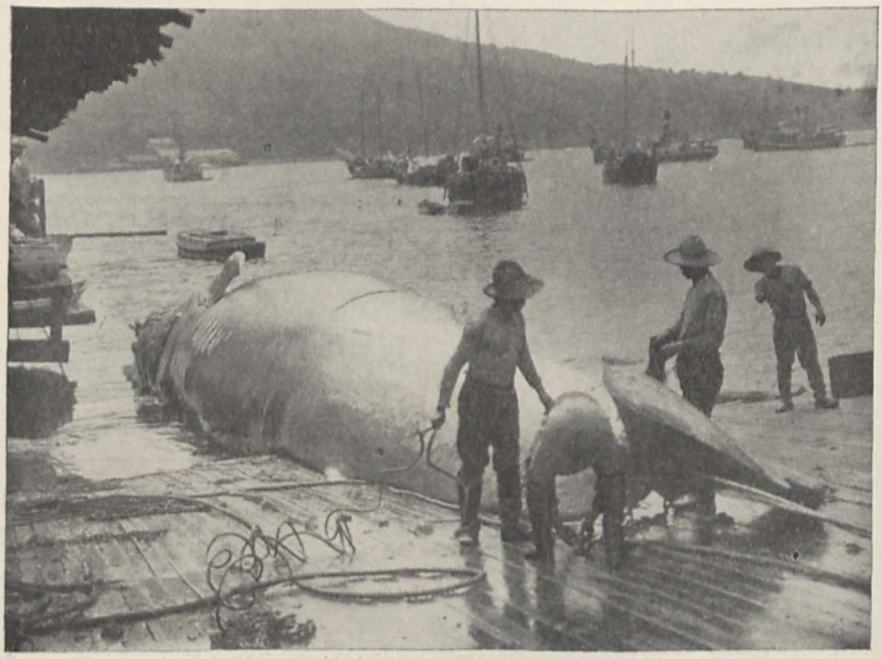

FIG. 2.—Drawing a Blue Whale upon the slip. Japan.

The great success of the Norwegian methods attracted so much attention that stations were erected in every part of the world where conditions were favourable—in British Columbia, south-eastern Alaska, Bermuda, South America, and the islands of the Antarctic; on the coasts of Japan, Korea, Africa, and Russia. Australia is soon to be invaded, and only a few months ago a company announced its plans for carrying on operations on a large scale in the Aleutian Islands. In New Zealand, humpback whales are being taken in wire nets, and so in nearly every part of the globe the pursuit goes on.

The number of whales taken during a season varies greatly with the locality, but at one of the Vancouver Island stations, when I was there in 1908, 325 were killed in seven months. In a single week twenty-six whales were captured, and on June 30 the ss. *St. Lawrence*, Captain Larsen, brought in four humpbacks, one blue whale, and one finner. Thus it is obvious that a naturalist who is fortunate enough to remain for some time at one of these shore-stations has before him wonderful opportunities.

Whales are such enormous creatures that the ordinary methods used in the study of other animals cannot be applied to them. Instead of having actual specimens before him for comparison, a naturalist must depend almost entirely upon photographs, notes, measurements, and descriptions. Until shore-whaling began such data were rare and most unsatisfactory. When a whale is "cut in" as it lies alongside a ship it is never possible to see the entire animal at once; it is almost impossible to secure photographs of real value for comparative work; even measurements can be taken only with difficulty, and not without a large percentage of error. Anatomical investigations are out of the question, because, as soon as the blubber has been stripped off, the carcase is turned adrift.

By the establishment of shore-stations these difficulties have been eliminated. The whales are usually drawn entirely out of the water upon a long inclined platform—called the "slip"—where, before the blubber is stripped off, they can be measured, photographed,

FIG. 3.—"Cutting in" a Right Whale.

[1] About the year 1875 a shore-station was established at Cape Cod, Mass.

and described. As they are being "cut in" it is possible to make a fairly detailed study of the fresh skeleton and other parts of the anatomy—if the investigator is not afraid of blood and grease.

Moreover, the great number of whales of a single species which are taken facilitates in an unequalled way the study of individual variation in colour and proportions, which evidently is greater among some of the large cetaceans than in any other group of mammals.

The opportunities for the observation and collection of specimens given at the shore-stations, which are located in widely separated parts of the world, has made it possible to investigate the theory, advanced some years ago, that most of the species of large whales are cosmopolitan in distribution; that is, that the humpbacks found in the Atlantic differ in no essential respects from those of the Pacific, and that all belong to a single widespread species.

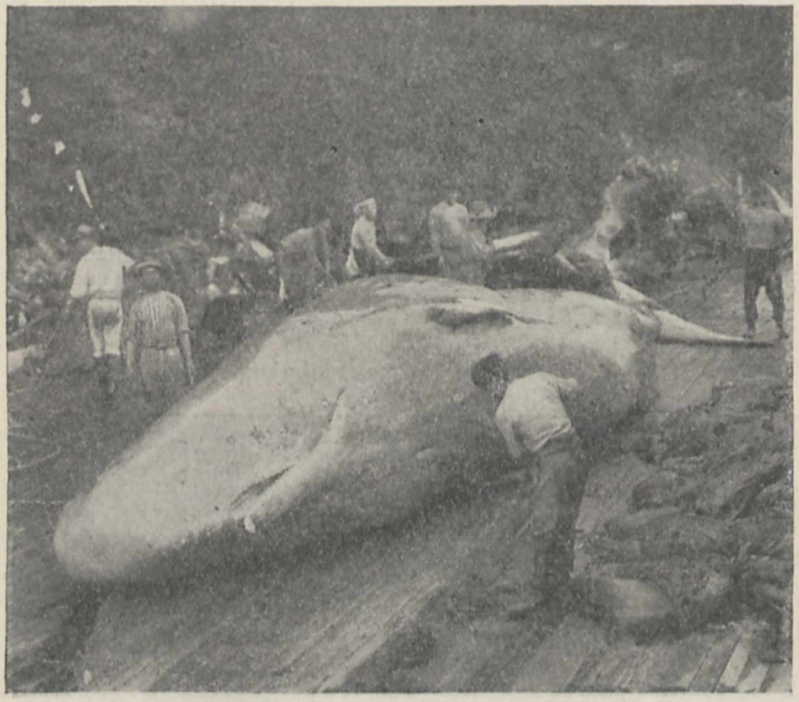

FIG. 4.—A Female Sperm Whale.

Dr. F. W. True, assistant secretary of the Smithsonian Institution, published in 1904 a great work entitled "The Whalebone Whales of the Western North Atlantic," in which he discussed the relationship of the Atlantic whales; this book was made possible in its present complete form only by study at the Newfoundland shore-stations. Other shorter papers, too numerous to mention, which have greatly increased our knowledge of these interesting animals, have appeared within the last ten or fifteen years, many of them illustrated with photographs of the whales described.

The Norwegian method of capture has also made possible, and, in fact, comparatively easy, a study of the habits of the large whales.

The ships which hunt from these shore-stations are trim little vessels, about 90 or 100 feet in length, and although they can scarcely be called comfortable, they furnish a not uninviting home for a short stay, if one is a good sailor. From the deck the movements of the whales can be easily seen and studied, and many opportunities are given to secure photographs of living animals. Often such pictures show many things that would otherwise have been unnoticed.

The directors of the shore-whaling companies and the managers of the stations have always been very willing to assist in the study of the animals which form the basis of their industry, and have generously allowed the use of their ships and stations. Not only this, but they have in many instances gone to considerable trouble to secure specimens that could be prepared and presented to museums for the purpose of exhibition and osteological study. Thus the old saying that "It is an ill wind that blows good to no one" applies very decidedly to the whaling industry. It is, however, deeply to be regretted that the wholesale slaughter of whales will inevitably result in their early commercial extinction; but meanwhile science is profiting by the opportunities given for the study of these strange and interesting animals.

ROY C. ANDREWS.

THE IMPROVEMENT OF INDIAN WHEAT.[1]

THE idea prevails that Indian wheats are weak and do not behave well in milling; their chief points of excellence are their great dryness and, owing to the thinness of the bran, the large proportion of flour obtained from them when milled. Mainly as the result of trials, carried out by Messrs. MacDougal in 1882, the cultivation of weak, soft white wheats for the purpose of export has been consistently advocated in India. Inquiry amongst the natives has shown, however, that a stronger type of wheat is preferred for their own use.

During the past few years the scientific selection and cultivation of these native strong wheats has been carried out at the Agricultural Research Institute, Pusa, on lines similar to the experiments of Prof. Biffen at Cambridge. The results have established beyond doubt that strong, free-milling wheats, but little inferior to Manitoba wheats, can be grown at Pusa. The selected varieties have been submitted to Mr. A. E. Humphries during each of the last three years, and his report, which is included in the bulletin, indicates that they possess great potentialities as regards baking value. They are particularly adapted for special treatment with malt extract and yeast foods, behaving in this respect as Manitoban good-grade wheats produced in a dry season.

From the cultivator's point of view the yield of a variety of wheat is of more importance than the quality of its grain. Much attention has been paid to this point at Pusa, and it has been established that the limiting factors affecting yield in India are the length of the growth period, the water supply, and, particularly in dry districts, the strength of the straw.

[1] "The Milling and Baking Qualities of Indian Wheat." By Albert Howard and Gabrielle L. C. Howard. Bulletin No. 22. Agricultural Research Institute, Pusa. Price 8*d*.

It was at one time considered impossible to combine high quality and high yield, but it has been shown now, both at Cambridge and at Pusa, that this is not the case. Half a dozen wheats have been bred at Pusa which give high yields of both grain and straw.

The problem of producing strong wheats in India suitable both for consumption in the country and for export to England, and at the same time profitable to the growers, is considered solved. Two shortcomings of the Indian wheats still await improvement. These are want of standing power of the straw and want of rust-resisting power.

At the same time, the producing power of the soil at Pusa has been doubled by hot-weather cultivation (see NATURE, February 17, 1910), by moisture conservation, and by embanking with occasional green manuring. In this way a yield of 40 bushels to the acre has been produced without irrigation or manure.

It remains to be proved that the selected wheats will do equally well in the farmers' hands in other parts of India, and that the methods adopted at Pusa can be applied elsewhere. E. F. A.

MY TROPIC ISLE.[1]

THIS book, which is beautifully illustrated by appropriate photographs, as well as admirably written, is quite above the normal type of its class. It is sufficiently romantic and suggestive of De Foe to avoid very clear geographical indications or maps to show the position of "My Tropic Isle," and one is left to infer that it is an island or islet not far from the coast of northern Queensland, and well within the area of tropical Australia. It was "an unpolluted isle, without history, without any sort of fame . . . the most fascinating, the most desirable on the coast of North Queensland," when permanent settlement began on September 28, 1897.

The author landed on this tropic isle weighing a little more than eight stone, and in a frail physical state, yet "trees had to be felled and sawn into proper lengths for piles. . . . With blistered and bleeding hands, aching muscles, and stiff joints he persevered." Whilst the house was being built they lived in tents—the "they" standing apparently vaguely, first for the author and a few friends, then, it may be conjectured, for a wife and children. Meanwhile, the Australian blacks they had brought with them obtained fish from the sea coast and killed scrub fowl and pigeons. Gaps in the provender were filled up with tinned meat and bread and jam. Later a small area of forest land and a patch of jungle were cleared for the cultivation of maize, sweet potatoes, and vegetables. Fruit-trees were planted, and have since "been in the ascendant to the detriment of other branches of cultural enterprise."

The gradual emergence of a fairly civilised and comfortable house, of a regularly supplied larder from the wild gifts of nature, from farm and plantation, is quite as fascinating as the opening chapters of "Robinson Crusoe." Then we are made acquainted with the other inhabitants of the isle, insects, such as large wasps, which build terra-cotta warehouses in which to store the semi-animate carcases of grubs; the solitary bees that turn by degrees favourite volumes into a solid block of waxen comb. These and many other insects and spiders are attacked by more or less fantastic lizards, and by bats, "sharp-toothed and with pin-point eyes, swooping in at one door and

FIG. 1.—Umbrella Tree (*Brassaia actinophylla*). From "My Tropic Isle."

[1] "My Tropic Isle." By E. J. Banfield. Pp. 315. (London T. Fisher Unwin, 1911.) Price 10*s.* 6*d.* net.

departing at the other, having rapidly garnered their prey from the rafters."

The chapter on "A Plain Man's Philosophy" almost recalls to one the musings of Prospero on a somewhat similar isle; that on "Silences" is worthy of R. L. Stevenson; "His Majesty the Sun" brings home to one the peculiar quality of the climate of northern Australia, which makes that region a country suited to the rearing of a white race, and therefore wholly different from the economic conditions of tropical Asia and Africa.

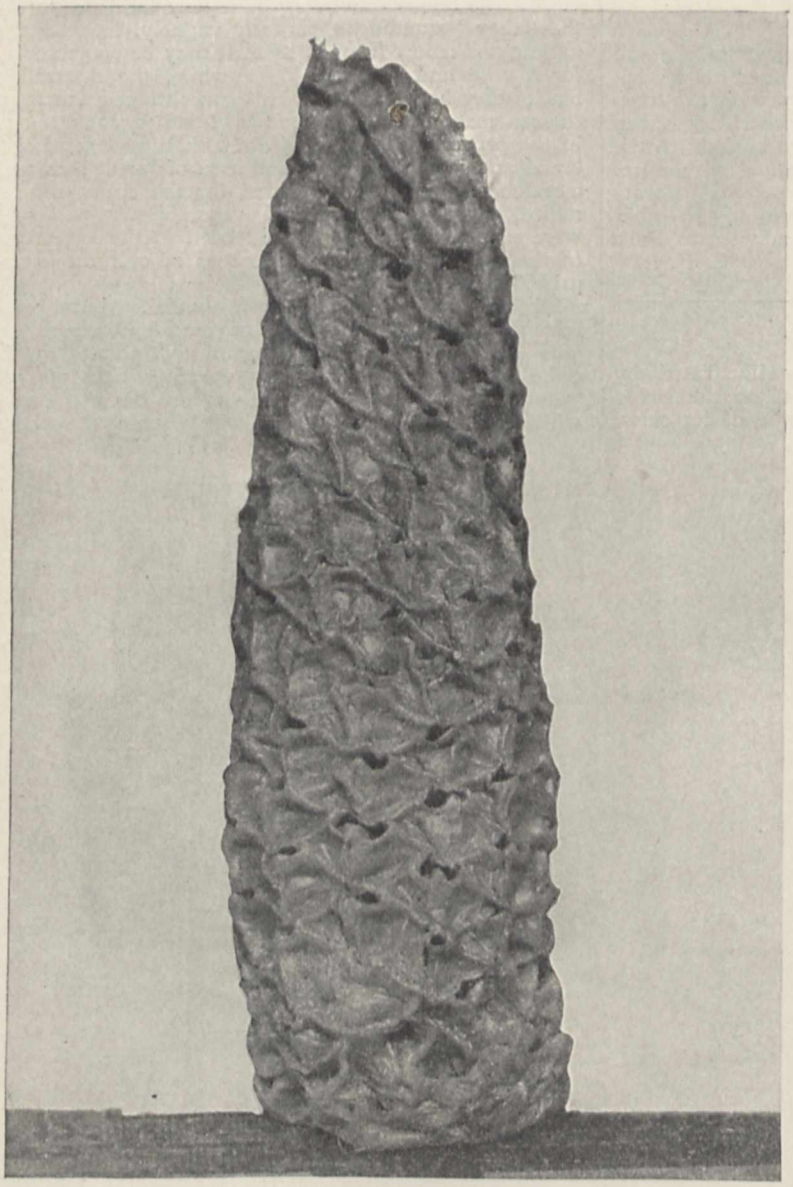

FIG. 2.—Egg Capsules of Bailer Shell. From "My Tropic Isle."

We are told much about sea-worms and sea-cucumbers, marvellous fish, so marvellous, in fact, that if there were not photographic reproductions done from the life to support the descriptions we might think the latter overdrawn. Delightfully described are the interdependent relations between the giant anemone and the painted fish (Amphiprion).

"The good fellowship between the dainty fish—resplendent in carmine, with a broad collar, and waistband of silvery lavender (or rather silver shot with lavender) and outlined with purple—and the great anemone is apparent. If the finger is presented to any part of the latter, it becomes adherent; or if the anemone is not in the mood for food, it curls and shrinks away with a repulsive demeanour. But the beautiful fish on the least alarm retires within the many folds of its host, entirely disappearing, presently to peep out again shyly at the intruder. It is almost as elusive as a sunbeam, and most difficult to catch, for if the anemone is disturbed it contracts its folds and shrinks away, offering inviolable sanctuary. If the fish be dissociated from its host, it soon dies. It cannot live apart, though the anemone, as far as can be judged from outward appearances, endures the separation without a pang.

"However, it is safe to assert that the association between the stolid anemone and the painted fish—only an inch and a half long—is for their mutual welfare, the fish attracting microscopic food to its host. And why should one anemone greedily seize a fish and another find pleasure in the companionship of one of the most beautiful and delicate of the tribe?"

The account of the development of the Bailer shell (Melo or Cymbium) from "a few drops of translucent jelly—as free from earthly leaven as a dewdrop" to a very large and capacious bowl-shaped shell, emitting egg-clusters sixteen inches long and twelve inches in circumference is most interestingly told. Other chapters of biological value and great literary charm are entitled "Some Curious Bivalves," "Barrier Reef Crabs," "Insect Ways," "Swifts and Eagles," "Socialistic Birds"; besides those which describe Hamed, the pearl-fishing Arab of Jeddah, and the black Australians with their superstitions, their quaint ways and dialect, their fine physical development and naïve charm of manner.

MALARIA IN INDIA.

IT is usual to preach nowadays that plain speaking does more harm than good; but I have reason to believe that some very plain statements which have appeared in NATURE and elsewhere on the subject of Indian medical research and sanitation have had a converse effect. It is now a great pleaure to learn from the third number of the quarterly publication of the Government of India, called *Paludism*, that that Government has set aside the sum of 500,000 rupees (about 33,000*l*.) for an Indian Research Fund to study medical and sanitary problems. No other Government possesses such a magnificent opportunity to add to the common stock of knowledge on such subjects. It rules an immense population; it draws a great revenue; and it is served by hundreds of well-trained medical officers. We are not yet informed as to the details of the allotment, but funds are the sinews of science as of war, and the Indian Government will certainly never regret the step it has taken.

For a number of years past increasingly good scien-

tific medical work has been done in India, and the number of *Paludism* referred to adds to it. Major W. H. Kenrick, special malaria officer, Central Provinces, studies the effect of malaria on birth-rates and death-rates—a difficult subject, which has been considerably neglected, though it lies at the basis of prevention. He compares thirty-four healthy villages possessing a spleen-rate of only 4 per cent. and a total population of 19,064, with thirty-three "hyperendemic" villages with a spleen-rate of 80 per cent. and a total population of 10,825. The *birth-rate* in Britain is, I understand, not much affected by season; but in healthy Indian villages it seems, curiously enough, to be highest in October and November, which the author attributes to increased frequency of conception after the gathering of harvest in the first months of the year. In malarious areas, however, these are also the most feverish months, owing to the accumulated effect of the untreated autumn infections, and the result is that the most favourable conception period is delayed until June–July and the corresponding maximum birth-rate until March–May. Yet the *total* birth-rate is not much influenced, even by severe *endemic* malaria, though it is much reduced by *epidemic*, that is, exceptional malaria.

The reason for this probably lies in a consideration discussed in section 31 of my book on the prevention of malaria. In regions of high static (*i.e.* constant) malaria-frequency, nearly all the children are rendered comparatively immune at puberty, so that there should be comparatively little sickness among the *adults*—enough only, perhaps, to delay conception among the women without stopping it entirely. But in epidemic times the frequency of reinfections is sure to be so enormous (see below) that the comparative immunity will be overcome, and the sickness will suffice to reduce as well as to retard the birth-rate.

It would be interesting to ascertain by such good studies as those of Major Kenrick how far malaria checks delivery as well as conception. Regarding the *death-rate*, he finds that during the three years 1908, 1909, 1910, they were respectively 24, 22, 23, in the thirty-four healthy villages, and 38, 32, 44 in the thirty-three hyperendemic ones (plague and cholera being absent in all), and concludes that malaria-frequency of over 80 per cent. spleen-rate measure causes an increase of from 10 to 15 per mille of total death-rate. Nothing shows better the enormous anti-human effect (as it may be called) of malaria in the tropics; the single disease, benign as it is, may cause a death-rate nearly equal to the whole death-rate of London due to all causes together.

Colonel J. R. Adie, special malaria officer, Punjab, found Plasmodia in 38 out of 150 British soldiers at Delhi Fort in November, 1910, and in 29 out of 71 children there. Yet all these were undergoing "prophylactic quinine treatment" at the time. This confirms what Malcolm Watson and others have observed elsewhere. In fact, I am beginning to believe that quinine is of little use in regions of very high malaria-frequency, for reasons to be given presently. It is surprising that the military authorities have not tried a more radical preventive measure at Delhi Fort long before this, in preference to allowing such an expensive article as a British soldier to be rotted by malaria in this manner. Colonel Adie also gives a good example of the errors of inadequate sampling. The 150 soldiers were examined in five successive batches of thirty each, and the percentages found infected were respectively 10, 36, 36, 20, 23, the mean being 25 per cent. Yet important conclusions, quite disregarding such error, have been previously based in India on even smaller samples.

The simplest, though not quite exact, method of measuring malaria-frequency is by observing the frequency of enlarged spleen (spleen-rate). But as it is easy to estimate roughly at the same time the degree of the enlargement, I have advocated for several years the additional computation of the average size of spleen and average degree of enlargement found. Thus in Mauritius in 1907–8, in 30,137 children examined by a number of workers at my suggestion, we estimated that the average size of the spleen was 2·54 times the normal, the whole number of children affected being 34 per cent. of the total number examined. The table of details showed a strongly marked positive correlation between the average spleen and the spleen-rate, as exhibited in contiguous columns; but I thought that owing to several sources of error it would not be worth while to work out the relation further. This, however, has now been ably done by Major S. R. Christophers, with the aid of my figures and some of his own. He finds that the very interesting and simple linear relation $A = 1 + 0{\cdot}05S$ holds where A is the average spleen estimated by my rules and S is the ordinary spleen-rate. This is certainly a much simpler function than was to be expected; but I will not discuss it at present, as a more detailed paper is promised.

I have no space to mention several other good papers and notes, largely entomological, in the number of *Paludism*. It is doubtful whether the entomologists will entirely accept the classifications of some of the Culicidæ suggested by James and Liston in the second edition of their book. The printing and appearance of the number leave much to be desired.

Years ago, in 1898, while infecting birds with Proteosoma by the bites of *Culex fatigans*, I made some observations which showed that such experiments might easily be utilised for studying questions of immunity and pathology in malaria. My work was interrupted and never resumed; but one of the most important sidelights was the following. Out of five sparrows which originally contained a very few Proteosoma, four showed a much more copious infection a week after being subjected to the bites of heavily infected mosquitoes. At the same time the infection of these birds was not so copious as in the case of most of the originally uninfected birds which I had previously dealt with (see my paper in the *Indian Medical Gazette*, vol. xxxiv., January, 1899). This obviously suggested (*a*) that fresh bites of infected mosquitoes will cause a severe recurrence even in subjects already infected; but that (*b*) this recurrent infection, though severe, will not be so severe as an original infection, probably owing to the previous establishment of partial immunity. I have often, fruitlessly, urged the continuation of this line of work. Major Christophers now reports ("Scientific Memoirs, Government of India," No. 46) two more similar experiments which, though they are not very convincing, tend to confirm the possibility of such reinfection. But he also gives eighteen experiments which strongly suggest that the severity of the infection in the birds depends largely on the number of, and degree of infection in, the mosquitoes—as already probable for theoretical reasons.

The importance of these points is rendered very manifest by my quantitative studies in epidemiology (see article in NATURE, vol. lxxxvii., p. 467, last paragraph but two), by which it is shown, for instance, that if 50 per cent. of the people are constantly affected under constant conditions, then about 63 per cent. of them will probably be infected or reinfected every four months. In such circumstances it will be extremely difficult to keep down the fever by quinine alone, a fact which explains the failures complained of in *Paludism*, pp. 7 and 34, and elsewhere. It must

therefore be combined with mosquito reduction when the malaria-frequency is high.

Dr. C. A. Bentley has published a very good report on malaria in Bombay and its prevention. He concludes that, as was manifest from the first, the principal measure must be the reduction of the carrier, *N. stephensi*. The cost should be about 100,000 rupees a year. Our studies of malaria are, then, advancing into fine detail; but I agree with Colonel King, C.I.E., that practical preventive measures should not be postponed until we actually become quite omniscient. That will imply a considerable loss of life in the meantime. We have already waited twelve years in India.

R. Ross.

THE LONGEVITY OF ANIMALS.[1]

ONE of the most satisfactory results of the reorganisation of the Zoological Society of London is the series of papers dealing with important aspects of animal life which are now issuing from the pens of the society's officials. Instead of being content to amass, as formerly, a mere collection of as many strange beasts as possible for the inspection of the idle and curious, the officials are now directing their attention to many important points concerning the life of animals which could not have been examined, except where such unrivalled opportunities exist for their prosecution. Thus the Gardens bid fair to become a centre for important studies, while the health of the animals improves as the results are brought to bear on their treatment and housing.

In a recent paper Dr. Chalmers Mitchell has collected the available information supplied by records in the Gardens concerning the length of life and viability of mammals and birds.

On first glancing at this paper we are struck by the immense amount of information collected, and, on the other hand, by the small amount of knowledge which we really possess on so important a subject.

This deficiency is not likely to be easily eliminated, since our powers of ascertaining the actual length of life of any wild animal are, and must always remain, strictly limited. Sometimes an individual animal becomes abnormally marked, so that we observe and watch it for a period, or the unnatural life of a captive affords us material for estimating the longevity of the wild race; but such isolated observations can at the best only be regarded as approximate, and our knowledge of the longevity of the bulk of wild animals must always remain meagre.

Even our knowledge of the longevity of common domestic animals is far below the standard which might be expected. Domestic fowls are said by Dr. Mitchell to be capable of living for thirty years, yet, owing to commercial reasons, few members of the farmyard flock reach five years. It is the same with cattle. Although their potential longevity is, according to Dr. Mitchell, about thirty years, we habitually kill all our beef cattle and bulls under five, and a vast majority of our cows under twelve years. The same principle holds with all domestic breeds, the tendency being to speed up the processes of life to such an extent that the career of the organism is concluded at an artificially early date.

On the other hand, there are methods which may eventually yield a considerable increase of knowledge, and one of these is used by Dr. Mitchell, who has tabulated the numerous records kept in the prosectorium of the Zoological Society, and has calculated the average and maximum longevity of a large number of mammals and birds which have lived and died in the Gardens. From these it appears that the average duration of life of any species in the Gardens is as a rule remarkably below the maximum duration, so that, to the majority of animals, captivity, even under the care of experts and in spite of the resulting protection from enemies, is anything but conducive to great length of life. Even, however, after allowing for the undoubted shortening of life resulting from captivity, the potential longevity of mammals in general appears to be surprisingly low, and it may be some satisfaction to know that the possible duration of life in man is probably greater than that of any other mammal, excepting, possibly, the large whales.

In this respect birds seem to be fully equal, if not superior, to mammals, amongst which those who live longest are certain of the larger carnivora and ungulates. For instance, the potential longevity of lions is between thirty and forty years; a polar bear lived to thirty-three years in the Gardens, and the largest ungulates may reach fifty years.

Both whales and elephants are popularly supposed to be creatures of high potential longevity, but as regards the former, the officials of the Zoological Gardens are naturally not in a position to offer any information. As regards the latter, it appears that their reputation has been wrongly acquired, since for them Dr. Mitchell estimates one hundred years as being the probable limit, and twenty to thirty years a fair average duration. On the other hand, there are amongst birds several groups which equal or exceed such figures. A raven has been known to reach sixty-nine years, an eagle sixty-eight, while more than one parrot has been recorded to have survived to close upon or more than a century. It appears that some birds of prey may also reach 100, and that herons, swans, and geese have a high potential longevity. The ostrich, to judge by its size, ought to live as long as any other bird, but thirty-five years is considered to be an extreme age for it.

The most difficult mammals to keep in captivity are probably the insectivorous bats. For these the maximum duration of life in the Gardens has so far been only five months, but the failure to keep them alive is undoubtedly due, not to their being naturally short-lived animals, but to their great delicacy under artificial conditions.

These bats commence to breed at relatively so late a period of their life and produce so few young at a time or in any single season that the majority of them must in nature reach an age of at least five years, that is, if they are to keep up their numbers and without making any allowance for the undoubtedly high death-rate which is always prevalent amongst wild animals. Dr. Mitchell has calculated the death-rate for the London sparrows at at least 50 per cent. in a stationary population; in the mixed assemblance of vertebrates in the Zoological Gardens it has been observed to be 28 per cent., both of which figures are very much above that of human beings.

Weissman has sought to establish a correlation between longevity and reproduction, but Dr. Mitchell refuses to accept his interpretation. He believes, not that longevity has become adapted to reproduction, but that the rate of reproduction has been adapted to average specific longevity. In any case, the death-rate amongst prolific wild animals maintaining a stationary population must be stupendous; for instance, if a mouse produces only two litters a year of six young in each, then if all survive to maturity there will be fourteen mice where before there were only two, and if the population is to remain stationary

[1] "On Longevity and Relative Viability in Mammals and Birds: with a Note on the Theory of Longevity." By Dr. P. Chalmers Mitchell, F.R.S., Secretary to the Zoological Society of London. From the Proc. Zool. Soc. Lond., 1911. Published June, 1911.

twelve must die, and these figures may be regarded as probably below the mark where food is abundant.

The relative prolificacy of the rodents as compared with many of the carnivora which feed upon them does not come within the scope of Dr. Mitchell's paper, but it is a remarkable instance of the interrelation of the system of life upon our planet that those which are preyed upon should be on the whole more prolific than those which prey.

Possibly the shortest-lived mammals are to be found amongst the shrews, of which a solitary individual is tabled in Dr. Mitchell's records as having survived captivity for one month. Shrews are extremely difficut to keep alive under artificial conditions, and evidence has lately been produced to suggest that, in the case of the two commoner British species, the average duration of life is only about a year, but, since shrews are amongst the most prolific of mammals, this short period is more than sufficient for the maintenance of their numbers.

It appears that there is no rule which can be laid down in advance to govern the probable length of life of any given species. Size has very little to do with it, although in the same group the larger usually live longer than the smaller. The climate from which a bird or mammal comes has the smallest possible relation to its viability in captivity; in fact, not nearly so much influence as the nature of the cages, or enclosures, which the captive animal is to occupy, since Dr. Mitchell shows that a system of combining free access to open air with suitable dry shelters of small size offers the most ideal conditions for the health of captive animals. Strange to say, it is not animals from the tropics that suffer most from the London climate, but those from the Arctic, which seem to find a difficulty in altering the rhythm of their moults. Those from south temperate regions are even in a worse plight, since they have to face the fact that the conditions of winter and summer are reversed in the northern hemisphere.

A remarkable suggestion of Dr. Mitchell's is that animals from thickly populated countries are on the whole more difficult to keep alive in captivity than those from regions where men are less known. This applies especially to British birds, and Dr. Mitchell suggests that their lower viability in captivity in England, as compared with that of their immediate allies from any other part of the world, is probably due to their intolerance of man, without which unfortunately they would not have been able to maintain their existence as wild creatures.

NOTES.

THE meeting of the All-India Malaria Committee of the Government of India at Bombay in November last marks a revolution in Indian sanitation. For years past the a revolution in Indian sanitation. For years past the nothing but quinine prophylaxis against malaria, and have not encouraged, or have even discouraged, mosquito-reduction—alarmed, apparently, at what appeared at first sight to be the cost of the latter measure. Owing, however, to constant discussions (in which NATURE has taken a part), another spirit has now shown itself. The conference passed a series of resolutions in which mosquito-reduction is at last recommended for India—years after it has been regularly employed elsewhere. This ultimately means the formation of a genuine sanitary service for the whole of India on the lines recently suggested by Sir R. Ross, Colonel King, and Dr. Simpson in *The Times*, and with the enthusiastic medical services which the Government has at its command we may expect great results in time. The Indian Press deals at length with the matter, and the *Madras Mail* remarks: "It is just fourteen years since Sir Ronald Ross, working in India—at Secunderabad—discovered the method of transmission of the malaria parasite from man to man by the anopheline mosquito. Malaria causes more sickness and mortality than any other disease in India; yet, knowing all about its method of transmission for the last fourteen years, what has been done in the interval in the way of practical application of the knowledge furnished by Sir Ronald Ross? Nothing! Verily, a prophet is without honour in his own country. There is hardly another country but has something to show—often most brilliant results. Now that the admission has been made that India has hitherto been on the wrong track, we again express the hope that something of a practical nature will shortly be done to mitigate the ravages of malaria in this country."

MR. GEORGE R. M. MURRAY, F.R.S., who died at Stonehaven on December 16, at fifty-three years of age, joined the Department of Botany of the British Museum in 1876, after having spent some time in de Bary's laboratory at Strassburg. He thus started his work at the museum well equipped for the study of the fungi. Murray approached with characteristic enthusiasm the task assigned to him by his chief, Mr. Carruthers, of building up the cryptogamic herbarium. There in the great collections, especially of fungi and algæ, lies the chief record of his work for nearly thirty years. His earlier work was on the fungi, but later he turned to the algæ, and in association with younger workers whom he had attracted to the museum, published a series of papers on the structure and affinities of certain genera. A number of these papers were brought together in the "Phycological Memoirs," which he edited (1892–5). In 1895 was published his "Introduction to the Study of Seaweeds," and in the same year he succeeded Mr. Carruthers as keeper of the Department of Botany. He next turned his attention to marine plankton, and accumulated a large amount of material, much of which he collected himself on various excursions on or across the Atlantic. He embarked on this new work with his usual energy and enthusiasm, but his scientific career was abruptly ended by a breakdown in health that necessitated his retirement. Murray's work was not limited to official duties. As a young man he was known as an able teacher and lecturer. He was for some time lecturer in botany at St. George's Hospital, and later at the Royal Veterinary College; and in conjunction with A. W. Bennett he brought out a text-book on cryptogamic botany. He was secretary to a committee which organised useful work of botanical exploration in the West Indies, and for some sessions he worked hard for his section at the British Association meetings. Until his health failed he was a keen supporter of the Linnean Society, serving on the council almost continuously from 1883 to 1900. He was elected into the Royal Society in 1897.

THE Board of Trade has been informed that the twelfth International Navigation Congress will be opened at Philadelphia on May 23, 1912, under the patronage of President Taft. Further particulars, including the conditions under which persons or corporations may participate in the congress, can be obtained from Lieut.-Colonel Sandford, general secretary of the congress, The Bourse, Room 344, Philadelphia, P.A. (U.S.A.).

THE death is announced, in his fifty-second year, of Mr. James Aitchison, who founded the business of Messrs. Aitchison and Co., opticians, about a quarter of a century ago, and as one of the founders of the Optical Society did much to promote study and research among members of

the optical trade. An obituary notice in *The Times* points out that it was largely through his exertions that technical classes for opticians were formed at the Northampton Institute, Clerkenwell. Mr. Aitchison was one of the prime movers in calling the Optical Convention in 1905, and he was treasurer of the guarantee fund for the Optical Convention to be held next year.

THE death of Sir J. C. Inglis, the general manager of the Great Western Railway, occurred on December 19. From an obituary notice in *The Times* we learn that, as engineer to the Cattewater Harbour Commissioners, he constructed the Mount Batten breakwater at Plymouth, and subsequently was responsible for the Princetown Railway, Newlyn Harbour, and the Bodmin Railway. He became a member of the council of the Institution of Civil Engineers in 1897, and was elected president of the institution in 1908, and again for a second term in the following year, one of his last official acts in that capacity being the laying of the foundation-stone of the new building in October of last year. He was a member of the Royal Commission on Canals and Inland Navigations.

THE Paris correspondent of *The Times* announces the death of three distinguished scientific men, namely, Prof. Lannelongue, M. Radau, and Prof. P. Topinard. Prof. Lannelongue, who died on December 21, in his seventy-second year, was appointed in 1884 to the chair of pathology in the University of Paris, and later he exchanged this appointment for the professorship of clinical surgery. At the time of his death he was president of the Academy of Medicine, and was elected to the Academy of Sciences in 1895.—M. Radau, who was seventy-seven years of age, was a member of the Bureau des Longitudes and of the Academy of Sciences. For many years he contributed articles on astronomy to the *Revue des Deux Mondes*, and he was the author of "Mémoires d'Astronomie," among other works.—Prof. Paul Topinard, the distinguished French anthropologist, was born in 1830. From 1872 to 1880 he was in charge of the collections of the Anthropological Society, and in 1876 was appointed professor at the School of Anthropology.

THE following lectures will be delivered at the Royal Sanitary Institute during January, 1912:—"Fresh Air," Prof. H. R. Kenwood; "Problem of After-care of Sanatoria Patients," Dr. T. D. Lister; "Employment of Patients in Sanatoria," Mr. M. S. Paterson; "Anti-tuberculosis Dispensaries," Dr. D. J. Williamson; "Open-air Schools," Prof. R. P. Williams. These lectures are arranged in connection with an exhibition illustrating the materials and methods of construction of economical forms of sanatoria schools, hospitals, and other temporary buildings, to be held in the museum during January.

THE jubilee annual meeting of the Yorkshire Naturalists' Union was held at Heckmondwike, on December 16, at the place where fifty years ago the union had its birth. There were more than three hundred members present, including delegates from thirty-eight affiliated societies of the Yorkshire Naturalists' Union. The presidential address of Mr. Alfred Harker, F.R.S., on "Petrology in Yorkshire," was delivered. Mr. T. Sheppard resigned his position as honorary secretary, and in view of his nine years' work in that position was elected an honorary life member of the union. Mr. W. Cash was similarly honoured. Mr. J. W. Taylor, of Leeds, was elected president for 1912. The new secretaries are Dr. T. W. Woodhead, and Mr. W. E. L. Wattam, Technical College, Huddersfield. The annual meeting for 1912 will be held at Hull on December 14.

A VALUABLE contribution to our knowledge of the use of iron in early Egyptian times has been made by a discovery during the excavation of the pre-dynastic cemetery of El Gerzeh, about forty miles south of Cairo, reported in the December issue of *Man*. Here, in an undisturbed tomb, a set of iron beads, associated with others of gold, carnelian, and agate, was found on a corpse. Prof. W. Gowland reports that they consist of hydrated ferric oxide, none of the original iron having escaped oxidation.

THE part played by the Jews in the preservation and revival of learning during the Middle Ages is the subject of a scholarly pamphlet by Dr. M. I. Schleiden. Agriculture, the greater industries, such as silk-growing, dyeing, and weaving, were all encouraged by them. The writer claims that they left no branch of science and learning untouched, and at the close of the Middle Ages handed on the results of their labours to the races which were now rising to a sense of their responsibilities. The value of the pamphlet is enhanced by full references to the literature of the question.

IN the seventh Bulletin of the Archæological Survey of Nubia, the exploration gradually extends southwards. While the early pre-dynastic and middle periods are unrepresented, the number of early dynastic graves shows little signs of diminution, and their contents are actually richer, indicating the centre of an early dynastic culture of a Nubian type, characterised by remarkable local types of pottery, copper implements, gold work, and stone work typical of Egypt in the latest pre-dynastic period or in the first dynasty. The crania collected have been sent to this country for examination by Prof. Elliot Smith, but, so far as the material has been examined, it indicates early negro immigration with a possible admixture of other racial elements.

IN the first part of vol. v. of the Journal of the Gypsy Lore Society several correspondents contribute accounts of the funeral rites of a well-known member of the tribe, Isaac Heron, who died last year at Sutton-on-Trent. Gypsy rites of interment have perhaps never been more carefully examined than in this valuable contribution. The corpse was buried in an oak coffin large enough to admit the body, which was dressed in stockings, pants, and a white linen shirt, and covered with a white shroud. Under the corpse his overcoat, lounge coat, waistcoat, and trousers, all of which were turned inside out, were laid. Some money and jewellery, the amount of which was not disclosed, were placed in the pockets of the dead man. After the funeral, which was performed in a Christian cemetery, his van was dismantled. The wheels, shafts, harness, and horse nosebag were placed inside, the contents were soaked in paraffin, and the conveyance was burnt. Among other peculiar features of the rite, the hands of the dead man were laid close to his sides, and a candle was kept burning from the time of death until the body was removed.

THREE papers in the second part of *Sitber. Naturhist. Verein d. preus. Rheinlande u. Westfalens* are devoted to the fauna of Lake Laacher (Laacher See), near Andernach, Messrs. R. Schauss, C. Röttgen, and O. le Roi dealing respectively with the crustaceans, the beetles, and the molluscs.

IN the report for 1911, the committee of the Bristol Museum and Art Gallery records the debt of gratitude owed by the city to the late Lord Winterstoke, by whom the Art Gallery and a considerable proportion of its contents were presented. When this gallery was opened in 1905 it contained very few pictures, whereas the value of those

now exhibited is estimated at 42,000*l*. In recording the loan of a collection of big-game heads from British East Africa, the compiler of the report includes in the list the white-tailed gnu and the blesbok, both of which are exclusively southern species. Possibly the first name may be a mistake for the white-bearded gnu, but it is difficult to guess what species has been mistaken for the blesbok.

In the Proceedings of the Zoological Society for 1902 Mr. R. Shelford recorded the mimicry of wasps belonging to two distinct genera by Bornean longicorn beetles of the genus Nothopeus, the imitation extending not only to form and colouring, but likewise to habits, and being so close that native collectors could with difficulty be induced to catch the beetles. A third instance of such mimicry has been described in West Africa in the case of a beetle allied to Nothopeus, the mimicked wasp being a fossorial species. To these instances Mr. C. Ritsema (Notes Leyden Mus., vol. xxxiv., part i.) adds a fourth, in which the widely spread *N. hemipterus* imitates in Nias Island the fossorial wasp *Macromeris splendida*, both insects being black with a pronounced metallic-blue sheen, especially on the wings. The author suggests that each of the eight species of Nothopeus mimics a wasp.

In 1882 Sir R. Owen described the remains of a turtle from the Cretaceous of Queensland as the type of a new genus and species under the name of *Notochelys costata*, the generic name being subsequently changed, on account of preoccupation, to Notochelone. Until quite recently nothing more has been known of this reptile; but in No. 10 of the Annals of the Queensland Museum Mr. C. W. de Vis provisionally refers to it two imperfect skulls from, presumably, the same horizon in another part of the country. The larger and less imperfect of these indicates a turtle apparently nearly allied to existing forms, the symphysis of the lower jaw being short, and thereby indicating that the suggested affinity with the Eocene Lytoloma (Cat. Foss. Rept. Brit. Mus., part iii.) is invalid. In describing the second specimen, which he regards as an immature skull, Mr. de Vis states that "the sclerotic plates are in place," thereby unconsciously showing, if the identification be correct, that it is not chelonian at all. Moreover, the tooth-like projections on the margins of the jaw described as "pseudodonts" appear from the figure to be true teeth, recalling those of mosasaurians. Whatever may be the nature of this problematical specimen, it certainly does not justify the assertion that Notochelone is a generalised type which cannot be included in any existing family.

Dr. C. Gorini, writing in the *Atti dei Lincei*, xxi. (2), 6, describes some interesting observations on the microbiology of cheese. It appears that certain acidopresamigenous and acidoproteolytic bacteria are capable of existing at such low temperatures as 10° to 50° C., and thus the ripening of cheese can take place during winter storage. Moreover, the enzymes of these bacteria continue to act at even lower temperatures.

A short flora of Cambridge forms the subject of part iii., vol. xvi., of the Cambridge Philosophical Society's Proceedings, the author being Mr. A. H. Evans, of Clare College. It is prefaced by a short historical account of the chief Cambridgeshire botanists. Unlike Babington, the author classifies the districts of the county according to their geological formation. In addition to phanerogams, ferns, and Characeæ, the flora contains lists of mosses and lichens by the Rev. P. G. M. Rhodes; algæ, including diatoms, by Dr. G. S. West; and fungi, by Mr. F. T. Brooks.

We have received the current number of the National Poultry Organisation Society, which deals with several minor but important problems in connection with the poultry industry, especially with the cooperative aspects, which it aims at fostering. The value of our imports of eggs and poultry continues to increase, and during the first eight months of this year amounted to nearly 4¾ million pounds sterling, nearly half of which came from Denmark.

Only a short time ago we had to chronicle the foundation by the Americans in the Philippines of an agricultural college and a journal, *The Philippine Agriculturalist and Forester*. The first numbers contained articles of local interest only, but No. 5, now to hand, already contains a very presentable investigation into the effects of some stimulants upon rice. The additions to soil cultures of small quantities of borax, manganese sulphate, mercury chloride, ferrous sulphate, nickel sulphate, zinc sulphate, and aluminium sulphate produced favourable effects, whilst copper sulphate was harmful.

Three years ago the Behar Planters' Association appointed an expert to conduct experiments for the purpose of ascertaining whether flax could be profitably grown and manufactured on Indian estates, the buildings and vats of which could be utilised for retting and scutching. A report has now been issued showing the financial returns during the past season, and thus putting the planters in a position to judge whether the new crop is as profitable as indigo. The quality of the flax is satisfactory, good prices being also obtained for the seed. The report forms Bulletin 25 of the Agricultural Research Institute, Pusa.

The current number of *The Agricultural Journal of the Union of South Africa* contains the unpleasant news that the much-dreaded San José scale, *Aspidiotus perniciosus*, Comstock, has found its way into the Transvaal. The discovery was made by Mr. J. W. Moore, of Potchefstroom, in working up a collection, and steps were at once taken to exterminate the pest. In the same journal an account is given of a new and very promising breed of maize picked out from a crop of Hickory King that had grown alongside Virginia horsetooth. Hitherto the yield has proved exceedingly good.

Among the sclerophyllous woodlands recognised by Dr. Schimper as a feature of those regions situated in the warm temperate zone where the rainfall coincides with winter is the chaparral, or dwarf forest of southern California. An account of this formation by Mr. F. G. Plummer, published by the United States Department of Agriculture as Bulletin 85 of the Forest Service, indicates that it is a truly natural type, occurring between the altitudes of sea-level and 8000 feet, and confined to the littoral district from Monterey to San Diego. True chaparral consists primarily of dwarf trees—not shrubs—stunted by reason of an insufficient rainfall. It is economically important as a ground cover for the watershed whence the water supply is obtained for irrigation and municipal purposes. About forty different species of trees are combined in the formation; the most desirable are those which produce good shade, are not inflammable and make vigorous growth, such as *Rhus laurina*, *Prunus ilicifolia*, *Heteromeles arbutifolia*, and species of Quercus; less desirable, but dominant are species of Adenostoma and Ceanothus.

The fifteenth volume of Transactions of the Leicester Literary and Philosophical Society, 1911, has a paper by Mr. H. Quilter suggesting an explanation of the presence of *Sambucus Ebulus*, the dwarf elder, or Danewort, in Leicestershire, and perhaps in Great Britain generally. It

is usually regarded as an introduced plant, and popularly supposed to have been brought by the Danes. The seven localities where it is recorded contain Roman remains. Anglo-Saxon medicinal books, deriving from Roman sources, mention the shrub under the names Low-wyrt and Weal-wyrt, the latter term implying that it was a denizen. The name Danewort does not occur until 1538. Mr. S. B. Bratley has some interesting notes on micrococci from diseased larvæ. Among other evidences of the work being done by the society in the popularisation of science is a good lecture on trees by Mrs. C. D. Nuttall. This contains a useful sketch of afforestation problems, and an interesting reference to the work of the Midland Reafforestation Association. Successful experiments have been made in raising plantations of trees on the waste coal surfaces and pit mounds of the Black Country. Some trees are growing well in pure coal-dust. The poplar, willow, ash, sycamore, and Wych elm do best. Oaks and conifers take less kindly to the peculiar atmosphere and soil. This is an interesting undertaking.

ABOUT three years ago the attention of the Royal Dublin Society was directed to the occurrence of considerable deposits of modern marine shells west of Mallaranny, in Co. Mayo, at heights of from 100 to 800 feet above sea-level. Mr. J. de W. Hinch (*Irish Naturalist*, 1911, p. 189) has now cleared up any doubts regarding their origin, by showing that the common limpet is by far the most prevalent form in these deposits; that the other species present are all edible; and that traces of fire occur on the sites where they occur. Mr. Hinch concludes:—"The deposit is certainly not a raised beach, nor a Glacial deposit. In my opinion it is a rock shelter of prehistoric times." The modern talus has in places grown over and entombed a large number of the shells.

MR. J. M. CLARKE has published in a separate form his "Observations on the Magdalen Islands" (New York State Museum Bulletin 149, 1911). These islands lie in the Gulf of St. Lawrence, north-east of Prince Edward Island, and are quaintly described as "sea-wracked [racked?] remnants of continental land." They are occupied by about 7000 persons, chiefly of French origin. A new term is introduced (p. 12), the "*demoiselle hills*; rounded, symmetrical, beehive-shaped elevations with grassy surfaces and separated by shallow or deep cauldron-like depressions." It appears that this term refers to what may be styled, on the same grounds, mammillations; the form, as we know in Jura, has always appealed thus to navigators. Mr. J. W. Beede describes and illustrates the Lower Carboniferous fossils from the islands, including several new species of Productus.

THE Bulletin of St. Louis University, vol. vii., No. 5, treats of seismology. At this university a Wiechert 80 kg. horizontal seismograph has been established. The records are made on a surface of smoked paper. From January to June, 1908, 19 disturbances were noted. During the same period, but with apparatus which records photographically, we see that 52 earthquakes were noted at Victoria, B.C., 47 at Toronto, 160 at Hamburgh, and 108 at Stonyhurst. All these observations have been corroborated by records obtained at other stations, and are therefore known to represent earthquakes which have disturbed very large areas. Fifteen colleges in the United States and one in Canada have been equipped with instruments similar to the type adopted at St. Louis.

TO *The Monthly Weather Review* for May, published by the U.S. Weather Bureau, Dr. O. L. Fassig contributes an interesting article on "The Trade Winds in Porto Rico," based on hourly observations for ten to twelve years at San Juan. The island lies wholly within the zone of the north-east trades, and the tables show a prevailing wind-direction from north-east to south-east during 77 per cent. of the entire year, or an aggregate of 281 days, and from south during 14 per cent., or 51 days. In the diurnal period, from about 9h. a.m. to 10h. p.m., the prevailing direction is from the east for the entire year, and from 10h. p.m. to 9h. a.m. from the south-east. The night winds, being lighter, vary somewhat more than those of the day. The average hourly wind-velocity for the year is about 11 miles; the minimum, 6 miles, occurs at sunrise, and the maximum, 16 miles, at about 2h. p.m. Judging from the movements of the clouds, the average depth of the trade-wind current probably does not exceed 10,000 feet; the lower clouds are wholly within the trade-wind drift. The changes in temperature due to change in the direction of the wind are, as a rule, very small.

IN a paper on the analytical basis of non-Euclidean geometry (*American Journal of Mathematics*, xxxiii., 3) Dr. W. H. Young, F.R.S., makes the following suggestive remarks:—"There is, it seems to me, a tendency at the present time to throw dust in the eyes of the mathematical public, or rather of the schoolboy public, in respect of the step taken which corresponds to Euclid's eleventh axiom. To efforts, now recognised by all mathematicians to be abortive, towards proving the eleventh axiom have succeeded treatments of the subject-matter of Euclid for future engineers and others which seem to gloze over the difficulty this axiom involves. I have recently proposed" (Quarterly Journal, 1910, pp. 353–63) "to emphasise the empirical character of the axiom by giving it a form which challenges attention, a form, moreover, having the double advantage that it relates to bounded space, and can be experimentally verified by the dullest schoolboy, even by one to whom the ideas of an angle represents an incompletely solved difficulty. If, on the other hand, we leave the region of school books, we find for the most part an air of unreality and half-heartedness in the treatment of the subject." In his present paper Dr. Young shows how the refinements of modern analysis give a consistent account of the three geometries which arise out of the alternatives for the eleventh axiom.

MESSRS. BURROUGHS, WELLCOME AND CO. have sent us a copy of the "Wellcome" Photographic Exposure Record and Diary for the year 1912. This, as many of our photographic readers are aware, consists of a very neat, nicely and strongly got-up pocket-book, and contains the essence of photographic information in tabloid form. In it are given the directions and observations on such matters as exposure, development, intensification, and the other procedures which go to the making of pictures. The information is very general, and the user of any plate or camera will find it equally serviceable. Instructions and explanations are given with regard to such topics as factorial and time development, machine, tank or stand development, the oil-pigment process, contact printing by artificial light, colour photography, &c. All the figures and factors, based upon actual experiment, have been worked out for all the principal films and plates, and are collected in a neat, convenient form. By the ingenious exposure calculator attached to the cover, correct exposures under all circumstances can be easily secured. In addition to all this photographic information, there are pages for diary and exposure notes, so that the book serves as a pocket-book as well as a work of reference. It should be noted that three separate editions of the pocket-book are pub-

lished, specially adapted for the northern hemisphere and tropics, the southern hemisphere and tropics, and the United States. Those who have not yet taken advantage of the valuable aid this pocket-book is when travelling about the world, or even staying at home, should make the experiment now and use one. The writer has for several years always possessed himself of a copy, and while he has had the occasion to employ all the three editions, he has found them most valuable in making the exposures, in recording the data, and in many other useful ways.

SOME novel conclusions in reference to the osmotic pressure of colloids are given by Messrs. Moore, Roaf, and Webster in the October issue of *The Biochemical Journal*, in a paper on the osmotic pressure of casein in alkaline solutions. It has sometimes been suggested that the osmotic pressure of such substances is due to the presence in them of small quantities of ash. But it is found experimentally that alkali moves against the osmotic pressure to the same side of the membrane as the colloid, with which it enters into combination. The authors conclude that the supposed impermeability of the membrane to ions is fictitious, and that its function is merely to hold together the colloidal aggregates by which the crystalloid is attracted and made to traverse the membrane. The thirst of the casein for alkali illustrates the manner in which the colloids of living cells can extract and concentrate crystalloids for their purposes from infinitesimally low amounts in the fluids bathing them, such, for example, as bone formation from the excessively low concentration of calcium ion in the blood, the formation of calcareous and siliceous shells in fresh-water and marine organisms, and many similar cases. Such concentrations arise from affinities of a molecular type between colloids and crystalloids, which vary from time to time, so causing periods of uptake and deposition in a rhythmic manner.

THE Patent Office Library is well known to all scientific workers in London. The liberal yet careful manner in which additions are made to the library, the wide range of scientific periodicals and journals, and the fact that it is available from 10 a.m. to 10 p.m., places the library in a unique position in London. The bookshelves are open to the visitors, a much appreciated privilege, but one requiring an intimate knowledge of the system of classification adopted if the time of the visitor and officials is not to be wasted. The new series of subject lists now being issued, while preserving the same form and general arrangement as the former one, is arranged so that the headings contain certain marks indicating the location of classes of books in the library. The most recent subject list in the new series deals with works on peat, destructive distillation, artificial lighting, mineral oils and waxes, gas lighting, and acetylene. It forms a pamphlet of 104 pages, and is obtainable at the Patent Office for 6*d*.

THE causes of variations in the mineral oils of the United States and other countries have given rise to many investigations and discussions. Not only do these differences exist in oils found in separate regions, but there are extreme variations in many oils occurring in adjacent localities. It is a plausible hypothesis that the transport of the oil from the lower strata may have been effected, or at least assisted, by capillary action, and during the passage upwards a fractionation of the oil will take place. Day showed that the unsaturated hydrocarbons are less diffusible than the paraffin hydrocarbons, and Gilpin and Cram confirmed and extended this view by showing that when petroleum is allowed to diffuse through tubes packed with Fuller's earth, the unsaturated hydrocarbons collect in the earth of lower sections of the tubes, while the paraffins tend to accumulate in the lightest fraction at the top of the tube. Similar experiments have been made by other observers. Additional evidence is given in Bulletin 475 of the United States Geological Survey, on "The Diffusion of Crude Petroleum through Fuller's Earth, with Notes on its Geologic Significance," by J. Elliot Gilpin and Oscar E. Bransky. They show that when mixtures of benzene and a paraffin oil are allowed to diffuse upward through a tube packed with Fuller's earth, the benzene tends to collect in the lower sections, and the paraffin oil in the upper, sections of the tube. Crude petroleum under similar conditions also undergoes a fractionation, and repeated fractionation showed that there is a tendency to the production of mixtures which will finally pass through the earth unaltered. Fuller's earth tends to retain the unsaturated hydrocarbons and sulphur compounds in petroleum, thus exercising a selective action upon the oil.

WE have received a reprint from the *Rivista di Fisica Matematica e Scienze Naturali*, Pavia, of a suggestive memoir by Prof. P. Palladino entitled "Les Composés Chimiques dans l'Espace," in which some novel ideas as to the constitution of matter are put forward. The basis of the hypothesis is stated to be essentially "the unity of matter and its possible groupings," and the author believes he has arrived at the form and relative dimensions of the atomic groupings of the unit of matter, or "quantities of combination," of the chemical elements. The memoir is illustrated by seventy-two geometrical figures representing the structure of the atoms and molecules of the principal elements and their compounds, and the text is interspersed with numerous graphic symbols, which act as a convenient notation to represent these various geometrical shapes of the elementary atoms and the molecules of their compounds. Definite shape is attributed to the unit of matter, namely, that of a tetrahedron; thus, for instance, the atoms of oxygen and of phosphorus are supposed to be built up of five tetrahedra, while those of hydrogen are composed of five polytetrahedra, each in turn composed of five smaller tetrahedra. The unit tetrahedron is supposed to be, in turn, composed of a number of electrons. The tetrahedra may be arranged in either a closed or an open manner in many cases, such as in those of oxygen and phosphorus, the difference of structure accounting for the existence of two forms of the same element, the less stable form (such as yellow phosphorus) corresponding to the open arrangement, and the more stable (red phosphorus, for example) to the closed assemblage. Prof. Palladino traces numerous chemical reactions and physical relationships to the forms which he thus attributes to the elementary atoms and the molecules of their compounds, and the whole memoir is both ingenious and highly suggestive.

A SECOND edition of Dr. Arnold Berliner's "Lehrbuch der Experimentalphysik in elementarer Darstellung" has been published by Mr. Gustav Fischer, of Jena. The first edition of the work was reviewed in the issue of NATURE for August 4, 1904 (vol. lxxiv., p. 317).

UNDER the title "Abhandlungen über Dialyse (Kolloide)," three of Thomas Graham's papers have been issued as No. 179 of Ostwald's *Klassiker der Exacten Wissenschaften*. The translation has been made by E. Jordis, who has also added a biography and bibliography, together with a series of critical notes.

Erratum.—In the summary of Dr. Tutton's Cantor lectures on "Rock Crystal," given in NATURE of December 21, a line of type was unfortunately omitted.

After line 20 from the bottom of column 2 on p. 264, ending with the words "known as," and before the next printed line beginning "twins," there should have appeared a line reading "amethyst. There are two well-marked kinds of quartz". Also the adjacent Fig. 14 should be vertically inverted.

OUR ASTRONOMICAL COLUMN.

SCHAUMASSE'S COMET, 1911*h*.—MM. Fayet and Schaumasse publish a set of elements and an ephemeris for comet 1911*h* in No. 4542 of the *Astronomische Nachrichten*. The ephemeris gives the positions of the comet to the end of March, 1912, and shows that the object should attain its greatest apparent brightness about the beginning of February, when it should be of about the tenth magnitude; the following is an extract:—

Ephemeris 12h. M.T. Paris.

1912	α h. m.	δ ° ′	log *r*	log Δ	$1/r^2\Delta^2$
Jan. 1	15 17·5	− 1 49	0·1116	0·2008	0·24
,, 9	15 52·4	− 3 43	0·0953	0·1899	0·30
,, 17	16 27·7	− 5 28	0·0822	0·1835	0·30
,, 25	17 3·0	− 7 2	0·0732	0·1813	0·31
Feb. 2	17 37·5	− 8 21	0·0689	0·1830	0·31
,, 9	18 10·9	− 9 25	0·0696	0·1877	0·30

This path lies through the southern parts of Serpens and Hercules, then through Ophiuchus and Aquila; the comet will pass about 3° north of Altair on March 9, 1912, and will remain a morning object throughout.

BROOKS'S COMET, 1911*c*.—Prof. Millosevich publishes an ephemeris, extending to March 3, for comet 1911*c* in No. 4542 of the *Astronomische Nachrichten*. The comet is now too far south for observation in our latitude, but was observed by Dr. Ristenpart at Santiago on December 9; its magnitude then was 7·5, and the observed position gave corrections of +7·6s. and +3·0′ to the ephemeris position.

In the same journal Dr. H. E. Lau records the magnitude observations made at the Treptow Observatory during the period August 26 to October 10. Comparing the observed with the calculated magnitudes, he finds that the former fit $1/r^2\Delta^4$ better than $1/r^2\Delta^2$; there is also a suggestion of a periodic oscillation in the observed magnitudes. Other magnitude observations are given, and Father Iniguez also gives the wave-lengths of the lines observed photographically and visually in the spectrum of the comet.

OBSERVATIONS OF MARS.—A telegram from M. Antoniadi to the *Astronomische Nachrichten* (No. 4542) states that the large telescope at Meudon revealed, on December 6, a singular brown spot to the areographic west of Argyre. On November 14 the same observer and M. Bosler were struck by the decided citron hue of the planet's surface, even the polar snows appearing yellowish. On December 4 and 6 the Solis Lacus region was seen, under good conditions, to be as it was in 1909, but the "lake" itself was more intense. It was on the second date that the large brown spot was seen situated in the western part of the M. Erythræum. Such a spot, although much weaker and uncertain, has been seen during previous oppositions, but never so plainly as now; it is about 600 kilometres long, and its coloration is entirely different from that of any other feature on the planet.

THE TOTAL SOLAR ECLIPSE OF APRIL 17, 1912.—In a paper read before the British Astronomical Association, and published in the current Journal (vol. xxii., No. 2), Mr. G. F. Chambers gives a number of interesting particulars he has collected concerning possible facilities for seeing the total solar eclipse of April 17, 1912. According to the different almanacs, maximum duration, which occurs in Portugal, will be from 0·6s. to 8·0s., the former being given by *The Nautical Almanac*, the latter by the *Berliner Jahrbuch*; the *Connaissance des Temps* gives 6·3 seconds. Mr. Chambers gives the times of sailing of ships to various ports in the peninsula, particulars as to methods of reaching, and accommodation in, the towns near to the eclipse path, and some idea of the cost. From figures supplied by Father Iniguez, the meteorological conditions at the Spanish stations would probably be unfavourable; and, on the whole, Ovar in Portugal, about eighteen miles south of Oporto, seems to promise the best chance of seeing the transitory phenomena. A party is being organised by Mr. Chambers, and intending participants should communicate with him.

PLANETARY ATMOSPHERES.—An interesting study of the production, the effects, and the disappearance of the atmospheres of planets is published by Prof. Arrhenius in the *Publications de la Société de Chimie Physique*. Starting with each planet as a separated portion of the solar nebula, the author traces out the general method whereby the metals, the hydrocarbons, &c., would become solidified parts of the planet's crust, and then shows how this would operate in the case of the earth. Carbonic acid would be the most resistant impurity of the atmosphere, and under the action of plant life and light would become decomposed. With less CO_2 the radiation would increase and the temperature of the earth's crust would decrease. Volcanic action would then interfere by producing more CO_2, and so an oscillation of temperature and climate would ensue. Prof. Arrhenius is unable to accept the long-period rotation of Venus, and describes a development on that planet which will be richer and more brief than it has been on the earth. Turning to Mars, he likens the conditions there to those obtaining in certain desert districts, *e.g.* parts of Persia, only the temperature is some 30° below zero according to him. The Martian "lakes" are analogous to the semi-solid *khévirs* found in Persia, and Prof. Arrhenius shows how the colours and the changes on Mars can be fitted with terrestrial equivalents of this type.

INTERNATIONAL SOLAR RESEARCH.[1]

THE interesting volume referred to below gives evidence of so much progress since the last meeting of the Solar Union at Meudon in 1907 that it is not possible in a limited notice to do more than mention some of the chief contents.

After giving a list of members of the scientific bodies constituting the union, and the names of those who attended the fourth conference at Mount Wilson, the minutes of each of the four meetings held on August 31, September 1 and 2, 1910, are given verbatim. At the first meeting, with Prof. E. C. Pickering in the chair, Dr. G. E. Hale gave a lengthy address on the recent developments of solar investigation. The preparation of the new sunspot map has been delayed by the necessity of arranging for spectra of greater dispersion to allow of the proper analysis of the Zeeman effect in spot spectra. It was decided that the scale should be not less than 5 mm. to 1Å the separate sections not exceeding 60 cm. in length. In the progress of work on comparisons between centre and limb, solar chromosphere and other allied problems, the question of the Tertiary standards is important, and it is proposed to undertake their determination in the near future. Dr. Hale also gave a very lucid description of the details of the new large tower telescope and spectrograph. Certain changes detected in the spectra of sunspots were outlined, the differences found being due to the varying strengths of magnetic field in the spot vortices, giving different separation of the components. An important statement is that the record of eruptive phenomena can be carried on with Hα better than with the calcium lines, and these eruptive phenomena are likely to be associated with magnetic storms on the earth.

A number of important resolutions by the Wave-length Committee were adopted, from which it is apparent that there is a good prospect of spectroscopists being provided in the near future with a trustworthy table of wave-length standards showing all the lines of most of the known elements on a uniform system. These will be referred to a number of "secondary standard" iron lines which have been determined by Fabry, Eversheim, and Pfund.

At the second sitting, Prof. W. W. Campbell in the chair, reports were presented dealing with solar radiation, spectra of sunspots, eclipse observations, &c. From an exhaustive

[1] "Transactions of the International Union for Cooperation in Solar Research." Vol. iii. (Fourth Conference). Pp. viii+231. (Manchester: University Press, 1911.) Price 7*s*. 6*d*. net.

series of pyrheliometric determinations at Washington (sea-level), Mt. Wilson (1800 metres), and Mt. Whitney (4420 metres), Mr. Abbot concludes that the most trustworthy value of the "solar constant" is 1·95 calories per sq. cm. per minute.

An important resolution was adopted providing that in future position angles round the sun's limb should be measured from the north to the east. This is opposite to the procedure followed during the last forty years in Italy, but Prof. Ricco thought that the Soc. degli Spettroscopisti Italiani would now be willing to agree to the change, in order that all observers should have the advantage of a uniform system.

In the reports on sunspot spectra the concurrent result is that the various metallic lines are, on the whole, affected in a systematic manner, such that the arc-flame lines are strengthened, normal arc lines unaffected, and enhanced (spark) lines weakened in spots. Certain elements—vanadium, titanium, scandium, &c.—show greater tendency to strengthening than others. With regard to the question of variation, it is evident that at least during the period of five years about the last maximum, no decided changes have been evident in the general spot spectrum. With instruments of very large dispersion certain changes have been noticed which, as before mentioned, are attributed to variations of intensity in the magnetic field of the spot vortex. Six observers have agreed to subdivide the region B—F for the continuance of visual observations of special phenomena.

The third session, presided over by Prof. E. B. Frost, was occupied with reports on the observations of solar rotation, work with the spectroheliograph, and an address by M. H. Deslandres on the "Motions and Forms of Solar Vapours."

The concluding sitting was mainly occupied with questions of administration, the chief point of interest being the enthusiastic adoption of a motion to extend the scope of the union to include astrophysics. A committee was appointed to examine and report on the question of classification of stellar spectra.

It was announced that in all probability a solar observatory would be established in Japan in the near future.

The next meeting of the Solar Union will be held in Bonn in 1913. CHARLES P. BUTLER.

THE ORIGIN OF MAMMALS.

AN outstanding feature of the zoological section at the Portsmouth meeting of the British Association was an excellent discussion on the above subject, in opening which Prof. G. Elliot Smith laid special stress on the influence exerted by the evolution of the brain in making mammals what they are and in supplying evidence showing whence they came. He pointed out that while all living marsupials are specialised in greater or less degree, so that no one of them can be looked upon as ancestral to the Eutheria, it must be admitted that the more highly specialised Eutheria must have passed, in the course of their phylogeny, through a stage not very different from that represented by Perameles, and that therefore there was a metatherian stage in the ancestry of the Eutheria. The mode of development of the blastocyst and the presence of a shell membrane, the arrangement of the hippocampal formation and cerebral commissure, and many other structural features, indicate that in most respects the marsupials have retained, in far greater measure than the Eutheria, the features distinctive of their common ancestor. Turning to the monotremes, not only is the skin and its hairy and glandular epithelium typically mammalian, but also the alimentary canal and liver, the diaphragm, the auditory ossicles and their mode of development, and the organ of Jacobson; in the brain the complex specialisation of the hippocampal formation and its curious fascia dentata—so peculiarly distinctive of Mammalia—is carried to a degree of differentiation at least as great as in other mammals; the characteristically mammalian neopallium is present, and emits a system of projection fibres forming pyramidal and cerebro-pontine connections, as in other mammals.

These and other facts demonstrate the kinship of monotremes to other mammals, and establish the monophyletic derivation of the Mammalia. But living monotremes are separated by a wide interval from Meta- and Eutheria. At a very early stage in the history of Mammalia, soon after the acquisition of skin, hair, milk glands, and the appearance of the typical hippocampus and neopallium, the Prototheria divided into two phyla, one of which retained the generalised features and the other specialised. From the former the common metatherian ancestors of all the Metatheria and Eutheria sprang by gradual transformation; from the latter were derived the living monotremes, which display a high degree of specialisation in association with the fixation of certain very primitive phases of mammalian structure, showing what the primitive mammal, just emerged from the reptilian stage, was like. All mammals have sprung from an oviparous prototherian stock, which, though vastly different from living monotremes, still deserved the name Prototheria; and there is an overwhelming mass of evidence—anatomical, embryological, and palæontological—to prove that the mammalian phylum sprang from the Reptilia, although certain features—the occipital condyles, the mesenteric vessels, the epiglottis, the mode of development of the heart, the nature of the skin and its sense organs, the auditory ossicles, and the early phases of the eutherian blastocyst—have been cited as arguments for an amphibian, in opposition to a reptilian, ancestry for mammals. But Hill has demonstrated the thoroughly sauropsidan derivation of the mammalian mode of blastocyst formation, while Osborn, Broom, and others have shown that the bicondylar arrangement of the amphibian occipital bone has persisted in many extinct reptiles, and especially in the Theriodonts, which present such a remarkable series of mammalian resemblances in their skeletons.

The process of differentiation of the mammalian hippocampal formation becomes intelligible only when the preparatory phases, represented in the reptilian brain, are known. In the amphibian brain, on the contrary, the cortical formation has become so specialised, or perhaps so degenerate, in comparison with that of its forerunner—the Dipnoi—or its successor—the Reptilia—that it must be regarded as being off the path which led to the Mammalia. In spite of the certainty that the mammalian brain passed through a reptilian stage in its phylogeny, the brain of no living reptile fulfils the conditions required in the actual ancestor of the Pro-mammalia. The brain of Sphenodon represents a blending of primitive features with lacertilian and chelonian characters, but it inclines too decidedly to the Lacertilia to afford a type of the ancestral reptilian brain. The extinct Therapsida (including Cynodontia) present a blend of primitive reptilian and primitive mammalian features, many of the characters of the skull of Rhynchocephalia, of the polyprotodont marsupials, and of the Insectivora being reproduced with surprising exactitude, as Watson has recently shown, and in the limbs prototherian peculiarities are often closely foreshadowed. If the actual ancestor be not discovered, the group of Cynodontia provides so many forms presenting mammalian characters of skull and teeth, limbs and trunk, that it is no longer possible to refuse to recognise these extinct forms as the representatives of the order to which the ancestor of the Prototheria belonged. Prof. Elliot Smith held that the ancestor of the Mammalia was scaly and laid eggs provided with a large amount of yolk, to mention only two obvious points among the definitely reptilian characteristics of the Pro-mammalia, and repeated that there is an extinct group of reptiles—the Cynodontia—which includes representatives conforming in almost every detail of structure to what would be expected in the near relatives of the earliest mammals, whereas there is no group of Amphibia which fulfils these conditions.

It seems impossible to derive either reptiles or mammals from the true Amphibia. In the course of evolution from the dipnoan stage the amphibian brain has in great measure lost precisely those features which were essential if it had to develop into the reptilian or mammalian condition. The features of the brain in Dipnoi so definitely foreshadow the conditions seen in the Reptilia that it is difficult to believe the Dipnoi can be far removed from the direct path leading to the Amniota; but the dipnoan brain, in its general plan, though not in the histological detail of

its cortex, is essentially amphibian. This fact, taken in conjunction with the palæontological evidence, suggests that the stegocephalian brain may have bridged the interval between those of Dipnoi and Reptilia. Perhaps both Amphibia and Reptilia have been derived from Stegocephalia. Recent research, especially on fossils from the Permian of Texas, has brought to light stegocephalians so closely resembling reptiles, and reptilian remains so stegocephalian, that there can no longer be any question as to the genetic relationship of the two groups.

Prof. Elliot Smith remarked that it is unfortunate that nothing is known of the brain in the Cynodontia, for he thought that the transformation of its cortex must have played a leading part in the evolution of the Mammalia. Broom states that the South African Theriodonts from which mammals were derived became distinguished from their American allies by the development of powerful limbs, and that "it was the lengthened limb that gave the start to the mammals." "When the Therapsidan took to walking with its feet underneath and its body off the ground it first became possible for it to become a warm-blooded animal. All the characters that distinguish a mammal from a reptile are the result of increased activity—the soft flexible skin with hair, the more freely movable jaws, the perfect four-chambered heart, and the warm blood." But Broom confesses his inability to explain how this fateful lengthening of the limbs was caused. Prof. Elliot Smith suggested that a realisation of the changes which took place in the brain in the transition from reptiles to mammals would seem to indicate an explanation of this and the acquisition of many other mammalian features.

The development of a definite neopallium (the cerebral cortex *sensu stricto*), the lengthening of the limbs, the increased activity, the freeing of the skin of its mail-like coat of scales and conversion of it into a highly developed tactile organ—all these events occurred at about the same time, and had a reciprocal influence one upon the other.

By the time the Reptilia were evolved the cerebral hemisphere had reached a stage of development which opened up vast possibilities of new developments. Though the cerebral cortex was still mainly olfactory in function, tactile, gustatory, visual, and perhaps auditory impulses were able to make their entry into it; but it exercised little *direct* control over the movements of the body, which were still regulated by the midbrain. The possession of this potential receptive organ in the cortex for receiving tactile impressions and bringing them into relation with impressions from the other sense organs gave an added importance to the tactile sensibility of the ridges of skin that intervened between the scales of the Hypotherian. Moreover, more precise movements of the limbs became possible, because more exact information was being provided of the positions of the limbs by these tactile impressions.

The enhanced importance of the skin as a tactile organ led to the atrophy of the scales, perhaps by a process of natural selection; and the greater perfection of the tactile sensibility of the skin, and of its receiving and recording apparatus in the cortex, reacted mutually one upon the other and gave birth to the neopallium. It is not without significance that from its earliest appearance the neopallium performed the function of regulating "skilled" movements of the whole body, *i.e.* such actions as are possible only when there is a highly developed tactile information bureau to render nicely adjusted movements possible. Moreover, quickness and increased activity are made possible by the neopallium, because it was put into direct connection *ab initio* with all the motor nuclei in the whole central nervous system by the pyramidal tract (which developed *pari passu* with the evolution of the neopallium), and also with the cerebellum (by the simultaneous development of the pons), which enabled the creature to coordinate the muscular activities of its whole body to perform quick, accurately adjusted, and skilled movements. It is such developments as these that made the mammals what we know them to be, that give them their dominant position and their plasticity, or power of rapid adjustment to varying environment.

It is only when such skilled movements are possible that long limbs, capable of supporting the body, can become useful appendages. The fact that such limbs were making their appearance in the Therapsida in Triassic times is tangible evidence of the birth of the neopallium in these pro-mammals.

Prof. Arthur Keith, in maintaining that mammals arose not from reptiles, but from Amphibia, remarked that the divergence between his views and those of Prof. Elliot Smith was not really so great, as the question involved not the Amphibia and reptiles of the present, but extinct forms in regard to some of which it was difficult to say to which of these phyla they should be referred. The common stock from which reptiles, birds, and mammals had been derived possessed three characters:—(1) an egg giving rise during development to an amnion and allantois; (2) the beginning of a cerebral cortex; and (3) lungs filled and emptied by movements of the body wall. Prof. Keith regarded this common ancestor as more amphibian than otherwise. He devoted special attention to the third character above named, and pointed out there was not in any living reptile a trace of a diaphragm, and that the lungs of reptiles were essentially different in structure from those of mammals, and, further, the movements of the body wall were different in the two phyla. He believed that the evolution of a new type of respiration, in which the whole body wall became a means of expanding the body and filling the lungs, was a great step in advance, and he considered that this occurred in an amphibian stock not far removed from the Dipnoi, and conceived that there was a common type (amphibian) from which the three types of respiration—reptilian, avian, mammalian—had been evolved. He also referred to the presence of His's bundle, which is found only in the heart of mammals, and suggested that this arose in the Dipnoi, and was transmitted through an ancient amphibian. Prof. Keith thought that an early amphibian, arising near the beginning of the Permian, was the stock from which came the higher vertebrates.

Dr. C. W. Andrews remarked that the agreement of the skeleton of Cynodonts with that of mammals is so remarkable that it is impossible to believe it accidental. Possibly in Middle Permian times lived some small animal of this group from which the mammals arose. The shoulder girdle, atlas, and lower jaw of some Theriodonts represented transitions from reptilian to mammalian conditions. The dentary became greatly enlarged, owing to the differentiation of the teeth, especially grinding teeth, extended backwards, and acquired articulation with the squamosal, leaving the quadrate and articulare on the inner side. Some of the South African Therapsida present so close an approach to mammalian characters that it seems impossible to believe that the Mammalia can have arisen from any other group.

Dr. Marett Tims pointed out that if the dentitions of the monotremes and of the Metatheria and Eutheria be considered, the monophyletic derivation of the mammals does not appear to be fully established. In the marsupials and Eutheria generally (leaving the Rodentia out of account for the moment) the dentition is of the *type* which may be referred to as trituberculate, though not of the trituberculate pattern, while the dentition of the monotremes is of an entirely different nature, being referable to that of the fossil Multituberculata. Dr. Tims said that his investigations on the tooth germs of the Caviidæ lend support to the view that, as already urged by Dr. Forsyth Major, the dentition of these rodents has a multituberculate character. On these and other grounds Dr. Tims was disposed to suggest the possibility of the diphyletic origin of mammals, and to believe that monotremes, and possibly rodents (though with much greater doubt), may have sprung from a different stock than that from which the marsupials and remaining Eutheria have arisen. J. H. A.

VERTICAL CURRENTS IN THE ATMOSPHERE.

IN a paper entitled "Die Messung vertikalen Luftströmungen," Dr. Paul Ludewig, of the University of Königsberg, describes some experiments made in three balloon ascents, for the purpose of determining the vertical currents in the atmosphere. The lack of information on this important point is made painfully evident at intervals in the inquiries into aëronautical disasters. The problem is

being attacked in this country partly by observations of pilot balloons and partly by observations near the earth's surface of the angle of elevation of a balloon, which in a horizontal wind floats very nearly at the same level as the point to which it is attached. Special difficulties arise owing to the rapid increase of the errors of observation in the first method as the balloon travels away from the observers, and to the influence of the instability of the wake in the second method. Dr. Ludewig's contribution will therefore be of special interest. He uses the principle that the barometer in the balloon shows the height above sea-level, and therefore the rate at which the balloon is rising relative to the earth, while a vertical anemometer carried by the balloon shows the rate at which the balloon rises relative to the air. The difference between the two rates gives the rate at which the air is rising relative to the earth or the strength of the vertical current.

The construction of a suitable anemometer is the principal difficulty. Dr. Ludewig uses a fan in a small cylinder, which hangs from the balloon in a vertical position; the revolutions of the fan are recorded photographically by an ingenious device, so that the inertia and friction are reduced to a minimum. When the anemometer was suspended in a horizontal current of air, the fan did not rotate, so that effects arising from variations in the horizontal velocity were practically eliminated. In addition to a barograph, a Bestelmeyer variometer was used. The instrument is a form of eye-reading microbarograph, which permitted of great accuracy in determining the small variations in altitude as the balloon travelled across the country. In the first ascent, made on January 22, 1911, the results obtained from the variometer and the anemometer agreed so closely that it was evident that no vertical currents were present. In the third ascent, on February 18th, when there was a steep gradient for westerly winds over central Europe, strong vertical currents were experienced, and the instrumental measurements showed that the motion was mainly upwards, and reached at times a speed of 3 metres per second at altitudes slightly less than one kilometre. A curve, showing in profile the country passed over by the balloon during the period for which the diagram of vertical motion is drawn, would add interest to the latter and possibly suggest the causes of the rapid variations in the upward current. E. GOLD.

BEACH-LA-MAR, THE JARGON OF THE WESTERN PACIFIC.

BEACH-LA-MAR is that peculiar variety of English speech which has arisen from the contact of uncultured civilisation with the savage or semi-civilised peoples of the western Pacific. It is a language born of the necessity of comprehension between primitive traders, and is thus, in its nature and purpose, akin to the Lingua Franca of the Levant, the Pidgin of the China Seas, the Chinook of the American fur trade, the Negro-English of the Guiana plantations, and the Krooboy talk of the African coast. Its name suggests but one of its origins, for Beach-la-mar is the sailor's mispronunciation of Bêche-de-mer, a name of the Trepang or Holothuria, which was prepared on the island shores for the markets of the East Indies. But the language began with the American whalers and the sandalwood gatherers of the early nineteenth century, who preceded the *bêche-de-mer* fishers of the 'forties and 'fifties. On the decay of the trepang industry the talk passed to the copra-collectors and the beach-combers, and was finally settled as the jargon of the Pacific by the "blackbirding" (more delicately described as the "recruiting of Polynesian labour") in the 'sixties, when it became the common speech of the natives on the Queensland plantations.

Few have recorded the speech, and in an entertaining little volume Mr. Churchill has noted all that is to be found relating to it, with some chapters by way of introduction.[1]

Mr. Churchill discusses the art of breaking English into jargon. It is delightfully simple, for "the proper way to make a foreigner understand what you would say is to use broken English." Politeness may give way to emphasis. Grammar and the elegances of speech do not matter. The want of these will not shock the native, for in no native language is it possible to be ungrammatical. In them intelligible speech consists in the placing of the vocables in the right order. Inaccurate arrangement is unintelligible nonsense. The native subjects the broken English to the rules of his own speech. As to this, Mr. Churchill, premising that a single parent for the many and diverse languages of Melanesia is as yet unproved, recognises that all the languages of that region are practically on the same plane of development, and so uses the designation "Melanesian speech" to indicate a composite of the knowledge of the languages there spoken. He regards them as isolating languages, and rejects the Malayo-Polynesian theory of Bopp, as well as the application to them of the term "agglutinative." He believes the words may be separated into monosyllabic elements, and these even may be susceptible of ultimate reduction to vowels, to which may be prefixed or suffixed a consonant with a definite power of qualifying or fixing a special meaning to the stem.

The rules of isolating speech applied to the Broken English formed the Beach-la-mar.

The vocabulary is nearly all English, and the marine element is strong. Mr. Churchill says, "There can be no hesitation in ascribing to forecastle English such exotics as *pickaninny*, *calaboose*, and *savvy*—longshore sweepings from the Spanish Main. The *squareface*, sole landward hope of the sailor, is scarcely known ashore. The sailor dialect has kept alive, and has given to these remote savages the special sense of *sing out* and *look out*, of *capsize* along with *copper*, of *slew*, of *look alive*, of *adrift* and *fashion*. Of certain elements of low, cant, vulgar English the sailors may have been the carriers." The Kanakas in the Queensland plantations enriched the vocabulary with Austral English, and to this "we must ascribe in the greater measure the inclusion of such terms as *tumble down* and *blackfellow*, of *flash* and *trash*, of *hook it* and *clear out*, of *hump* and *wire in*, of *gammon* and *bloody*." Such words as *kaikai*, food, *likelik*, little, *tambo* or *tabu* come from the island tongues, and one word, *rauss* (? clear out) is German.

Mr. Churchill has given a bibliography of the subject in fifteen entries. He has produced a most instructive and interesting book. It illustrates a simple language in the making, and records a form of speech which will disappear with colonisation and mission schools. It is to the presence of these in the Torres Straits that a decadence in jargon noted by Mr. Churchill is due. SIDNEY H. RAY.

[1] "Beach-la-mar, the Jargon or Trade Speech of the Western Pacific." By William Churchill. Pp. 54. (Published by the Carnegie Institution of Washington, 1911.)

THE FRACTURE OF FLINT BY NATURE AND BY MAN.

AT a meeting of the Prehistoric Society of East Anglia, held at Norwich on November 4, the natural fracture of flint and its bearing on rudimentary flint implements was discussed by Mr. J. Reid-Moir.

Subjoined is a summary of the main points described:—

(1) Experiments were shown in natural percussion produced by placing a number of flint nodules in a sack and shaking them violently together. The following results were obtained:—

First, some of the flints were flaked on the edge by blows which had impinged at all angles, as would be expected from fortuitous blows.

Secondly, nearly all the blows had impinged obliquely, thereby blunting the edge and showing prominent ripple-marks.

On the other hand, human blows are always delivered at a *constant angle* to the edge of the flint, and are delivered vertically to the edge, as it is much easier to remove flakes thus than by oblique blows, which is nature's method.

Nature must of necessity detach flakes obliquely, because out of the 180 angles at which it is possible to edge-flake a flint, there is only one which gives a true vertical flake.

These vertical flakes do not show ripple marks, as the force of the blow does not pass through the body of the flint.

It was also seen that fortuitous blows produced a large number of truncated flakes on the edge of the flints, which are not seen to anything like such a large extent on human

implements, as such flaking is not required in their manufacture. With fortuitous flaking the rain of blows is practically incessant, and truncated flakes are of necessity produced.

Many of the specimens shown exhibited marked sinuous edges, but the blows which caused them were all oblique and impinged at varying angles.

(2) Experiments were performed in natural pressure by means of an ordinary and a differential screw press (with a rubber ram), giving a pressure ranging from 40 to 300 tons to the square inch.

It was found that through a thin layer of sand the pressure was incapable of fracturing the thinnest flint flakes.

On a hard surface, the pressure and resistance being equal, flakes were detached from flint nodules showing two bulbs, one at each end of the flake and opposite to each other.

In the case of a flake detached by percussion, only one bulb occurs. Therefore this fact provides an excellent test for differentiating between man's work and flaking by natural pressure.

If the under surface on which the flint rests is not sufficiently resistant, a flake detached shows only one bulb, which is entirely different from that produced by percussion.

When a suitable flint is carefully placed upon another equally suitable, and pressure applied, a "hollow-scraper" can be produced showing much finer flaking than that resulting from percussion.

It is known that the finer flaking on Neolithic implements, such as arrow-heads and "pigmies," is always produced by pressure applied by man.

A large number of specimens was shown to illustrate each experiment described.

THE MEDICAL WORK OF THE LOCAL GOVERNMENT BOARD.

THE report of the medical officer of the Local Government Board for the year 1910–11[1] has been issued with commendable promptitude. Dr. Newsholme's report, which occupies the first seventy pages of the volume, gives a comprehensive review of the public health in 1910 and of the work of the medical department of the Board, and epitomises some special subjects considered during the year, public vaccination, and the auxiliary scientific investigations carried out for the Board.

The review of the public health gives some of the more important facts as to the incidence of particular diseases, and a comparison is given graphically for the ten years 1901–10. It is gratifying to find that there has been a decline in the death-rate for all the following:—general death-rate, infant mortality, enteric fever, scarlet fever, diphtheria, puerperal diseases and accidents, and phthisis and tuberculous diseases. Measles alone has not markedly diminished. One of the most striking declines in the death-rate is that of enteric fever, which has diminished from about 16 per 100,000 in 1901 to about 4·5 in 1910, a percentage decline of 70, representing a saving of nearly 10,000 lives in 1910 compared with 1901, and a financial saving estimated at 1,492,800*l*. Pulmonary tuberculosis (phthisis, consumption) was responsible for 38,639 deaths in 1909, still a heavy mortality; but had the same death-rate existed in this year as in 1871–80 the deaths would have been 78,308: this saving of life represents a financial saving of nearly *six millions* sterling. Preventive medicine may well be proud of such results as these!

The circumstances of the outbreak of plague in Suffolk are discussed, but these have already been dealt with in our pages.

Of the auxiliary scientific investigations, Dr. Gordon has once more studied the types of streptococci present in the fauces in scarlet fever. He has found that the scarlatinal streptococci are indistinguishable from streptococci present in other disease processes; this leaves the problem of the etiology of scarlet fever still unsolved. Infantile diarrhœa has been investigated by Dr. C. J. Lewis at Birmingham, Dr. S. M. Ross at Manchester, Dr. R. A. O'Brien at London, and Dr. T. Orr at Shrewsbury. Of diarrhœa cases, 49·2 per cent. yield non-lactose fermenting organisms from the fæces; of non-diarrhœa cases, only 19·1 yield similar organisms, showing a much greater frequency of non-lactose fermenters in diarrhœa than in health. No one type of organism, however, has been found with sufficient frequency to justify the assumption that the disease is necessarily or usually attributable to one and the same organism.

Dr. Andrewes contributes a study of the bacteria present in the air of sewers and drains, a subject previously investigated by him for the Board in 1906–8. In the case of sewers, the dissociation of micro-organisms from the sewage is very small. In the case of drains, where there may be much more splashing than in sewers, organisms dissociated from the sewage may be far more numerous and may be carried by air currents in large numbers for considerable distances.

Dr. Inman has studied the secondary infections in pulmonary tuberculosis. He considers that in nearly every case of "open tuberculosis" of the lungs the tubercle bacillus is the predominant infecting agent.

R. T. HEWLETT.

[1] Fortieth Annual Report of the Local Government Board, 1910–11 Supplement containing the Report of the Medical Officer for 1910–11.

THE HEDLEY GOLD FIELD, BRITISH COLUMBIA.[1]

THE mining town of Hedley on the Similkameen River, in British Columbia, a little west of the 120th meridian and about twenty miles north of the United States boundary, is the most important mining camp in that district, and is of interest owing to the unusual character of its ores. The town is situated near the mouth of the Twenty Mile Creek, a canyon from 2500 to 4000 feet deep and with walls sloping at angles of 40°. The first mining claims were discovered there in 1894, and though many small mineral deposits have been found in the district, there are only two producing mines, the Nickel Plate and the Sunnyside Mines, of which the former is the most productive gold mine in Canada.

The country consists of Upper Palæozoic rocks, doubtfully identified as Carboniferous; they include a lower series of limestones, quartzites, and argillites, a middle series of limestones and quartzites—the Nickle Plate Formation and an upper series of tuffs and volcanic breccias—the Red Mountain Formation. The sedimentary series was invaded in early Mesozoic times by intrusions of gabbro and diorite. The ore deposits are unique in America, for they are contact metamorphic deposits containing arsenopyrite as the principal gold-bearing mineral. The ores are developed along the contacts between the gabbro and diorite with the sedimentary deposits. The igneous rocks have metamorphosed the limestones, but have had a comparatively small effect on the quartzites, argillites, and tuffs. The mineralisation is greatest where the contact alteration is greatest, and though gold is found in all the sulphides the highest values occur in the arsenopyrite. The granodiorite has had comparatively little effect either as a source of metamorphism or of ores, and the gabbro has been far more active than the diorite. The gabbro forms the foot-wall or is closely associated with the ore bodies in the two producing mines and in some of the smaller ore deposits.

After the intrusion of the igneous rocks the field was faulted and fissured; but neither faults nor fissures are of much economic importance. The faults were later in date than the ore bodies, and the fissures are filled with barren veins of quartz and calcite, and contain no ore deposits of commercial value. The ores, in fact, do not occur in well-defined lodes, but they grade off imperceptibly into barren country rock. As the ore deposits occur parallel to the bedding planes, it has been suggested that the gold was originally scattered through the sedimentary rock, and has been concentrated by the igneous activity; this suggestion was all the more natural, as the gold has been found widely distributed through the sedimentary rocks. It is found in them, however, only within the sphere of influence of the

[1] "The Geology and Ore Deposits of Hedley Mining District, British Columbia." By C. Camsell. Canada Department of Mines Geological Survey Branch, Memoir No. 2. Pp. 218+xx plates+8 figs+4 maps. (Ottawa, 1910.)

igneous rocks. Mr. Camsell rejects the hypothesis of the sedimentary origin of the gold, since no ore bodies have been found in any rocks except those that have been metamorphosed by the diorite-gabbro intrusions.

Mr. Camsell's description makes it quite clear that the ores are of metamorphic origin, and were due to the action of mineralising solutions given off from the intrusions. The gold has certainly not in this case come up from deep-seated fissures independent of the igneous rocks. The disturbance of the original arrangement of the ores by secondary enrichment is of comparatively secondary importance; the enrichments, as is so often the case, are best developed where some impermeable layer has prevented the further movement of descending solutions.

The memoir is illustrated by a series of excellent maps, sections, and photographs. A few lines on p. 178 are unintelligible, apparently through an accident in setting the type. J. W. G.

BEIT MEMORIAL FELLOWSHIPS FOR MEDICAL RESEARCH.

THE trustees of the Beit Memorial Fellowships for Medical Research elected the following persons to fellowships on December 16. In each case we give the general character of the proposed research, and the institution in which it is proposed to carry out the research.

Dr. P. G. E. Bayon.—Investigation on the streptothrix stages of various acid-fast germs. Differentiation and classification of the acid-fast group of germs, with special reference to leprosy and tuberculosis. Treatment and diagnosis of leprosy on specific lines. At the Lister Institute, and, if possible, at a leper camp in India or Robben Island.

Evelyn Ashley Cooper.—An investigation of the protective and curative properties of selected foodstuffs and other substances and of their ingredients against beri-beri (polyneuritis); of the nature of their active constituents; and of the value of the foregoing in the treatment of forms of neuritis induced by conditions other than those predisposing to beri-beri. At the Lister Institute of Preventive Medicine, Chelsea.

Elizabeth Thomson Frazer.—An inquiry into the value of the complement fixation test in tuberculosis as a guide to diagnosis and treatment. At the Bacteriological Laboratory, Pathological Institute, Royal Infirmary, Glasgow.

George Graham.—Investigations on metabolism in health and disease, especially in relation to the retention of nitrogen in kidney disease. At the Pathological Laboratory, St. Bartholomew's Hospital; the laboratories of the II. Medizinische Klinik Krankenhaus, München, Bavaria, Germany.

Dr. James Andrew Gunn.—Research in pharmacology and experimental therapeutics:—(1) the toxicity and trypanocidal action of arsen-lecethid; (2) further investigation of the action of harmaline on the uterus, with the view of determining its possible value as a substitute for, or adjuvant to, ergot; (3) natural immunity to certain glucosides; (4) an investigation of certain pharmacological and toxicological group-actions. At the Pharmacology Laboratory, University College, London.

Dr. Willoughby Henwood Harvey.—Pathological conditions of the kidney brought about by certain products of putrefaction which are produced in the alimentary canal ("Autointoxication and Experimental Nephritis in Rabbits," *Journ. of Path. and Bacteriol.*, 1911, vol. xvi.). The precise nature and conditions under which certain pathological changes are produced in the kidneys by large doses of urea, and the effect of certain purine derivatives, particularly caffeine. At the Pharmacological Laboratory, Cambridge.

Judah Leon Jona.—The toxæmias attendant on pregnancy and childbirth. At the Lister Institute of Preventive Medicine.

Rowland Victor Norris.—An investigation into the formation and metabolism of glycogen in the organism, and its bearing on diabetes and other pathological conditions. At the Lister Institute of Preventive Medicine.

Charles Henry O'Donoghue.—The relation of the œstrus cycle to the functional activity of the mammary glands, and generally to investigate the development, morphology, and physiology of the mammary apparatus in the mammalian series. At (1) the Zoological Laboratory, University College, London; (2) the Institute of Physiology, University College, London.

Charles Claud Twort.—The immunity reactions in Johne's disease of cattle (pseudo-tuberculous enteritis), and their relation to leprosy and to human, bovine, and avian tuberculosis. At the Brown Institution.

TECHNICAL INSTITUTE PROBLEMS.[1]

THIS institute now coordinates all the teaching that used to take place in many small science classes in the city. You have a costly and magnificent building with many thousands of evening students and a few day students, and it is important to know whether you are doing with it all that may be done. All technical colleges in the country have much the same history and are trying to solve the same problems. I do not know what the salaries are here, but the curse of all other science colleges known to me is that the salaries are only half what they ought to be, and there ought to be more professors and teachers. A city puts up a magnificent building with well-arranged laboratories full of expensive apparatus, and it economises in the most important item—the teacher. As the Americans say, an expensive gun is all right, but what of the man behind the gun?

I shall speak particularly of the needs of the engineering trades, but what I say applies to nearly all the manufacturing trades of the town.

A boy at fifteen fit to be an apprentice ought to be fond of reading English books, to be able to write an account of things he has seen and done, to be able to do simple computation such as easy mensuration, to do a little mechanical drawing, and he ought to know something of natural science. Such an apprentice begins to learn and begins to be useful in his trade from the first day; he is sure to attend evening classes in this institute, and he will at the age of twenty-one have had a very fine training. But 98 per cent. of apprentices knew little when they left school at thirteen; they have had time to forget that little, and they know almost nothing when they enter the factory. Therefore for nearly two years in the factory they are mere message boys; they have no inclination to go to evening classes, and if they had, or if their masters were to insist on such attendance, they would benefit very little.

It is very easy to blame the masters, but I tell you that the average apprentice has been ruined already; it is scarcely worth while trying to teach him anything.

In spite of their ignorance, these apprentices in the past acquired a manual skill which is the wonder of foreigners. But much of that skill is now comparatively useless. The machine tool-shop has become far more important than it used to be, and labour-saving tools have greatly displaced handicraft; head work has become far more important, and if a man is not to be a mere tool-minder he must know something of the sciences which underlie his trade. It is also important that he should be happy through interest in his work, else he will develop into a mere labour-saving tool himself, without imagination and without initiative—a poor sort of citizen. Again, reforms in workshop methods and invention depend greatly upon the ideas of the workmen, which gradually reach their superiors.

There is, however, no need to impress upon you the necessity for evening science classes. You have them here. But see what a great waste there is! This costly building, its well-equipped laboratories and well-trained staff of teachers, are devoted during the first two years of a boy's life here to teaching him the things that he ought to have learnt at his primary school or in some continuation school. I may tell you that in Scotland and the north of England a great effort has been made in the last ten years to capture the boy of thirteen. In Scotland it is compulsory that he should attend continuation-school classes in the evening, and it is going to be made compulsory also in England. In Scotland, however, it is being recognised that the

[1] From an address delivered at the opening of the new engineering laboratories of the Municipal Technical Institute, Belfast, on November 24, by Prof. John Perry, F.R.S.

ordinary primary-school master can only teach these boys as he has taught them already, and special kinds of instruction are being given in many places which really fit the boy of fifteen for science class work.

I knew, as others did, about this great college of yours, and I wondered where you would find apprentices here who were fit to take these evening classes. But I have made a discovery. You here are actually taking boys of thirteen in the day time and giving them just that kind of instruction which will fit them perfectly for their work; and these boys when apprentices will, I hope, come to your evening classes. This is a temporary expedient, forced upon you, for it is a pity to devote your space to such elementary work; but it is very important that this example should be set. Four years ago I found that the Hull Institute had this system. A boy who is from twelve to thirteen years of age, and has perhaps passed the sixth standard, may attend the institute in the day time until he is fifteen years of age. He does some freehand drawing, practical plane and solid geometry, and mechanical drawing; there is what is called a mathematical laboratory; I pay the mechanical laboratory work a high compliment when I say that it is there as well done as it is here; there is laboratory work in heat, electricity, and chemistry. The results are very wonderful. I had to use a high standard when I asked the boys questions. They could write an account of the work they were doing in decent English; their reasoning powers were evidently well developed; they had power to use elementary algebra and trigonometry in new problems. I could not imagine a better training for boys who intended to enter the shipbuilding and mechanical and electrical and other engineering works of Hull. I am glad to think that you are doing this also in Belfast.

Just as in Scotland, this problem of the ignorant apprentice has been attacked in the north of England during the last six years by means of continuation schools, and many important institutes are now able to fill their spaces in the evening with boys of fifteen who have already passed the kind of standard presented by what is called the Lancashire and Cheshire Union. It results that later, in the six years from fifteen to twenty-one, there are numerous students who are acquiring a scientific and practical knowledge of engineering which is much superior to what is obtainable in the best American and German science colleges of university rank. I say superior, because these British boys are not only being given a practical knowledge of higher mathematics and of science, and not only is there more common sense in our use of laboratories, but these boys become skilled in their trades because they learn their trades in real workshops working side by side with real workmen, doing work which has to be paid for.

If you want to know how much can be done in evening classes, I advise you to visit the great Glasgow Science College or the Heriot-Watt College at Edinburgh, which have also large day classes. Graduates of the universities in engineering come to the evening classes of these colleges to get post-graduate instruction, and yet these colleges cannot themselves confer degrees. The great success of these evening classes is due to the dogged persistence of the Scotch people in introducing common sense into their primary-school teaching and in coordinating it with the science-class teaching.

You have seen these laboratories, but it is possible that many of you do not quite understand what an important work they are doing. In secondary schools and colleges we used to teach only 5 per cent. of our students, those who were capable of abstract reasoning, and we called them the clever students. We called the others stupid until they thought themselves stupid, and we did not recognise the fact that these others were in many cases very much the cleverer. They refused to reason about things they did not understand—that they were not familiar with. And so their honest minds refused to follow their teachers in geometry and other parts of mathematics; they refused the study of what is often called natural science in schools. Yes, and in spite of the mental training which is always bragged about by Latin masters and other teachers of philology and grammar, the average boy was stupefied by all the scholastic work he did, and if it had not been for their sports, their teaching of themselves by observation and experiment out of school, we should have stupefied them for their lives.

I have always felt that my best work was in teaching that average student whom most teachers call stupid, but whom I regard as the most earnest and hard-working and honest, and altogether best of all students. And now in every university, in every polytechnic of Germany or science college of America, there are great laboratories, and in most of them the average student still has no chance. Teachers will not exercise their common sense. Why, a man can train a monkey or a dog or a bear because he studies the animal; he never studies the average boy, whose mental powers are infinitely greater: he calls him stupid.

In mechanics we deal with mere matter and its motion. The fundamental ideas of time, length, area, volume, weight, force, velocity, &c., are quite familiar to all boys, and yet the average boy cannot be taught the simplest combinations of these ideas, such as momentum. And the stupefied boy, who is to become a mechanical engineer, is now placed in an engineering laboratory, where the experiments are simple enough, but they give him no new ideas; and because the big testing machines, which are perfectly easy to understand, cannot be seen anywhere else, he is said to have had a complete laboratory training.

If things are bad in mechanics, think of the training of an electrical engineer! Of course, an electrical engineer must first and foremost be a good mechanical engineer, but he must also know about the laws of electricity. Well, he is placed among the most delicate apparatus used in testing, consisting of reflecting galvanometers and resistance coils and Wheatstone bridges, and he does a lot of exercises and passes an examination, and after two years' work he knows absolutely nothing of the simple principles of electricity; his mind is in a state of confusion on the whole subject.

Now before teaching geometry you ought to make a boy familiar with geometrical notions by his own drawing and measurement and computation, and so you ought to familiarise a boy with notions of current and electromotive force and resistance by letting him play and measure with the simplest kinds of electrical apparatus. For these things are really abstract notions, and they cannot be comprehended at all easily by the average boy.

If you ask a boy "What is force?" and he gives you the answer, "Force is the rate of change of that vector which we call momentum," you must give him full marks. If you ask "What is Ohm's law?" and he answers "Current is electromotive force divided by resistance," again you must give him full marks. And yet it is years before the engineer knows thoroughly well what these words mean, and many a student who takes prizes never gets to know what these words mean.

Now all through the laboratory work here you will see that there is an effort to make a student really understand the few fundamental principles which underlie all engineering work. These principles are few and simple-looking; but if a man knows them thoroughly well, as well, for example, as he knows his way about his own house in the dark, then there is scarcely any new problem, however complex, in his engineering work that he cannot solve; and it is only the student who has fiddled with simple electrical apparatus, making simple measurements and experiments, who can understand how to use your delicate testing apparatus or electric generators and motors. If the fundamental principles are part of his mental machinery he will have no difficulty in comprehending the most difficult things.

Although we speak of our ways of teaching as "practical geometry," "practical mechanics," "practical electricity," &c., you must not get the idea that these are degraded subjects. Academic people had the names "geometry," "mechanics," &c., for subjects taught in the old way; our subjects are the old subjects taught in a new way, and it has been abundantly proved already that the new way is the only way by which the average student can learn at all; and not only this, but it is the very best way for all students. Almost no student, however great he may be as a mathematician, taught in the old way, has a real knowledge of mechanics; force and momentum are always abstractions to him; mental phenomena are his only study,

mere logical deductions from a few simple premises which, for all he knows, may be quite wrong.

Academic methods of teaching mathematics have quite failed with the average student, whereas the system which is called practical mathematics has proved most successful, not only with him, but for men who are capable of becoming great mathematicians. The average student now gets a thoroughly good working power over what are usually called higher mathematical methods; he can use his knowledge readily in all kinds of practical problems. It used to be that when an evening mathematics class was started in September only about one-third of the students were in attendance in December, and when May came round there might be only one or two students in the class. Now the attendance keeps up to the end of the session, and there is scarcely any subject in which the students show so much interest. Their eyes and faces are bright, they work hard, and they evidently enjoy the work. We have merely introduced some common sense into the teaching; we have approached the student's mind from another point of view than the old academic one, from the only side on which he has ever been taught anything—the side of observation and trial. We educate his reasoning powers through concrete examples until he gets a firm grasp of abstract truths. There is nothing really new in what we are doing; it was insisted on by Milton, by Herbert Spencer, and by many another philosopher. The authorities of this institute were among the first to adopt this method of teaching.

I praise all these things which your institute is doing, and I think that my praise is of value, because I am specially competent to speak of these things. Many of you understand better than I do the value of the textile and other trade classes, but we all feel that the work that is being done in them is valuable work.

I wish I had time to speak about it, but I am neglecting a great deal in this address. For example, I am saying nothing about some exceedingly important research in engineering science that is going on in this institute which is adding to our knowledge of the strength and trustworthiness of materials and other things.

I said in opening the advanced laboratories to-night that there was a scientific educational thread of thought running through the whole scheme of Prof. Smith. Before he enters that laboratory a student must be prepared for this higher work by work in the other laboratories. Every unit to be experimented upon is small; that is, it is not a huge thing that scares the student; a group of three or four students can take charge of the work; and it is not so small but what the results of experiments shall be of practical value. The actions of steam engines, steam turbines, gas engines, oil engines, petrol engines, electrical generators, various pumps and water turbines, refrigerators, and many other things, can be fully investigated through actual measurement of their performance in all sorts of circumstances. It is almost the best laboratory of its kind that I have ever seen.

As I am speaking of the evening work in particular, what I say is that few boys at the age of fifteen are fit to be apprentices in any kind of engineering in Belfast; but if a boy is fit he will certainly attend these classes in the evening, and in the day time if he is allowed. If he attends two or three nights, and perhaps half a day twice in the week, until he is twenty, then I say that he has had a finer engineering training than he could have had as a rich man's son in Germany or America or anywhere else.

I know the breed well; I get fifteen or twenty of them every year who have scholarships to maintain them in London. They know all that is in the text-books before they come. Four or five of them come from the Government dockyards, where they have attended excellent science classes and have been five or six years in the workshops, and the rest are all good workmen too.

But Belfast men of this type ought not to have to go to London or Dublin to complete their scientific education. They ought to be able to do this in Belfast in attending the day classes of this very college. Why, even two years of the highest kind of instruction here would fit men like National Scholars for the best posts. I need not tell you, however, that even then they shall only have entered on the race for the highest posts; much experience of men and things, and a foundation of character, a developed imagination and general culture, and much else go to the making of the great engineer.

This evening work is now the most important work of your institute, and if you can only improve the character of your students at fifteen or sixteen the work will become infinitely more important; but surely this costly institution is not going to neglect the work that is more important still—its work during the day.

Do you know why those clever experienced National Scholars and others of which I spoke just now—do you know why they come to us in London? It is because the Royal College of Science is the only college of high rank in Great Britain where these men can pursue their studies. If they can write a decent letter; if they can write in fair English an account of anything they have done or seen, that is enough to secure admission. We give them chances of learning French or German free of cost, but they can get the highest honours which the college has to give without a knowledge of these languages.

There is not one college of university rank in Great Britain which these students can enter unless for a time they cease the studies they love, to work up Latin and French or German merely for the purpose of passing a matriculation examination. Now just as there are great classical scholars who cannot comprehend Euclid, so many of the men who most incline to the study of natural science hate Latin and Greek, and, indeed, all other languages than their own, and the study of these languages ought not to be forced upon them.

Your college here ought to give the highest kind of instruction in the day time to all kinds of engineers; Belfast needs such a science college, and you ought to aim at getting three or four hundred of fit students every year. This college ought to be, and will, I hope, become the great engineering school of the Queen's University of Belfast, and every day or evening student who is made fit to be an engineer ought to receive a university degree.

In a university there are always many schools, and every student ought to pass an entrance examination. Now I wish to direct attention to the fact that the authorities of modern universities have forgotten the object of an entrance examination. It is simply to test whether a man is likely to benefit by any of the courses of study. Four hundred years ago all lectures were in Latin, all books were in Latin; unless a man knew Latin he could not benefit by any of the courses of study, and it was right to reject him; there was a commendable custom at some Oxford colleges that if a student spoke one word of any other language he was fined. Then at the Renaissance Greek was made obligatory, and geometry for students who had to follow certain courses of study.

And now, when all lectures are in English, when our English literature is greater (if we include translations) than any other literature that has ever been, we still make a knowledge of Latin and Greek compulsory.

The Queen's University of Belfast is intended for the education of men who intend to enter professions connected with politics, divinity, law, education, medicine and surgery, economics, literature, and engineering. In almost all cases a knowledge of Latin, and in many cases a knowledge of Greek or of one or more modern languages, and above all a university degree, are essential for professional qualification.

No one, therefore, can object to obligatory Latin and other philological subjects being required from the greater number of the existing students of Queen's University, which has been so eminently successful in preparing men for some of the above professions. It has been so successful that people forget that the general higher education of the community is being altogether neglected, the general culture of professional men is being neglected; and in the case of professions involving applications of physical science, the numerous branches of engineering, useless obligatory subjects are insisted upon, so that for these professions the university is a harmful institution.

Medical students have so much hard work in various kinds of grammar subjects required for matriculation that they must be forgiven for their utter ignorance of all things in natural science. But an outside Philistine may also be

forgiven when he suggests that the whole country might benefit if the school training of medical students put them more in sympathy with scientific discovery. It is a well-known fact that there are medical men in lucrative practice, said to have the highest university qualifications, who tell you frankly that they do not believe in bacteriology.

The greatest of your professional men passed through school and entered college with the smallest possible acquaintance with natural science; their university course involved very little study of natural science; that course was so narrow that, although we hear such men talk of their love for literature they take no pleasure in reading Shakespeare or Jane Austen or Goldsmith or Dickens, and they take no interest in those applications of science which are transforming the world. Now I consider with Sir Norman Lockyer that the study of natural science is as important a line of defence of the British Empire as our Army and Navy.

And yet all the most expensively educated clever men are ignorant of natural science. In several papers and speeches.[2] I have pointed out the great loss which the country feels on account of this and the absence of breadth of culture and mental power which are due to it. However harmful the present university standard may be to clever men, it is even worse for the average man, because all our secondary schools train boys as if they were going to a classical university. The average boy represents more than 90 per cent. of all the boys in the higher schools. I say that he is capable of the highest kind of training; you may make him fond of books, and he will then educate himself until he dies. You can put him in the way of being fond of English literature, of writing good English; of easy computation; of recognising the significance of scientific discovery; of being proud of himself; of having confidence in his reasoning powers. He will not then readily let his emotions be played upon by an eloquent foolish speaker, and he will not easily be deceived by a quack of any kind. You can make him a well-educated man, fit to be a citizen of Belfast, to take scientific charge of a business that he likes; but, once for all, understand that it is not through Latin or Greek or academic mathematics that you will develop his mental powers.

At present Latin is the curse of his young life. He spends two or three years on Euclid or on a wretched thing that has taken the place of Euclid; you do not try to make him familiar with geometrical ideas, and yet you think he will learn to reason about them. You try to teach him everything through books, through words, although you know that since he was an infant he learnt everything that he did learn through experiment and observation. Whatever is likely to be unessential to him in life you teach him laboriously; he gradually takes in as much as enables him to pass examinations, and then he quickly forgets it all. No part of his school work has been a pleasure to him. You know all this, but you say that his mind is trained, although he may forget his school work. Well, it is not of much use, but I will say to you that you have not trained his mind. Whatever you have done has been to enslave and degrade the boy's mind. You have made him believe himself to be stupid. He did get training from his friends, from play; and he and his companions will go on educating each other through their sports, as puppies do. But how different his life would be if you let him teach himself through his own scientific experiments. At the age of twenty-one he dislikes books; he reads no newspapers; even the sporting news he would prefer to hear by word of mouth. He cannot write his own language—the language of his mother, his wife that is to be, his enemies and friends. The first chance of real literary education he has is when he falls in love, and he has to be careful of his spelling and grammar when he writes love-letters. Then it is that he finds himself with too small a vocabulary. Read the evidence of Lord Roberts before the War Commission; without that it is scarcely possible that you can believe that nineteen-twentieths of our public-school boys should be so illiterate as they are. They are ignorant of everything that is essential to their life except what they learned outside the class-room. But they speak the truth; they have a sense of personal honour; they scorn meanness. They often become what is called good men of business if they are well-to-do, and they manage business and estates on old-established lines well enough; but alas for them if the businesses which they manage are changing their character! All businesses are getting to be conducted now more and more on scientific lines; scientific management means success, and unscientific management means failure in nearly all businesses nowadays, and most public-school boys are so spoiled that they cannot be trained. I can speak particularly of manufactures which are applications of physical science. If such a boy is pitchforked into works he learns nothing. If he enters a technical college like this he has no knowledge, no habit of thought on which it is possible to build.

I have been during my life several times all over the globe, and wherever I have gone I have found numbers of average English public-school boys who were fitted by their training for no job but that of a hewer of wood and a drawer of water; children of Gibeon they are, and so they must remain. The last time I was in Winnipeg I had strong evidence of the poor reputation of the numerous gentlemanly young Englishmen who were trying to make a living in Canada and the United States; whereas the sons of poor parents coming from schools where they were taught only English subjects and how to compute were thought to be starting on brilliant careers.

There is an enormous number of young engineers whose fathers paid great premiums for them on their entering works, and they cannot get work to do or they are glad to get the wages of a common fitter. Perhaps they have picked up sufficient knowledge to be able to look after engines and electrical machines, but their knowledge is very superficial; their labour is really unskilled, and small changes in the character of the work they are asked to do find them incapable. They are always talking of themselves as victims of competition, of an overstocked profession. And yet they cannot help seeing numerous men who were once poor, men who were compelled to earn wages since they were fourteen years of age, occupying high positions; men whose school training did not unfit them for entering a college such as this, and for obtaining the most advanced knowledge of the theory and practice of their profession.

If school education were taken out of the hands of the pedants, the average boy might have a delightful school life.

The Belfast well-to-do business man knows instinctively that his secondary schools are all wrong, and, as a rule, he takes his boy away from school at fifteen and he puts him in business. In this way he avoids a great many of the evils of the public-school life—the stupefying school work, and the self-protective rush of the boys to sports, to loafing, and the minor vices.

Training in natural science, laboratory work in drawing and in computation, is the very best method of development of the reasoning faculties. It is good for the boy who is called clever; it is the only possible method for the average boy. The civil engineer has but little theory; he needs but little knowledge of mathematics; but of all men he ought to be most intimately acquainted with the fundamental principles of science. He has few formulæ or fixed rules; judgment and experience enable him to see his way to the solution of problems of great complexity, so that he needs to have his reasoning powers developed more even than the electrical or mechanical engineer, who has very definite rules to guide him in his professional work.

A great day science college in Belfast would give just the training that Belfast business men desire. By means of it their businesses would be conducted more and more on scientific lines.

Well, you can have such a college. In London, in the colleges of the City Guilds, at the Royal College of Science, in several of the polytechnics, there is no difficulty in filling the class-rooms in the daytime. In Glasgow and other cities there are great science colleges where again there is less and less difficulty found in filling the class-rooms in the daytime with students who are fit for the work.

There is no city of the size of Belfast in Germany or America where there is not a great science college which is filled with students doing the highest kind of engineering work and other science work in the day time; and here

[2] See, for example, "England's Neglect of Science" (NATURE, July 5, 1900) and an address delivered at Oxford (NATURE, December 31, 1903).

you have the college, but where are the day students? You are blinding your eyes to facts: you have no boys in Belfast who are prepared for modern business life in your schools; you have no boys fit to begin study at this college. The sooner you set about such a kind of school work as is necessary the better.

I do not know what the Model School is like now, but fifty years ago it produced better boys of the kind that you now want than any school in the world.

If you would sink your pride, and as a temporary measure take here in the day time boys of fourteen and teach them until they were seventeen, showing Ulster how good modern-school teaching might be given, I feel sure that you would make a rapid success. But such school work ought to last only until your example would be followed by outside schools. It strikes me, in fact, that you ought to show both the primary and the continuation and the secondary schools what they ought to do.

There are now quite a number of secondary schools in England and Scotland which provide science colleges with just such intelligent students as they want. Our unscientific rulers have given an Intermediate Board to Ireland which takes care that there shall be no such schools here. Nearly all the great English public schools have made a vigorous attempt to give the kind of education which is needed, but unfortunately the movement languished because it is opposed to all the traditions of such schools, and there are things like Latin which no schoolmaster will part with. This is the reason why the modern sides of the English public schools are such failures.

Your difficulty here is felt in many other places, but in some other places it has been grappled with and conquered.

I repeat, it is in your power to make this the great science school of the University, not merely developing applied science, but developing scientific discovery in both physical and biological science; but your schools do not yet prepare boys for such studies.

At present the Queen's University of Belfast refuses to recognise your students unless they pass entrance examinations in Latin and French or Latin and German. The time is coming when you yourselves will be able to confer a science degree on your cleverest students, the students who have had sufficient self-respect to neglect subjects which for them were not educational.

MOMENTUM IN EVOLUTION.[1]

IT is a fact well known to palæontologists that many widely separated groups of the animal kingdom have, during the course of their evolution, and especially towards the end of that course, shown a strongly marked tendency to enormous increase in size.[2] We see this in the extinct eurypterids, giants amongst the arthropoda, in the huge labyrinthodont amphibians, in many reptiles of the Secondary period, some of which attained a length of 180 feet or more, and amongst mammals in the extinct Tinoceras and the still surviving elephants and whales.

Comparative anatomists are familiar with similar phenomena exhibited by individual organs, such as the extraordinary development of horns and spines on many of the extinct reptiles referred to, the gigantic and grotesque beak and helmet of the hornbill, and the tusks of Babirusa.[3]

The exuberant development of some organs of this kind may possibly be attributed to the action of sexual selection, and, indeed, our daily experience of our own species seems to warrant us in believing that there is no limit to the grotesque results which may ensue from the unrestricted exercise of the æsthetic faculties by either sex; but it scarcely seems reasonable to attempt to explain all such bizarre and monstrous productions in this manner.

In all the cases cited, and in many others which could be adduced, either the entire body or some particular organ appears to have acquired some sort of momentum by virtue of which it continues to grow far beyond the limits of utility, although perhaps in some cases a new use may be found which will assist the species in maintaining itself in the struggle for existence. An enormous increase of mere bodily size, however, seems in the long run to be always fatal to the race, the place of which will be taken by smaller and presumably more active forms. The gigantic amphibians are all extinct, so are all the really gigantic reptiles; and of the gigantic mammals only a couple of species of elephants and a few whales survive, all of which are being rapidly exterminated in competition with man.

Is there any justification in recent developments of biological science for the belief that a race of animals may acquire a momentum of the kind referred to which may ultimately lead it to destruction? Is there some brake normally applied to the growth of organisms and organs, and, if so, are there occasions on which the brake may be removed, leaving the organism to rush to destruction like a car running away downhill? I hope to be able to show some ground for believing that both these questions may be answered in the affirmative.

It is, I think, now generally accepted by physiologists that the growth of the different parts of the animal body is controlled by internal secretions or hormones, the products of various glands. Thus we know that disease of the pituitary body in man leads to acromegaly, one of the symptoms of which is great enlargement of certain parts. The most dreadful of all diseases to which human beings are liable, cancer, is essentially due to an unrestrained multiplication of cells, and consequent abnormal growth of tissue, which may very possibly be correlated with the extent to which some specific controlling secretion is produced in the body. In short, we are justified in believing that, in the individual, growth is normally inhibited or checked by specific secretions, and that in the absence of these it will continue far beyond the ordinary limits.

The question next arises, Can we apply this principle to the race as well as to the individual? I see no reason why we should not do so, and, paradoxical as it may seem, I think we may be able to explain the growth of the organism as a whole, and of its various organs, beyond the limits of utility, as an indirect result of natural selection.

When a useful organ, such as the tusk of a wild boar, is first beginning to develop, or to take on some new function for the execution of which an increase in size will be advantageous, natural selection will favour those individuals in which it grows most rapidly and attains the largest size in the individual lifetime. If growth is normally checked and controlled by some specific secretion, natural selection will favour those individuals in which the glands which produce this secretion are least developed, or at any rate least active. This process being repeated from generation to generation, these glands (whatever may be their nature, and we may use the term gland for any cell or group of cells which produces a specific secretion, whether recognisable as a distinct organ or not) may ultimately be eliminated, or at any rate cease altogether to produce the particular hormone in question. Moreover, this elimination may take place long before the organ the growth of which is being favoured by natural selection has reached the optimum size. When it has reached this optimum it is certainly desirable that it should grow no larger; but there is no longer any means by which the growth can be checked: the inhibiting hormone is no longer produced, the brake has been removed, and further growth will take place, irrespective of utility, until, when the size of the organ gets too great to be compatible with the well-being of the individual, natural selection again steps in and eliminates the race. The same argument, of course, applies to the size of the body as a whole, as well as to that of its constituent organs. Is it not possible that, the normal checks to growth, being thus removed along certain lines by the action of natural selection, a definite direction may be given to the course of evolution which the organism will continue to follow, irrespective of natural selection?

I shall probably be told that all organs vary, and that when any particular organ has reached the optimum size

[1] Paper read before the Section of Zoology of the British Association at the Portsmouth meeting by Prof. Arthur Denny, F.R.S.

[2] *Vide* Dr. Smith Woodward's presidential address to the Geological Section of the British Association, 1909.

[3] Darwin supposed that these tusks, which are curved backwards in such a position as to render them useless as weapons of offence, might still be defensive and used to parry blows, but this scarcely seems sufficient explanation of their enormous development.

natural selection will prevent it from going further by eliminating the unfavourable variations, *i.e.* those which exhibit further increase. It may be admitted that the organ in question will probably exhibit variation in size after reaching the optimum, due to differences in nutrition and other peculiarities of the individual environment; but I fail to see how, in the absence of the gland which produces the specific controlling secretion, and which we have assumed to have been already eliminated, there are likely to be any variations of a minus character suitable for natural selection to work upon. In other words, it appears to me probable that natural selection, having once let go her control of growth, would be unable to regain it. In order that she might do so, it would be necessary either that the glandular organ which originally produced the inhibiting hormone should be again developed or that some other organ should take its place. It is, however, generally admitted that an organ, once lost, is never redeveloped, and it does not seem likely that any other glandular organ, which we may suppose to be already occupied in producing a specific secretion for some other purpose, would be able to take on new duties and provide the necessary control before it was too late to save the organism from destruction.

If there is a possibility of any cumulative effect from generation to generation there seems no reason why, in these circumstances, increase of size should not continue indefinitely until it becomes incompatible with existence. Have we any right to assume any such cumulative effect? I think we have, for we know very well that the whole ontogeny of any one of the higher animals is nothing but the accumulation of a number of successive stages which have been added one after the other in the individual lifetimes of past generations. This, at any rate, is the teaching of the recapitulation hypothesis, in the truth of which I, for one, am a convinced believer. We also know from the facts of embryology that as each successive stage is added there is a tendency both towards an increase in the length of time occupied in development and also towards compression and abbreviation of the earlier stages, so as to make room for new chapters of the record.

It seems, therefore, not unreasonable to assume that any increment in size which is gained by an individual animal or one of its organs before the period of reproduction, or before the germ cells which will give rise to the next generation are matured, and which is the result of the removal of some controlling factor, will tend to be inherited in the offspring in a cumulative fashion. If not, why have other features in the ancestral history been accumulated by heredity? It may be said that after the maximum rate of growth has once been attained there will be no further increase in the size of the organ; but I think there will, if only because there will be a slightly increased time available, owing to the lengthening of the period of development in which growth may take place. Then, even if there is no further acceleration of the actual rate of growth after the controlling influence has once been completely removed, the lengthening life-history will still afford opportunities for increase of size. It seems not impossible, however, that acceleration might also continue in connection with the shortening up of the stages of development in the ontogeny.

I should like to meet in advance another objection which may be raised to the views herein advocated. It may be urged that many of the bizarre and almost monstrous characters under discussion, such, for example, as some of the excrescences of the dermal armature in extinct reptiles, can never have had any value as adaptations, and that therefore natural selection could never have encouraged them to increase so much in size as to get beyond her control. Here, however, the principle of correlation comes in. Just as many different parts of the body are affected by disease of the pituitary gland, so the removal of the gland which controlled the development of some undoubtedly useful organ, such as a frontal horn, might at the same time permit the growth of all sorts of excrescences which have no adaptive significance.

I need hardly say that I have no wish to speak dogmatically with regard to the cause of that remarkable momentum which organisms certainly seem in many cases to acquire during the course of their evolution. Our knowledge of internal secretions and their specific action upon the different parts of the body is still in its infancy; indeed, it has hardly commenced; but I venture to point out to biologists a possible clue to what has been for a long time an insoluble enigma. I hope that my suggestion will be freely criticised, and that it may give rise to a discussion from which some grain of truth will ultimately emerge.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LORD HALDANE has been elected Chancellor of the University of Bristol, in succession to the late Mr. Henry Overton Wills.

THE Clothworkers' Company has supplemented its previous grant of 500*l.* to the Bedford College for Women Building Fund by a further grant of 500*l.*

REUTER reports that the council of the University of Paris has sanctioned a scheme for an exchange of students between the Universities of Paris and London.

THE Paris correspondent of *The Times* announces that the Marquise Arconati-Visconti has endowed the University of Paris with the sum of 20,000*l.*, which is to be employed for the benefit of the faculties of medicine and of letters.

THE annual meeting of the Mathematical Association will be held on Wednesday, January 10, 1912, at the London Day Training College, Southampton Row, London, W.C. There will be an address by the president, Prof. E. W. Hobson, F.R.S., and the following papers will be read:—on the work of the International Commission on Mathematical Teaching, C. Godfrey; on some unrealised possibilities in mathematical education, G. St. L. Carson; a plea for the earlier introduction of the calculus, C. V. Durell.

IN August last Mr. Snowden, M.P., sent the Prime Minister a memorial, signed by more than 400 members of the House of Commons, urging that the time had come for a new inquiry into the system of appointment and the method of promotion in the Civil Service. The Prime Minister has now replied that the Government has come to the conclusion that such an inquiry, by a Royal Commission, would be useful and opportune. The composition of the commission and the terms of reference will be announced in due course.

WE learn from *The Pioneer Mail* that the Government of India has decided to place Lieut.-Colonel E. H. V. Atkinson, R.E., principal of the Thomason College, Rorkee, and Mr. T. Dawson, principal of the Victoria Technical Institute, Bombay, on special duty early in the new year. The object of the special duty is to bring the technical institutions of India into closer practical relations with the employers of labour in the country, whether they be Government workshops or factories or private concerns. Colonel Atkinson and Mr. Dawson will study the existing requirements of employers of labour, and how far they can be met at existing institutions. They will also make proposals for establishing closer connection between the existing business concerns and the existing technical institutions. On entering any province they will report themselves to the local government, and conduct their inquiries on lines approved by the local government and in the company of any person whom the local government may appoint for the purpose. It is hoped that employers of labour will cooperate with the Government in this important practical work.

THE necessity for the establishment in this country of a lectureship in tropical agriculture forms the subject of a leaflet which has been circulated by Mr. S. Simpson, of 49 Finsbury Pavement, London, E.C., and a copy of which has been received. The departmental committee appointed in 1908 by the Board of Agriculture and Fisheries to inquire into and report upon the subject of agricultural education in England and Wales, put on

record, the leaflet points out, the opinion that universities, in making provision for the training of agricultural experts, are doing not only a national but an imperial work, and one of the recommendations was to the effect that it would assist in the provision of suitable agricultural experts for the development of British tropical and sub-tropical colonies if a readership or lectureship on tropical agriculture were established at one or more British universities. Nothing has yet been done to carry out this proposal. Mr. Simpson urges the pressing necessity for the step, and suggests that the Imperial College of Science and Technology should by all means be the first place at which such an urgently needed lectureship is instituted.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Meteorological Society, December 20.—Dr H. N. Dickson, president, in the chair.—W. **Larden**: Solar halos and brocken spectres. The author described some phenomena round the sun which he had observed at St. Moritz in the Engadine. These included (1) brilliant colours not arranged in rings; (2) a series of rings; (3) the large halo of 22° radius; and (4) parhelia, &c. He gave a description of a complicated system of halos and parhelia which he had observed on one occasion at Silvaplana in the Engadine.—W. H. **Dines**: The statical changes of pressure and temperature in a column of air that accompany changes of pressure at the bottom. It appears on investigation that the changes will depend on the manner in which the change at the earth's surface is produced, and also upon the initial vertical distribution of temperature. Furthermore, it is necessary to assume that the air column is bounded laterally by some rigid boundary, otherwise the pressure produced at any given height could not be maintained. The place of such a boundary is probably taken in nature by the lateral acceleration of strong winds, although we do not know how such winds are originated. We do know, however, that in the lower strata the differences of pressure that occur are, on the average, just balanced by this acceleration, and we may reasonably infer that it is also the same at higher levels. Mr. Dines stated that the term "ascending current of a cyclone" has been used, but it appears to be incorrect. The actual phenomena seem rather to be a bulging upward of the strata between 1 or 2 km., and the isothermal a bulging downward of the strata above the isothermal, accompanied with a lateral expansion of the strata below the isothermal.

MANCHESTER.

Literary and Philosophical Society, December 12.—Prof. F. E. Weiss, president, in the chair.—L. E. **Adams**: The duration of life of the common and lesser shrew, with some notes on their habits. The author shows that his recent observations on the moults and habits of shrews confirm his theory that all adult shrews die in their second autumn. His conclusion is based on the following evidences:—(1) all individuals examined during and shortly after December were sexually immature; (2) the genitalia are not atrophied as winter approaches; (3) adult shrews do not moult into winter pelage; (4) the measurements of a large number of shrews show that a maximum size is reached in summer. In his notes on habits, from observation of a captive shrew, he refers to the extraordinary appetite, the nature of the food accepted or rejected, the mode of burrowing, and the limited power of sight.—T. A. **Coward**: A note on the little owl, *Carine noctua* (Scopoli), and its food. Mr. Coward contends that the earlier records of the occurrence of this bird in Britain are founded on doubtful evidence, and do not justify its inclusion in the British list as an occasional wanderer from the Continent. The bird is charged with being destructive to game. The examination of regurgitated pellets throws no light on this assertion, but provides interesting information about its food. The author referred also to the food of the southern little owl, *C. glaux*, mentioning especially the discovery of portions of a *galeodes* in its pellets. He suggests that the inorganic matter in the pellets may be due to the bird's habit of eating earthworms.

EDINBURGH.

Royal Society, November 20.—Prof. Hudson Beare, vice-president, in the chair.—Dr. John **Brownlee**: Point binomials and multinomials in relation to Mendelian distributions. The author showed how the moments about the centre of gravity for any distributed expression such as might arise in Mendelism could be calculated. The general theorem is that if the distributed expression consists of a series of factors, and if the moments of the complete expression be denoted by μ_2, μ_3, μ_4, and those of the factors of which it is made up by

$$\zeta'_2, \zeta'_3, \zeta'_4, \zeta''_2, \zeta''_3, \zeta''_4, \text{ &c.},$$

then

$$\mu_2 = \Sigma\zeta'_2 \quad \mu_3 = \Sigma\zeta''_3, \quad \mu_4 = \Sigma\zeta'_4 + 6\Sigma\zeta'_2\zeta''_2.$$

By this means the moments of any complex expression such as $(3+1)^m(1+1)^n$, n, m, r being integers, could easily be calculated, and any continuous curve which arose in the crossing of two characters which were capable of quantitative measurement could be analysed. (1) For pure blending forms such as $(1+1)^n(1+0+\ldots+1)^p$ arise; (2) for blending with partial dominance, forms like $(1+0+2+0+0+1)^n$; (3) for dominance, forms like either $(3+1^n)$, having the dominant elements all coming from one side, or $(3+1)^p(1+3)^q$ if so many come from both blendings; for both these forms the second moment is identical if $p+q=n$, and thus the standard deviation would afford a true measure of comparison even between symmetrical and asymmetrical distributions; (4) if coupling occurred either internal or external there arise forms like $(1+2(n-1)+1)^r$, $(n-1+2+n-1)^r$, where $n=2^r$. — W. **Gordon** and G. H. **Gulliver**: The influence of the ratio of width to thickness upon the apparent strength and ductility of flat test bars of soft steel. The bars were rectangular in section, with a uniform thickness of a quarter of an inch, and widths varying from half an inch to four inches. Neither elasticity nor ultimate strength was appreciably influenced by change of section, but the ductility as measured by the percentage of extension was found to vary considerably. For a fixed gauge-length of 8 inches the extension increased as the ratio of width to thickness varied from 2 to 7, remained sensibly constant as the ratio varied from 7 to 12, and then rose as it varied from 12 to 16. The extreme difference of extension was 10 per cent., or nearly one-half the extension of the narrowest bar. For a variable gauge-length equal to $11{\cdot}3\sqrt{\text{area}}$, similar results were obtained, but the extreme difference of extension was only 2 per cent., or about one-fourteenth of the extension of the narrowest bar. These peculiarities were found to be connected with the changes of section in the neighbourhood of the constriction.—Prof. Sutherland **Simpson**: Observations on the body temperatures of some diving and swimming birds. The large number of birds examined included the storm petrel, cormorant, razorbill, guillemot, grebe, gannet, gull, kittiwake, &c. There were eighteen different species found in the Orkneys, the Firth of Forth, and in and around Cayuga Lake, New York, U.S.A. In all cases in which the sex was determined the rectal temperature was slightly lower in the male than in the female. Of the orders examined, the highest temperatures were found in the Longipennes, the lowest in the Tubinares. The series arranged according to body temperature did not run parallel with the zoological series.—Dr. Thomas **Muir**: The theory of circulants from 1861 to 1880.

December 4.—Prof. F. O. Bower, F.R.S., vice-president, in the chair.—Dr. J. **Stephenson**: *Branchiura sowerbyi*, Beddard, and on a new species of Limnodrilus with distinctive characters. From specimens found in India the author was able to add to our knowledge of the former species, of which only a limited number of specimens had

been so far described.—E. M. **Horsburgh**: The railway transition curve. The mathematical and dynamical conditions to be satisfied by the transition curve by which transition is to be made from one straight track to another were discussed in a new way, and a comparatively simple method deduced for practical setting off of the curve.—A. C. **Cumming** and Alex. **Gemmell**: The preparation and properties of basic copper nitrate, and the hydrates of copper nitrate. Only one basic nitrate was found, namely, $Cu(NO_3)_2,3Cu(OH)_2$. Copper oxide with 100 per cent. nitric acid yields copper nitrate trihydrate, nitrogen peroxide, and oxygen. Copper oxide does not interact with nitric anhydride. The conditions for the formation of copper nitrate trihydrate and hexahydrate, and their range of stability, were studied.—A. C. **Cumming** and E. W. Hamilton **Smith**: The reduction of ferric salts (1) by sulphurous acid and (2) by zinc dust. Ferric salts are most quickly reduced by sulphurous acid if the acidity is kept as low as possible, but if the reaction of the mixture is alkaline no reduction takes place. Various zinc alloys were compared with zinc for the reduction of iron, but offered no advantages. A rapid method for reduction with zinc dust was described.—A. C. **Cumming**: Note on a perforated silica plate for excluding flame gases from a crucible during ignition. The hole was made of the appropriate size to hold the crucible. With this device calcium carbonate was quickly reduced to oxide with a good Bunsen burner.

MELBOURNE.

Royal Society of Victoria, November 9.—Prof. E. W. Skeats in the chair.—Frederick **Stoward**: The effect of certain chemical substances on the vitality of the buds of potato tubers, and their disinfective action on the potato blight (*Phytophthora infestans*). Steeping for three to six hours in 5 per cent. or 10 per cent. sulphuric acid retards growth. Treatment for twenty hours in 10 per cent. solution kills the buds. Steeping for ten days in various disinfectants in very dilute solutions, or even in pure water, prevented germination of the fungus.—F. **Chapman**: New or little known Victorian fossils in the National Museum. Part xiv.—On some Silurian trilobites. *Ampyx parvulus*, Forbes, var. *jikaensis*, var. nov., *A. yarraensis*, *Illaenus jutsoni*, *Encrinurus* (*Cromus*) *spryi*, and *Homalonotus vomer*, are described as new.

BOOKS RECEIVED.

Traité de Géologie. II. Les Périodes Géologiques. By Prof. É. Haug. Fascicule 3. Pp. iv+1397–2024. (Paris: A. Colin.) 11 francs.

Lehrbuch der Biologie für Hochschulen. By M. Nussbaum, G. Karsten, and M. Weber. Pp. xi+529. (Leipzig: W. Engelmann.) 12 marks.

The Year-book of the Learned and Scientific Societies of Great Britain and Ireland. Twenty-eighth annual issue. Pp. vii+374. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*.

The Gentle Art. Some Sketches and Studies. By H. Lamond. Pp. xi+303. (London: J. Murray.) 6*s*. net.

The Age and Growth of Salmon and Trout in Norway as shown by their Scales. By K. Dahl. Translated by J. Baillie. Edited by J. A. Hutton and H. T. Sheringham. Pp. ix+141+plates. (London: Salmon and Trout Association.) 5*s*.

Die Fauna Südwest-Australiens. Edited by Prof. W. Michaelson and Dr. R. Hartmeyer. Band iii., Lieferung 11B. Pp. 395–467+plate. (Jena: G. Fischer.) 4.50 marks.

A Treatise on Plane Trigonometry. By Prof. E. W. Hobson, F.R.S. Third edition. Pp. xv+383. (Cambridge: University Press.) 12*s*. net.

Philips' Nature Calendar, 1912. Pp. 14. (London: G. Philip and Son, Ltd.) 6*d*. net.

Tatsachen und Theorien der atmosphärischen Polarisation nebst Anleitung zu Beobachtungen verschiedener Art. Edited by Prof. F. Busch and Dr. C. Jensen. Pp. 532. (Homburg: Lucas Gräfe & Sillem.)

Penrose's Pictorial Annual. The Process Year-book, 1911–12. Edited by W. Gamble. Pp. xii+224+plates. (London: A. W. Penrose and Co., Ltd.)

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