THURSDAY, AUGUST 17, 1911.

A POLYGLOT DICTIONARY OF PLANT NAMES.

A Dictionary of Plant Names. By H. L. Gerth van Wijk. Part i., pp. xxiv+710. Part ii., pp. v+711–1444. (Haarlem: Published by the Dutch Society of Sciences, 1909–1910.)

THIS is one of those books that cause wonderment and admiration—wonderment, because it will be used, we should say, by comparatively few persons, and admiration of the author, who has devoted so much of his life to the service of the few, the work having been some twenty-five years under compilation.

"It is planned that it will enable one to find the name by which a plant is known in four modern languages, if one knows the Latin name, and also to find the Latin name, if only the name in one of these four languages is known."

The languages chosen are English, French, and German, "to which the editor naturally added Dutch names."

In the first volume, now under review, the Latin names are alphabetically arranged, followed by the names used in English-speaking countries, or used in works written in English; by the names used in French-speaking countries, or used in books in the French language, &c. The author's aim has been to include the vernacular names of wild and cultivated plants, of varieties and subvarieties, of parts of plants now or formally (formerly) used in medicine or industrially, and of flowers and fruits; also the scientific names given to parts of plants which are, or were, used in medicine, &c., &c. This, of course, is an immense task, and a task that could scarcely be accomplished in a critical manner by one person. Therefore, if we say that Mr. Gerth van Wijk has achieved only a partial success, it must not be regarded as unkind or ungrateful criticism. To be generally useful a polyglot dictionary of any subject should be compiled on methodical and discriminating principles. The casual inquirer requires assistance where the student can find his way, and the mere heaping up of names is of little service to him. By casual inquirer we mean a person who has to consult a dictionary in connection with his occupation, profession, or pleasure, and for whom it is necessary that the information offered should be presented in an easily intelligible and practical form.

Now, it may be assumed that nearly everybody of the reading community comes under this category. A selection of examples of treatment will be of more service than general criticisms. As a component of pasture herbage, and as a weed, *Achillea millefolium* is one of the commonest herbaceous plants in the temperate regions of the northern hemisphere, and it has a correspondingly large number of names. In addition to the common English names, milfoil and yarrow, about thirty other English names are cited; they are mostly, however, of quite local application. These are arranged in alphabetical order, beginning with arrowroot, and continuing with the equally unfamiliar and unused bloodwort, camil, cammick, cammock, carpenters'-grass, dead man's daisy, devil's nettle, dog daisy, and so on. Then follow the French names, about equal in number, and the German, occupying a solid column, and numbering upwards of one hundred and fifty! Passing the less numerous Dutch appellations, we come to the officinal Latin designations of parts, as *capitula achilleae, folia millefolii*, &c., and nearly one hundred German names in relation to medicinal properties, some of them repetitions from the main list.

With all this great wealth of German names there is nothing to show which are in common use, or generally accepted as book names. No doubt a very large proportion of these names are either book names or of quite local use, and many of them mere dialect variants, of interest only to the etymologist. We have not Pritzel and Jessen's "Die deutschen Volksnamen der Pflanzen" before us at present; but Mr. Gerth van Wijk seems to have copied everything. The same in English; but although we miss all reference to Holland and Britten's "Dictionary of English Plant Names," we think the author must be indebted to it. Selecting another common plant, the daisy; there are four columns of foreign names, mostly German and Dutch. The dandelion occupies another two pages, and in this way the 1444 pages are filled with names without distinction, save that those in commoner use are printed in spaced type.

Of course, an author is at liberty to make the book of his mind, and it is perhaps scarcely legitimate to suggest that he should have done something else; but if he had taken the popular names (not translated names) from the leading "floras," pharmacopœias, and publications on economic botany, he might have produced a useful work. We are told by the author that the second volume is to contain the popular names in alphabetical order, with the Latin names appended. Has he estimated, we wonder, the amount of expansion these solid columns of names will undergo when each one begins a separate line? Well, the pagination would be tripled, at least! It should be added that what the author has set himself to do he has done very well. Errors are not prominently frequent, but there are names puzzling enough, and some apparently impossible. The nomenclature of the "Index Kewensis" has been followed so far as possible for the Latin names, and the position is this: knowing the Latin name of a plant, it is easy to arrive at the lists of popular names; but supposing it is wished to find the equivalent of poppy, apart from its Latin name, in French or German, the dictionary does not help us; nor will the second volume supply this kind of information. Indeed, to attempt this now in the author's plan would extend the work beyond imagination; yet, after all, this is just the kind of information that most of us want, and turning up common names, such as daisy and poppy, in ordinary French and German dictionaries, the ordinary equivalents are found.

W. BOTTING HEMSLEY.

PROBLEMS OF WATER SUPPLY.

The Geology of Water Supply. By Horace B. Woodward, F.R.S. Pp. xii+339. (London: Edward Arnold, 1910.) Price 7*s.* 6*d.* net.

THE geology of water supply is one of those applied subjects which are extremely difficult to treat of adequately within the limits of a small volume, inasmuch as geology constitutes only one of the factors which have to be taken into consideration, and the part which it plays varies with so great uncertainty that each individual case must be dealt with practically on its merits. It may be said at once, however, that we have here an extremely useful book, one which sets forth with great clearness the main geological features to be recognised by the engineer, chemist, or physical geographer when confronted with a problem of water supply, and indicates to him the critical point where the geological doctor must be sent for. The examples quoted in illustration of general principles are naturally mostly taken from the British Isles, but there are many of great interest from other parts of the world, particularly from the United States and the British Dominions beyond the Seas.

After an introductory chapter and some general remarks on rainfall and atmospheric impurities, the author states some general geological considerations, and proceeds to describe the modes of dispersal of rain on the surface and underground, special reference being made to rivers and underground channels, swallow holes, pipes, bournes, dumb-wells, and springs. Then follows a chapter on surface sources of supply, which include storage of rain-water, supplies from springs, streams, and rivers, ponds, dew-ponds, and lakes and reservoirs. The geological interest increases in the next chapter, on underground sources of water supply—wells of all kinds—and then follow three chapters on the water-bearing strata of England, working backwards through the geological record. The succeeding chapter, on prospecting for water, applies the information already provided to the selection of sites for wells and borings, having regard to the quantity and quality of water required, the geological uncertainties underground, and, incidentally, to the belief that trustworthy aid can be obtained from various methods of water divining. This is, in our opinion, the most valuable chapter in the book; the hints as to the examination of particular districts and the diagrams illustrating local peculiarities which may be met with are extremely clear, and will form a useful warning to the non-expert of the danger of trusting too much to apparent simplicity of structure.

The next section of the book concerns itself with the water supply in polar, arid, and other regions, and in islands, where special conditions arise; a non-geological chapter refers shortly to the quality of water and the examination thereof by chemical and bacteriological analysis; and, lastly, we have a chapter of great interest on mineral waters, *i.e.* waters which contain in solution more than the 60 or 70 grains per gallon which marks the "potable" limit.

A final chapter adds to the growing body of evidence which may one day be deemed sufficient to justify the constitution of a National Water Board, which would enable "the various independent authorities dealing with the conservancy of rivers, with canals, drainage, sanitary matters, and water supply," to act to some extent in concert.

A useful glossary and bibliography and a satisfactory index are appended.

In reviewing a suggestive book of this kind it would, of course, be easy to embark upon a discussion of many things which, as the author is always careful to point out when he comes to them, are still largely matters of opinion, but space forbids more than the mere laying of emphasis upon one or two points. We note the need for further investigation of the conditions of percolation, and the solvent action of water in a permeable formation such as limestone. Where the limestone formation is exposed it would seem that, the solvent power of the percolating water being quickly lost, solution takes place chiefly along cracks or joints, which are opened out into fissures, caves or underground channels being formed where the rock material is strong, and subsidence occurring where it is weak; but where the permeable formation is overlain by an impermeable, it appears that percolation takes place with great slowness, and water obtained by boring through the upper strata is not quickly replaced from a distance. The analytical work of Mr. W. W. Fisher and Dr. J. C. Thresh in the oolites in Oxfordshire and the chalk under London is extremely significant; it suggests important conclusions in connection with, *e.g.* the lowering of the water-table under London, the outflow of water from the chalk in Kent and Hertfordshire and in other parts of England where similar structures occur.

With regard to maps showing underground contours, we agree that contours delineating the upper surface of covered water-bearing formations are valuable, and that an extension of work similar to that of Mr. W. H. Dalton is desirable. But we think that Mr. Woodward underestimates the usefulness of maps representing underground water-contours, which give much information as to the direction of flow of underground water and its variations from time to time under varying rainfall and pumping.

We note few slips, but it may be worth pointing out that the New River derives much of its supply from an intake from the Lea, and the Glencorse reservoirs largely supplement the Crawley springs in contributing water from the Pentland Hills and Edinburgh. H. N. D.

PARASITISM.

Survival and Reproduction: a new Biological Outlook. By H. Keinheimer. Pp. x+410. (London: J. M. Watkins, 1910.) Price 7*s.* 6*d.* net.

THE plentifully quoted pages from the writings of Darwin, Kropotkin, and others contained within the structure of this book form far more than its skeleton. Their presence justifies the statement that the work contains many luminous passages and much translucent information.

That part of the work which spatially connects the

unmistakably clear words of penetrative genius and the brilliantly facetted phrases of clever men, and which is contributed by the author, is, however, of another kind: rather fluorescent than luminous, and by no means transparent.

Not that the author is without some literary deftness and incapable of pressing home a plain fact in a convincing manner. Thus, for instance, where he acknowledges his indebtedness for embodying so large a part of Geddes and Thompson's well-known work on "Sex and Evolution," explaining that it would be mere presumption on his part to attempt to do again what they have already done far better than he could do. Reading the book, it is soon clear that this is true, and, as of great relevance, a truth as well stated although otherwise evident. That it is stated well no one will deny.

The author's own meaning is presumably contained in the commentary paragraphs that follow each of these lengthy quotations. The redundancy of reiterated references to "parasitism" contained within these comments is reminiscent of a well-known dialogue between two dramatists unfortunately departed to the nether-world and there contesting their respective excellences in metrical statement. Entitled to one line with which to conclude his fellow competitor's heroic verse, one candidate secures a repeated success by the use of always the same phrase, some such simple phrase as "and I lost a little oil-can."

From these reiterated comments it would appear that parasitism is responsible for many things, chiefly perhaps for "the passing of natural selection." This is by no means surprising when the author's comprehensive concept of "parasitism" is fully grasped. The term is defined as connoting

"Every condition whereby one organism lives predaceously, stealthily, or indolently, *i.e.* retrogressively, by the work of others. In view of the dynamic interdependence of life, the epithet must also apply to all transitory phases of violation of fundamental laws of assimilation and division of labour, even the highest and most strenuous organisms occasionally being guilty of such transgressions."

To this definition there are, however, so many numbered corollaries that "parasitism" is by no means understood until wider reference is made. Briefly, let it be said that there is the whole work to refer to.

Herbert Spencer, so it would seem, has anticipated this intellectual venture in a somewhat remarkable manner. Thus the author quotes his explanation of the limits to cell-growth in terms of an increasing disparity between mass and surface, and appends the following comment: "Herbert Spencer here very lucidly, though unwittingly, states the case of pathology and parasitism, and consequent limitations."

The author deliberately stating this case, so it would seem, is by no means so clear, and as a consequence places difficulties in the way of that criticism which he foresees apparently without fearing.

"Anyone honestly wishing to challenge my views is, of course, very welcome to do so. But if criticism is to be effective, it must state categorically in what particulars I am wrongly interpreting observed facts, and must also show that my physiological position is unsound."

This statement may become more pregnant when the author has detailed these particulars, and provided a view of his physiological position.

J. S. MACDONALD.

THE DIVINING ROD.

Graf Carl v. Klinchowstroem. Bibliographie der Wünschelrute. Mit einer Einleitung von Dr. Ed. Aigner: der gegenwärtige stand der Wünschelruten-Forschung. Pp. 146. (München: Ottmar Schönhuth Nachf., 1911.)

THIS book contains a fairly complete list of the various publications in regard to the divining-rod, beginning with the work of R. P. Bernhardus, published in 1532, and ending with papers issued during the current year. This list extends over 103 pages, and the contents of each book or paper are indicated by a brief note following the title of the publication.

The list is naturally more complete in respect of German publications than of any others; there is a useful index giving the names of the various authors who are mentioned. The thanks of those who are interested in the matter are due to Graf von Klinckowstroem for the care he has taken in collecting the information and presenting it in useful form. There is also an interesting introduction by Dr. Eduard Aigner, of Munich, who endeavours to sum up impartially the present condition of matters in connection with research on the action of the divining-rod. He points out quite correctly that the attitude of those who refuse to investigate the matter at all is just as absurd as that of their opponents, who are willing to accept all the claims of the "diviners" without further investigation.

Dr. Aigner also points out that a certain percentage of failures does not necessarily prove that the "diviners" do not possess the powers they claim, for if these powers have any real existence, they may be conditioned by circumstances at present unknown to us, and one may be at times asking the "diviners" to perform experiments under impossible conditions.

An explanation of the recorded successes of "diviners" is suggested, which presupposes the power of the "diviners" to recognise the difference produced in the atmosphere by the presence of water, metals, &c. The most important argument in favour of this is based on the investigations of Dr. Kurz and Prof. Gockel (*Physikalische Zeitschrift*, x., p. 845) and of T. Wulf (*idem*, x., p. 997), in which a lessening of the gamma-radiation over water is said to be proved. This lessening is said to take place over quite insignificant water-sources.

If this view were correct, it ought, of course, to be possible to produce a physical apparatus capable of replacing the "diviner," and several articles of this kind are on the market. The reviewer has applied for permission to test some of these, but he has not so far succeeded in inducing those concerned to allow him to do so. Dr. Aigner says that successes of one

form of apparatus are spoken about, but that they do not appear to have been verified by competent authority.

The reviewer is of opinion that further experiments are desirable, and that these should be directed mainly towards ascertaining whether or not the movements of the "diviner's" rod are caused by any influence outside himself. The experiments are difficult to carry out, because it is clearly fair that the conditions should be those acceptable to the "diviner"; these vary greatly, few "diviners" being entirely in agreement when asked to describe clearly the extent of their powers. J. WERTHEIMER.

DIOPHANTINE ANALYSIS.

Diophantus of Alexandria: a Study in the History of Greek Algebra. By Sir T. L. Heath, K.C.B. Second edition, with a Supplement containing an Account of Fermat's Theorems and Problems connected with Diophantine Analysis and some Solutions of Diophantine Problems by Euler. Pp. vii+387. (London: Cambridge University Press, 1910.) Price 12*s.* 6*d.* net.

THIS is far from being a mere reprint of the first edition; in fact, it is in great part a new work, which, in conjunction with Tannery's critical edition of the "Arithmetica," makes Diophantus at last accessible to the ordinary reader.

The introduction, besides giving a historical account of Diophantus, the MSS. of his works, and the writers who have dealt with them, contains most interesting and valuable sections on Diophantus's notation and methods of solution. As to the first, we are astounded, as in the case of Archimedes, at the ease with which enormous numbers are computed, in spite of the cumbrous Greek notation. An instance in point is the famous cattle problem (attributed to Archimedes), which is briefly discussed on pp. 121–4. Its solution involves the Pellian equation $t^2-4729494u^2=1$, and according to Sir T. Heath's calculations, the value of one of the unknowns of the problem would be a number containing 206,545 digits. Of the methods of Diophantus not much can be said, because he uses so many ingenious devices to suit different problems; but we may note his dexterity in choosing his unknown quantity, and his curious plan of "working back" by a sort of rule of false position. A good example of the latter is v. 29 (p. 224): "To find three squares such that the sum of their squares is a square," where it will be seen that an insufficient assumption is corrected and modified in a sort of tentative way until a solution is found.

It would be unprofitable to go into any detail here on the nature of Diophantine problems in general; to appreciate them it is necessary to read Diophantus, Fermat, and Euler. By a very happy inspiration, the present volume has been made to include all the notes of Fermat upon Diophantus, and extracts from his correspondence with Frénicle and others; besides this we have solutions of seventeen Diophantine problems by Euler, which are models for those who feel inclined to work in this fascinating field. There can be little doubt that there are still numbers of arithmetical problems to be solved by Diophantine methods, and Fermat's method of reduction (*descente*) for proving the impossibility of certain indeterminate equations awaits rediscovery and development. Moreover, the theory of algebraic forms and symmetric functions ought surely to lead to new arithmetical applications of a Diophantine type. To give an example of the sort of thing we mean: Let x, y, z be three variables; we have identically

$$\Sigma x(y-z)^3=(y-z)(z-x)(x-y)(x+y+z).$$

Now put x, y, $z=\xi^3$, η^3, ζ^3, and suppose that $\xi^3+\eta^3+\zeta^3=m\xi\eta\zeta$; then the previous identity leads at once to

$$A^3+B^3+C^3=mABC$$

with

$$A,\ B,\ C=\xi(\eta^3-\zeta^3),\ \eta(\zeta^3-\xi^3),\ \zeta(\xi^3-\eta^3).$$

This is a partial sample of what Fermat would call a *descente*; of course, it is now well known as the theory of residuation of points on cubic curves, but it is interesting to see how it results from an elementary algebraic identity, and there are still arithmetical problems in this connection which do not appear to have been solved.

It may interest those who are unacquainted with the subject to give one typical Diophantine problem and its solution. The problem is "To find two positive integers such that their sum is a square, and the sum of their squares a biquadrate." One solution is (4565486027761, 1061652293520), and it has been proved by Lagrange that, as Fermat "confidently asserted," this is the simplest solution. More exactly: the same problem may be put in the form, "Find a right-angled triangle such that the hypotenuse and the sum of the sides are both squares," and Fermat's assertion was that the above solution gave the smallest of such triangles.

In conclusion, it may be remarked that there is a *crux* in the Greek text which does not seem to have been finally disposed of. After putting the problem, "To find two numbers such that their sum and product are given numbers," Diophantus adds the condition, "the square of half the sum must exceed the product by a square number." ἔστι δὲ τοῦτο πλασματικόν. It would be possible to translate this, "This is artificial" (as opposed to "natural"), but there does not seem to be any point in this. On the other hand, to translate "This can be seen from a model" would give good sense, because we should only have to replace a diagram in Euclid by a corresponding arrangement of counters; unfortunately, this seems to read more into the text than is legitimate. Neither of these alternatives is proposed in the note on p. 140; the editor prefers, on the whole, Xylander's *effictum aliunde*, which is not far in sense from "artificial," in the context. The same phrase occurs in two other places, and in each case we can give a quasi-geometrical arrangement of counters to show that the condition is necessary; so far, this is in favour of the second alternative suggested above. G. B. M.

A TEXT-BOOK ON HELIOTROPISM.

Light and the Behaviour of Organisms. By Prof. S. O. Mast. Pp. xi+410. (New York: J. Wiley and Sons; London: Chapman and Hall, Ltd., 1911.)

THE question of the influence of light upon organisms must have appealed to the inquiring mind ever since a moth was seen to fly into a candle or a plant was observed to bend towards the sun. The closing of many flowers at night coinciding with the opening of others would have also been arresting movements to many unknown observers. But how subtle the influence of light may be has only comparatively recently been appreciated. The bending of plants towards the sun may readily be explicable on the ground of the importance of light in the preparation of the plant-food, but the hydroid zoophytes were discovered to possess the same property of bending towards the source of light, although they do not find thereby any known assistance to their maintenance. Larvæ of many diverse marine animals are also strongly attracted by light, and these, again, make no use of it so far as is known. Many animals, indeed, prefer rays of a particular region. As Lord Avebury showed years ago, the common Daphnia, if covered by a spectrum, aggregates under the green and yellow rays; ants, on the other hand, aggregate chiefly under the red and green rays, showing a special avoidance of violet and ultra-violet rays. Such varied and definite susceptibility seems quite unintelligible unless it is connected in some way with well-being, and no one has as yet shown any such correlation. The problems, then, of the meaning of the attraction or repulsion which light exerts are evidently very diverse, and the work of Mr. Mast is devoted to their analysis and consideration.

The first section contains an interesting historical summary of observations chiefly upon plants. Ray was apparently the first to suggest an explanation of the movements of plants, which he attributed to the flow of sap, being attracted to the problem by the sensitive mimosa then recently introduced from America. Early in the nineteenth century de Candolle reversed the daily periodic sleep-movements of leaves by exposing them to a new light rhythm —an interesting anticipation of F. Darwin's work. Many other points of interest are raised, including a discussion of the use of such terms as "tropism," originally the relation between the bending of a plant and the source of stimulation.

In part ii. the author sets out an account of his experiments on certain plants (Plumules of Indian corn and leaves of Tropæolum), and arrives at the conclusion that differences of light-intensity are responsible for the movements (observed by a special "light-grader"), but the method of regulating the movements is still a mystery. The section on the light-responses of unicellular plants and animals includes some original observations, as does that upon cœlenterates and various larval forms of higher animals. The general summary of this section is given on pp. 228–235, and includes a useful analysis of the work of many writers. The third part of the book is concerned with general considerations—the adaptive nature of light-responses, the phenomenon of aggregation in different intensities, and so on. This section and the last (which deals with reactions of animals to different wave-lengths) are very diffuse, and might well have been considerably shortened, as in many cases the discussions are not capable of leading to any definite solution; and if the excuse be offered that "behaviour" in its broadest sense was the subject of treatment, then surely the problem of colour-adaptation might have been mentioned. The points that emerge from this work are that there are many striking movements towards or away from the source of light which are quite unintelligible unless animal metabolism is favourably effected thereby, and we have no reason to suppose it is; and, secondly, that the way in which these orientations are effected is equally obscure. The book is written by a pupil of Jennings, who has done so much to analyse the behaviour of the lower organisms. It contains a very useful bibliography, and should prove helpful to that increasing number of experimental biologists and psychologists who are interested in the behaviour of organisms.

F. W. G.

PLEASANT PATHS OF NATURE.

The Airy Way. By George A. B. Dewar. Pp. vii+253. (London: Chatto and Windus, 1910.) Price 6*s.* net.

IN a delightfully breezy volume Mr. Dewar plays lightly on the word "airy" in its varying application, straying, by the way, into the rapid-running waters—the fishes' airy way. Following two most interesting chapters on flight and one on the watery way, the contents of the rest of the volume may be sufficiently indicated by the chapter headings dealing with the airy moor and links, the fritillaries' airy way, the airy lane and common, rooks in the airy way, and "my airiest downs"—a year's observations on the chalk. Field naturalists will be grateful to the author for his gift of conveying impressions in a few words—impressions which many may have felt, but could not perhaps express so aptly.

A few quotations from this pleasant book will serve to illustrate the pertinence of his remarks and the accuracy of his observations. Of the swift, a bird for which he has a great admiration, he says that it *is* flight, and is fitted with two scythes to cut and sweep through the air. Of the start of birds from the ground he writes:

"Hide behind a hedge or wall, and, when every pigeon beak is down, tap your stick on the ground. As you tap—whilst sound is still coming from the stone—every bird is in the air. You would as soon try to reckon the time between the hammer striking the cap and the discharge of the cartridge as reckon the time between the stick striking the stone and the discharge of the pigeon party."

And of the salmon:

"No man swims if a salmon swims. The keeping afloat, and the slow movements of a man in comparatively still water, should not be given the name we give to the swift, sure, glorious action of the salmon in the fury of storming streams. Does a man who

sits in a flying machine which makes its way through the air 'fly'? If so, the swift and the merlin and eagle have an action for which we should find another name. One thing such acts have in common—progress. They have little else."

Mr. Dewar says truly that though no date in a calendar can end or begin winter, yet there are some natural events—small touches, but sure—that end one season and begin another. One of them is the nest—with the eggs—of the earliest song-thrush. "The nest may be set in a winter hedge, and a return of iron days and nights kill the work and prevent other thrushes starting on their nests for weeks to come. It does not signify. The first thrush nest found in March in the thorn or ivy, the clay dried, the eggs laid, ended winter." But he does not do the fly-catcher justice when he says it can squeak, and has besides a fretful monosyllable or so, and there is his music. It is true that the fly-catcher very rarely sings, and that many people have apparently never heard the song; but it does really sing occasionally for all that. How one wrong letter will alter the look of a sentence, and even puzzle the reader for a moment! We notice "swallow" written for "sallow" in one place, and "root" for "rook" in another.

TEXT-BOOKS OF PHYSICS.

(1) *Mechanics and Heat: a Text-book for Colleges and Technical Schools.* By W. S. Franklin and Barry Macnutt. Pp. x+409. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 7*s.* 6*d.*

(2) *A Text-book of Physics.* By H. E. Hurst and R. T. Lattey. Pp. x+638. (London: Constable and Co., Ltd., 1910.) Price 8*s.* 6*d.* net.

(1) WITHIN the last half-century much experience has been gained as to the methods which can be used most profitably in the teaching of science; nevertheless, there is still much diversity of opinion as to the best method to be used. Followers of the heuristic school maintain that a student should build up his knowledge of science by his own unaided exertions, the function of a teacher being to guide the student's mind insidiously toward the correct path. Has any teacher ever attempted to proceed severely on these lines? It may be doubted. So far as the teaching of physics is concerned, such an attempt would be so ridiculously futile that no one could have made it seriously. Ideas such as those connoted by the words "energy," "potential," "entropy," and a host of similar expressions could scarcely be derived by any student, even if he were of the type that might develop subsequently into a Kelvin or a Rayleigh. Quite apart, however, from the question of possibility, it may be argued that no student has received a satisfactory training unless he has learned to profit by the knowledge which has been accumulated by others. Dismissing, then, the claims of the heuristic system as enunciated by its most rigid adherents, the question arises, To what extent is a student necessarily dependent on personal observation, and to what extent is it profitable for him to imbibe ideas directly from his teacher? No general answer can be given to this question, since so much must depend on the personalities of both the student and the teacher; but if it be accepted that science is the study of real phenomena, it must follow that the **practical** work done by the student must be sufficiently extensive to give him a clear idea of the phenomena which he investigates. Not only the nature of the experiments, but the order in which they are performed, is of importance. Most of the difficulty experienced by students in becoming acquainted with the dynamical properties of solids and fluids is due to the practice of studying the laws of statics exhaustively before the laws of motion have been mastered; much of the time now spent in the experimental study of statics might be devoted with advantage to the performance of simple experiments designed to illustrate the laws of dynamics. In a systematic course of study an accurate and comprehensive knowledge of mechanical principles should be gained as early as possible, for most of the exact sciences cannot be mastered without such a knowledge.

Messrs. Franklin and Macnutt have advisedly devoted the first 269 pages of their text-book to the study of the mechanical properties of solids and fluids; such subjects as virtual work, the properties of rotating bodies (including the gyrostat), the analysis of the stresses called into play by straining an elastic substance, and the fundamental laws of hydrodynamics are dealt with in a simple but illuminating manner. A few errors may be noticed. The action of the Pitot tube cannot be deduced from the force exerted by a jet of liquid impinging normally on a plane. The velocity of stream, as measured by a Pitot tube, should be equal to $\sqrt{2gh}$, where h is the height at which the liquid stands in the tube, instead of $\sqrt{gh}$, as given on p. 260. The depression of the surface of the water escaping from the central outlet of a laboratory basin is not essentially due to rotation of the water; even when the water approaches the outlet radially its velocity must increase and its pressure must diminish. In general, however, the treatment of the subject is excellent, and the student is afforded an opportunity of becoming acquainted with many interesting phenomena connected with engineering practice, which are not generally mentioned in books devoted to the theory of mechanics.

The second part of the book is devoted to the study of heat. The first and second laws of thermodynamics are discussed fully, and the most interesting properties of solid liquids and gases are dealt with in passing. The graph given on p. 401 exhibits the rate of cooling of a teapot as compared with that of a Dewar's vacuum flask, and is interesting as showing that the rate at which the teapot loses heat is scarcely affected by radiation, being due almost entirely to convection and, to a small extent, to conduction. How many teachers, it may be wondered, have explained that a silver teapot loses heat more slowly than a porcelain one, on account of the high reflecting and consequent low radiating qualities of polished silver?

(2) Messrs. Hurst and Lattey have written this book for students preparing for the Preliminary examina-

tion in physics in the Oxford Natural Science School; the general standard adopted is somewhat lower than that required for the examinations in physics for the Intermediate B.Sc. of the University of London. The book has been carefully written, and the diagrams are well drawn and reproduced. A large assortment of questions (without answers) is given at the end of each chapter. For the rest, there is not much to distinguish this book from many others on the market. The ordinary ground is covered in a trustworthy but somewhat uninspiring manner, and very little attention has been devoted to display. One or two errors may be mentioned. Ohm's law cannot be proved by the aid of experiments conducted with the potentiometer, as stated on p. 520; the use of the potentiometer is based on the truth of Ohm's law. One of the diagrams on p. 466 indicates that when a charged body is suspended inside an insulated metal can, the distribution of the lines of force radiating externally from the can depends on the position of the body inside the can. This conclusion is well known to be inaccurate. A very bad example is set to students on p. 16, where it is stated that—

"A velocity of 20 miles per hour was gained in 15 minutes; if the acceleration had been uniform, $\frac{20}{15} = 1\frac{1}{3}$ miles per hour had been added in each minute, or $\frac{1\frac{1}{3}}{60} = 0{\cdot}02\dot{1}\dot{3}$ miles per hour in each second."

One of the first things that should be impressed on a student of physics is that recurring decimals have absolutely no meaning with regard to physical measurements. E. EDSER.

EXPERIMENTAL PSYCHOLOGY.

Lectures on the Experimental Psychology of the Thought-Processes. By Prof. E. B. Titchener. Pp. ix+318. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1909.) Price 5*s.* 6*d.* net.

A Text-book of Psychology. By Prof. E. B. Titchener. Part II. Pp. ix+303–558. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1910.) Price 6*s.* net.

IN these books Prof. Titchener has made two valuable additions to the list of excellent psychological text-books that already stands to his name. The first takes its place by the side of his "Lectures on Feeling and Attention" as another detailed and advanced discussion going to the very heart of general psychological theory; the second is the completion of a new "Text-book of Psychology," intended to take the place of his well-known "Outline."

The lectures on thought-processes are five in number, in which are discussed the general function of mental imagery and its relation to thought, "objective reference" as the universal characteristic of consciousness, the modern methods employed in the experimental investigation of the thought-processes (by Marbe, Binet, Watt, Ach, Messer, Bühler, &c.), and the general conclusion as to the existence of a distinct "thought-element" to which most of these investigators find themselves driven. Titchener finds this conclusion unjustified by the facts, and to be explained, partly at least, by a confusion of the psychological with the logical point of view. "Cortical set," *i.e.* a purely physiological factor, together with a residuum of mental imagery, a residuum so inappreciable that it escapes introspection, are to be looked upon as the more probable factors in the make-up of so-called "imageless thought" than any ultimate thought-element.

The first lecture contains an excellent account of the difference between modern psychological sensationalism and the older sensationalism of the associationist school. Whether the difference is so fundamental as Prof. Titchener imagines it to be is perhaps doubtful. When, *e.g.* he writes: "The experimentalists, on the other hand, aim to describe the contents of consciousness not as they mean but as they are," one may perhaps be allowed to demur. Would not such a complete abstraction of mental process from meaning make a theory of knowledge impossible? A distinction so rigorously drawn between psychology and epistemology or metaphysics really implies a denial of the existence of the latter sciences. In Lecture II. an analogy for the reference to an object implied in all thought is taken from physical organisation.

"Every constituent part of an organism points to and implies all the other parts. In the same way the ideational process which is the vehicle of conceptual meaning is involved in a network of reproductive tendencies; it points to and implies all the special ideas that fall under the concept in question."

Is it not more accurate to say that the "reference" and implication in the former case is explicable on the analogy of that in the latter, and not *vice versa*? The complete identification of "meaning" and "context" may solve many difficulties, but does it not raise still greater difficulties in doing so? Such doubts as these may arise in perusing the lecture, but Titchener does really come to close quarters and grapples with the central difficulty in a way that does much to justify his unshakable faith in psychology and its competency to include the whole field of mental life.

The later lectures are an excellent description and criticism of experimental work on thought. The conceptions of *Bewusstseinslage* and *Aufgabe* are fully explained and the exact position of the problem up-to-date made clear. In the "Notes," which fill more than 200 pages, the original authorities are extensively quoted, and many points are discussed in much greater detail. The entire book will be found of the utmost value to the advanced student.

The "Text-book of Psychology," Part II., deals with Perception Association, Memory and Imagination, Action, Emotion, and Thought, all in a clear and straightforward way. The descriptions are based upon experimentally-determined data, and give an excellent idea of the extent to which Experimental Psychology has widened and deepened the more general science. Very full references for further reading are given at the ends of the chapters. By the device of type of two different sizes the book has been made suitable both for the beginner and also for the more advanced student. W. B.

OUR BOOK SHELF.

The Art of the Goldsmith and Jeweller: a Treatise on the Manipulation of Gold in the Various Processes of Goldsmith's Work, and the Manufacture of Personal Ornaments, &c., &c., for the Use of Students and Practical Men. By T. B. Wigley, assisted by J. H. Stansbie. Second edition, revised and enlarged. Pp. xii+264. (London: C. Griffin and Co., Ltd., 1911.) Price 7*s.* 6*d.* net.

THE work of the goldsmith and the jeweller, like that of many other craftsmen, has undergone a striking change of late years. Formerly the goldsmith was an artist making his own designs, and working them out with infinite patience and cunning, but seldom finding himself bound down to routine. He served an apprenticeship and was taught the various branches of the craft. Now that vast quantities of cheap jewellery of all sorts are manufactured, largely by the use of machinery, the workmen, even if something more than mere machine-minders, are engaged on some one special branch and learn no other. Such a system, of course, threatens the artistic side with extinction, and the establishment of technical schools and the production of such books as this one under review, revealing the mysteries of the ancient craft, become a necessity.

Mr. Wigley, with his long experience as headmaster of the Jewellers' and Silversmiths' Association Technical School, has the advantage of knowing what teachers and students require, and has written a very useful book. It is not detailed enough for students without demonstrations, but for the same reason it would not be painfully tedious to practical men, and would be by no means out of place in the workshop.

Details, however, are not lacking. Students are warned against certain pitfalls with almost meticulous care. As an instance, there may be cited the remark on p. 36, in dealing with the preparation of gold alloys:—"In adding decimal quantities together it is important to keep the decimal points under each other." On the other hand, some workshop knowledge is assumed, as on p. 70, where we are told that a lathe may be used for "turning pillars and small fittings, milling bezels, knurling edges of stud backs, sawing off joints, &c.," none of these terms being explained.

The book does not give an accurate picture of the industry as it exists to-day, as it leaves out of account most of the labour-saving machines and large-scale manufacturing methods. Moreover, the artistic side is not so persuasively presented as in Wilson's "Silver Work and Jewellery," and little space is devoted to history, but the book seems exactly adapted for those preparing for the technological examinations of the City and Guilds of London Institute, and thus it thoroughly justifies its existence.

The Adventures of James Capen Adams, Mountaineer and Grizzly Bear Hunter of California. By Theodore H. Hittell. Pp. xiii+373. (London: T. Werner Laurie, n.d.) Price 6*s.* net.

As we learn from the introduction, this book has a somewhat remarkable history. It first saw the light at Boston, U.S.A., so long ago as 1860, but, on account of the breaking out of the civil war, only a comparatively small number of copies appear to have been issued, and its publication was soon discontinued altogether. The present issue is an exact replica of the original, and is thus out of date in the matter of typography and illustrations; indeed, in the case of the latter this is self-apparent, as they are in a distinctly "prehistoric" style. The remarkable history of the book is, however, by no means exhausted by the above, for Mr. T. H. Hittell, who took down the narrative from the lips of J. C. Adams in the autumn of 1856, is still alive, and has acted as editor of the present issue. In saying that the book is a replica of the original, it might have been mentioned that the introduction and a postscript are new. The latter gives an account of the last days of Adams, who joined Barnum's exhibition, and appears to have died soon after 1860, if not, indeed, at the close of that year.

Such interest as the book possesses for the naturalist is to be found in the circumstance that it relates to a period when the big-game fauna of North America still retained a considerable share of its original abundance; and it is specially noteworthy to find Adams describing how he once "rounded up" a herd of prongbuck (antelope), and actually killed some half-dozen with his knife. But Adams, although he had a try at game of every kind, appears to have devoted special attention to grisly bears, which he not only killed, but captured and tamed to such degree that they were used for carrying baggage on the march. The book is thus well worthy of the attention, not only of those devoted to sport, but also of those interested in animal-taming. R. L.

A New Law of Thought and its Logical Bearings. By E. E. Constance Jones. With a preface by Prof. Stout. Pp. viii+75. (Cambridge: University Press, 1911.) Price 2*s.* net.

MISS JONES'S object in this brief essay is to propound "a certain analysis of categorical propositions of the forms *S is P, S is not P,* to show that this is the only general analysis which it is possible to accept, and to indicate its bearing upon logical science." We need propositions of these forms for significant assertion, and without them no satisfactory statement can be given of the three fundamental laws of thought. The first two of these are commonly formulated as (1) *A is A,* (2) *A is not non-A,* and the third sometimes as *A is either A or non-A.* Desperate efforts have been made by logicians to give a valuable meaning to *A is A*; but if *A is A,* interpreted as *A is A,* is retained as the first fundamental law, there is no possible passage from it to *A is B.* Lotze therefore gives up (theoretically) *S is P. A is A* tells us no more than *A is A,* and if we begin with it, we must also end with it, if we are to be consistent. We must, then, not begin with it, but with a law of significant assertion—assertion of the forms *S is P, S is not P.* If we start with the principle that *every subject of predication is an identity (of denotation) in diversity (of intension)* this law and the laws of contradiction and excluded middle do furnish a real and adequate and obvious basis and starting point of "formal" logic.

Miss Jones illustrates and applies her contention in a concise but interesting way, and Prof. Stout thinks that she makes out her case.

Electricity in Locomotion: an Account of its Mechanism, its Achievements, and its Prospects. By Adam G. Whyte. Pp. vii+143. (Cambridge: University Press, 1911.) Price 1*s.* net.

THE author gives in a very concise form a brief history of the first tramways and railways, and proceeds to show how the development of electric tramways has taken place in spite of great opposition from the æsthetic point of view, and also from causes arising out of the Tramways Act of 1870. The various systems of electric traction are carefully considered and the advantages of each fully discussed. Further chapters deal with the trolley omnibus, accumulator, electric traction, and regenerative control. The causes of failure of the accumulator-driven vehicle are ade-

quately considered, and also the advantages of the trolley omnibus when acting as a feeder for electric tramways.

The latter part of the book is devoted to petrol-electric vehicles and electric railways, while a chapter is included which deals with electric traction curiosities. A full description is given of the system and working of the Metropolitan District Railway, the London, Brighton, and South Coast electrified line, and the "Underground" Tube combination and the other tubes.

With regard to the petrol-electric systems, some interesting facts are given dealing with its aspect with regard to marine propulsion as advocated by Messrs. Durtnell, Mavor, and others. The advantages of the system, if successfully applied to warships and liners, would be enormous, but at present it has not got very much beyond the experimental stages, though there is hope that it may prove its worth in the near future.

Finally, the monorail systems are described, together with some other general arrangements of self-contained generating stations on wheels, &c., making, with the previous chapters, an interesting summary of the history of electric traction from its commencement to the present day.

British Ferns: a Pocket "Help" for the Collector. By F. G. Heath. Pp. x+130. (London: Sir Isaac Pitman and Sons, Ltd., 1911.) Price 2*s.* net.

THE author's knowledge of fern species and their habitats has been manifested in previous publications, so that one is prepared to find this real pocket-book, measuring 6½ by 3¾ inches, a trustworthy and desirable acquisition when making an excursion in quest of ferns. Forty-five species are enumerated, but varieties with one exception are omitted. The descriptions are written primarily for the amateur collector, and serviceable assistance is provided in the illustrations. The information is tabulated under the headings frond length, description, usual habitat, and localities. The list of localities, given as fully as possible, represents an arduous piece of work. Certain introductory sections are prefixed, of which the two giving definitions and general habitats are most desirable and helpful, but the others are imaginative rather than scientific; it is not necessary to go beyond the statement that every point of the germ (sporeling) is equally ready to produce roots or a stem. Disregarding the first four sections, the book provides a compact, informative guide.

Aërial Locomotion. By E. H. Harper and A. Ferguson. With an introduction by Prof. G. H. Bryan, F.R.S. Pp. xii+164. (Cambridge: University Press, 1911.) Price 1*s.* net.

POPULAR handbooks on aërial navigation are now issuing from the press in a constant stream, and as their number grows the reviewer naturally judges of each new arrival by comparing it with its forerunners.

The exact public for which the little book under notice is intended is difficult to determine. The book is accurate, but it is dull; it is unattractive, and is poorly arranged. We cannot imagine the book being read for amusement, as the style is difficult to follow, or for information, owing to the absence of shoulder-notes, index, sectional arrangement, and other of the common aids to study.

Clarity of expression is lacking in very many places, while the sentence on p. 60, "If the elevator is carried normally in a different position during flight, all the conditions of flight are changed," is quite incomprehensible.

As has been said, the book is accurate, but it is scarcely calculated to attain its apparent object of interesting the public in the science of aëronautics.

Nature's Pageant: The Story of the Seasons. By Margaret Cameron. Pp. iv+120. (London: Blackie and Son, Ltd., 1911.) Price 1*s.*

THIS little book is an attempt to teach nature-study to children of seven years of age. They are supposed to read the simply-worded story, in which plants and animals talk, and to look at the pictures. In our judgment, nature-study lessons are of little value unless they are concerned with the observation of the objects themselves; and such attempts as are here given to combine information with imagination are not the best means of cultivating interest in literature or science.

Assaying and Metallurgical Analysis. For the Use of Students, Chemists, and Assayers. By E. L. Rhead and Prof. A. H. Sexton. Second edition. Pp. x+451. (London: Longmans, Green and Co., 1911.) Price 12*s.* 6*d.* net.

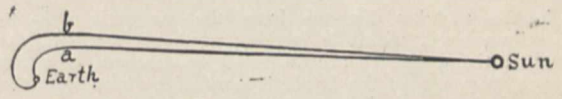
THE differences between this edition and the preceding one are not important. A few new methods are included, such as the determinations of copper and of iron by titanous chloride and the volumetric estimation of nickel by cyanide, but the text generally remains unchanged, and the merits and occasional defects of the book have not been modified. It is still one of the most useful works on the subject available.

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.*]

On the α-Ray Theory of Aurora Borealis.

IN a letter to NATURE of April 13 (vol. lxxxvi., p. 213) I gave reasons for the view that at least some of the forms of aurora borealis are caused by a type of rays which, as regards absorption by matter, follow the same law as α rays from radio-active substances. In the letter I also mentioned that the diurnal distribution of aurora apparently would require a negative charge of the rays.



My arguments which lead to a negative charge was based on the assumption that the simplest orbits, like that of (*a*), ought to occur more frequently than the more complicated, like that of (*b*), both of which are theoretically possible. This assumption, which indeed might seem legitimate, is not, however, a consequence of exact mathematical calculation, for the problem of finding the relative probability of the occurrence of the various possible orbits has not yet been solved.

Further, an exact determination of the diurnal distribution of aurora is made difficult through the effect of sun—and moonlight; but, even if we take it for granted that the aurora are most frequently found on the evening side, there is, so far as our present knowledge goes, no necessity for assuming a negative charge of the cosmic rays.

Moreover, the explanation of the thin drapery form, given by Störmer,[1] requires orbits like (*b*) having turned round the magnetic axis a great angle, and if such an orbit is going to strike on the evening side a *positive* charge is necessary. These matters will be more fully discussed in a subsequent paper.

There are some other points not mentioned in my previous note which are of considerable interest. In order to explain from the radiation theory the formation of thin drapery bands, a strictly homogeneous radiation is neces-

[1] Arch. des Sci. Phys. et Nat., 1907.

sary. Now we know that the α radiation given out during one radio-active transformation is, in fact, homogeneous.

A most peculiar property of aurora is the formation of parallel bands. It seems as if the bands were mutually connected in some way. When one band leads the others will form similar equidistant curves, and it is frequently observed that if one of the bands moves, the others will undertake a similar movement.

I think these most peculiar properties will be immediately understood if we assume each band to be produced by its own homogeneous radiation, and that the homogeneous radiations corresponding to the various bands start from the same source. If so, the various groups will be subject to the same conditions, with the exception that they will be slightly differently bent by the fields of force which they have to pass through on their way to the polar regions. If, therefore, one homogeneous bundle makes itself felt as a thin luminous band along the magnetic parallel, the rays from the other groups, having started under the same initial conditions, must give rise to bands similar in form, but with a difference in position, corresponding to the difference of stiffness of the various groups.[1]

Now the existence of homogeneous groups given out from the same source is a simple consequence of the α-ray hypothesis, because a number of different radio-active compounds will be formed through the atomic disintegration and eject groups of homogeneous α radiations.

In that way the auroral drapery bands should form a kind of *magnetic spectrum* of the α rays given out by some radio-active matter present at the sun. Thus a possibility opens out of studying and identifying the radio-active substances on the sun by examining the magnetic α-ray spectrum produced by the earth's magnetic field in the form of drapery bands.

In the following table is given the "magnetic auroral spectrum" of the radium family calculated on the assumption that the earth's magnetic field is that of an elementary magnet :—

Substance	$\phi_0 = 16{\cdot}5^\circ$ d. km.	S_d	$h = 120$ km. β °
Radium	0	 24	... ... 11·5
,, F	24	 15	... ... 7·2
,, emanation..	39	 25	... ... 11·9
,, A	64	 69	... ... 33·0
,, C	133		

ϕ_0 is the angular distance from the magnetic axis to the radium band, which is farthest north, h is the height to which the draperies are supposed to descend, d is the distance from one of the bands to that of radium, S is the distance in km. and β the angular distance between successive bands. The draperies are supposed to be seen near the zenith at the height $h = 120$ km. Any attempt at identification with actual observations is hardly possible with the material at my disposal, but such identification may be possible, *e.g.* through the development of the photographic methods. I think, however, that the values found are of the right order.

Summing up, I think we may say that, so far as our present knowledge goes, the properties of auroral drapery bands, and probably other forms of aurora, are well explained by assuming that they are caused by α rays from some radio-active substances on the sun. In order that the rays shall preserve homogeneity, it is necessary that the radio-active matter is distributed in extremely thin layers, and in such a way that the radiation gets out without traversing other kinds of matter.

The arguments in favour of the α-ray hypothesis are, in short, the following :—

(1) The straight-lined structure of the draperies is explained from the small scattering of α rays.

(2) The rapidity with which the luminosity stops at the bottom edge of the band is explained from the "range" of the α rays.

(3) The maximum intensity of the luminosity is explained from the variation of ionisation along the path of the α particle.

(4) The explanation from the radiation theory of the thin drapery bands is in favour of a positive charge, while the diurnal distribution of aurora gives at present very little information in this respect.

(5) The parallel drapery bands are explained from the fact that a mixture of radio-active substances formed by atomic disintegration gives out a mixture of homogeneous groups of α rays.

(6) Calculation of the height of aurora from the relation between velocity and range found by Bragg, Kleeman, and Geiger has shown that α rays with velocities of the same order as found for ordinary radio-active substances would get down to heights varying between 70 and 300 km., which is, indeed, the interval of height most frequently found for aurora.

(7) According to Störmer's calculations, the draperies, when formed by α rays, should appear at an angular distance of about 17° from the magnetic axis, which gives very nearly the right position of the auroral zone.

(8) Radiation of the β-ray type cannot explain the structure of the draperies on account of their great scattering, and being magnetically much softer than the α rays they do not give the right position of the auroral zone.

(9) The spectrum of aurora has not yet been interpreted in terms of spectra physically known. This negative result indicates that the auroral spectrum owes its peculiarities, not so much to the gases present as to the peculiar way in which the light is produced.

In my opinion the spectrum should be produced by α rays penetrating through the upper strata of the atmosphere. It might be possible for those who possess a sufficient quantity of radium to examine the spectrum produced when α rays pass through rarefied gases.

L. VEGARD.

University of Christiania, May 30.

[1] See Störmer's papers on corpuscular orbits.

Occurrence of a Fresh-water Medusa in Indian Streams.

DR. ANNANDALE'S interesting announcement, in NATURE of August 3, of the discovery of a fresh-water Medusa in streams of the Western Ghauts, emboldens me to mention that, at the beginning of the hot season of 1879 or 1880, I saw and handled one of these beautiful little creatures in the lake at Purulia, in Chota Nagpore.

This lake, as I remember it in those years—since when I have never had an opportunity of revisiting it—was a sheet of water of no very great size, and a maximum depth of about 24 feet, said to have been formed by damming the mouth of a wide and shallow ravine so as to catch and hold the ordinary surface drainage. Its flora and fauna were just those of an ordinary Indian "tank"; in the cold season it was used as a sort of port of call by wild-duck; and in the rainy season two little islets that rose above its waters became discordant and unfragrant nurseries of night-herons and snake-birds.

I caught the Medusa—there was only one—when taking my customary morning swim, and though I afterwards kept a look-out, I never saw another.

The few friends to whom I ever mentioned the matter always very politely changed the conversation; but Dr. Annandale's discovery now leads me to think that it might be worth while to look for medusæ in the pools of the Damuda, Subanrika, and Kasi Rivers, which run through Chota Nagpore on their way to the Bay of Bengal.

Heathlands, Belvedere, Kent. A. ALCOCK.

Interglacial Conditions in the South of England.

RECENT observations here through excavations connected with the opening up of the district have enabled me to appreciate the importance of the letter which appeared in NATURE (December 15, 1910, p. 206) from Mr. Hazzledine Warren on the "Arctic Plants from the Valley Gravels of the River Lea." He speaks of the evidence as leaving "no doubt that the Pleistocene age was closed by a partial return to glacial conditions, succeeding an epoch when temperate conditions prevailed." Reserving for the moment a discussion in any detail of the evidence now to hand in the upper Valley of the Stort (an affluent of the Lea), I merely wish, with your courtesy, to say now that the physical evidence bears out Mr. Warren's contention;

for we must, I think, recognise hereabouts a younger Boulder Clay as distinct from the "Chalky Boulder Clay" of the Herts and Essex plateau, along with interglacial deposits consisting largely of the outwashings of the older Boulder Clay.

It is easy to understand that a great latitudinal range of variations of climatic conditions in these lowland regions of south Britain would be necessarily contemporaneous with the more definitely marked *altitudinal* variations of the snow-line in the Alpine regions of Britain and Europe, whether from regional subsidence or otherwise. One may venture to say that we have here a record contemporaneous perhaps with that of the "Hessle Boulder Clay" or the "Purple Boulder Clay" (Brit. Mus. "Guide to the Stone Age," p. 8), and with the "Würm" (vierte Vergletscherung) of Alpine glaciation (Credner, "Geologie," tenth edition, p. 739); also Werth, *Globus*, Band xcvi., No. 15, p. 231).

A. IRVING.

Bishop's Stortford, August 9.

The Anti-kathodes of X-Ray Tubes.

THE special requirements to be fulfilled by materials adapted for use as anti-kathodes are somewhat exacting, and the range of such materials is therefore limited. It is, further, unfortunate that the platinum, tantalum, &c., are in general costly, and that the expense of X-ray tubes is hence, considering their life, high. In casting about for some means of avoiding this difficulty it has occurred to me that carborundum, a material now quite familiar as an abrasive, might be a suitable facing for the anti-kathode. Carborundum, being a product of the electric furnace, is exceedingly refractory; electrically it is a very bad conductor. Messrs. Helm have constructed for me a tube fitted with an anti-kathode from a square inch of carborundum grinding slip, and I have used this tube, so far as my limited laboratory means allow, with perfectly successful results. My coil is only of low power, and I have no means of making any comparative tests of a quantitative type. It seems likely, on theoretical grounds, that the emission from such a tube would be of low penetrative power, but, so far as I can judge, the tube does not seem to pass so readily into the hard condition.

My object in this letter is to bring this matter to the notice of others who are in a position to test the properties of carborundum as an anti-kathode material. If its radiation is of a low penetrative type, such a tube might have advantages in certain superficial treatments in electro-therapeutics, *e.g.* ringworm of the scalp, &c. I should be greatly interested in hearing of any experimental trial.

J. SCHOFIELD.

Technical School, Keighley.

The Action of Carbon Dioxide on Litmus.

I WRITE to direct attention to the inaccuracy of a common statement in elementary text-books describing the action on litmus of carbon dioxide in solution.

It is generally stated that the action of carbon dioxide is to turn litmus "wine red," while the fact is that carbon dioxide dissolved in distilled water turns neutral litmus red, just like any other acid.

The cause of the wine-red colour usually obtained is the presence of alkaline bicarbonates as impurities. That this is the case can be seen by adding a drop of ammonia or of sodium carbonate solution to the carbon dioxide solution, when the colour changes, first, from red to blue, and then, after an interval which depends on the amount of alkali added, to the wine red usually associated with the action. A weak solution of lime water acts similarly, and this would seem to give the genesis of the error, as if hard waters are used to make up the solutions the wine-red colour is produced.

The point may not be of the greatest consequence, but it does not seem to be generally known, and the columns of NATURE would seem to offer the best means of disseminating, to those whom it chiefly concerns, the knowledge of another "text-book" error.

M. M'CALLUM FAIRGRIEVE.

The Edinburgh Academy, July 26.

THE BUSHONGO: AN ETHNOGRAPHICAL STUDY OF THE CENTRAL CONGOLAND PEOPLES.[1]

IT is difficult to write an adequate review of this work, the result of Mr. Emil Torday's last expedition to central Congoland (1907–9), an expedition in which he was accompanied by Mr. M. W. Hilton-Simpson and a very clever painter, Mr. Norman H. Hardy. Mr. Torday has had the advantage of the collaboration of Mr. T. A. Joyce, of the British Museum and the Royal Anthropological Institute, and Mr. Joyce has been able to bring to bear on the compilation his exceptional knowledge of negro arts, implements, customs, religious beliefs, morals, laws, social life, games, songs, and folklore.

The water-colour drawings by Mr. Norman H. Hardy are, beyond all question, the best that have ever been executed so far in Negroland. They have the absolute fidelity of photographs, with at the same time an appreciation of composition and colour which makes them really works of art. Special instances to justify this praise are:—Plate 5, a masked dancer of the Bangongo (Fig. 1); plate 7, female dancers amongst the Bangongo; plate 8, a Bangongo embroideress; plate 9, a portrait of a Bangongo blacksmith; plate 11, Shika, a young girl of the Isambo tribe; plate 12, a young Bashilele man, with the profile of an ancient Egyptian (Fig. 2); and amongst the black-and-white drawings, plate 17, a study of a native engaged in the manufacture of vegetable salt (Fig. 3), together with certain interiors of houses. Three of the plates referred to are here reproduced in a reduced form.

FIG. 1.—A masked dancer of the Bangongo.

1 'Notes Ethnographiques sur les peuples communément appelés Bakuba, ainsi que sur les peuplades apparentées'. Les Bushongo." By E. Tordey and T. A. Joyce. Annales du Musée du Congo Belge. Publiées par la Ministère des Colonies. Ethnographie, Anthropologie—Série III: Documents Ethnographiques concernant les populations du Congo Belge. Tome II.—Fascicule I.—Coloured illustrations by Norman H. Hardy. Published by the Museum of the Belgian Congo, Brussels.

It must have been a subject of regret to Mr. Torday that Mr. Norman Hardy's health gave way, and that he was not able to remain with the rest of the party during the whole of the expedition. Otherwise, his album of absolutely truthful pictures of life and scenery in the heart of Congoland would have been even more complete than it is. Of course, the great part of the praise which critics may bestow on this splendid ethnographical work (which, I believe, is to be completed in a further volume), will be awarded to Mr. Emil Torday, who conceived the whole plan of the expedition, is exceptionally well versed in the study of the Negro, took the greater part of the photographs which so effectively illustrate this monograph on the central Congoland peoples, and has shown himself able for some ten or eleven

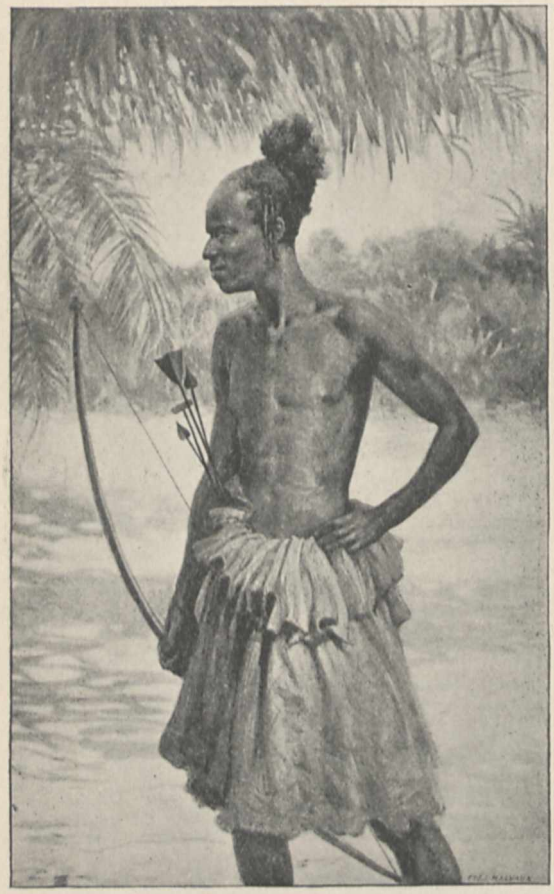


FIG. 2.—A young Bashilele man (with an "ancient Egyptian" profile.)

years past to penetrate remote parts of British Central Africa and of the Belgian Congo, where other Europeans would have found it dangerous and perhaps impossible to proceed, because they did not possess Mr. Torday's unique gift of discriminating sympathy with and understanding of the savage, the semi-savage, and the half-civilised negroid.

In the region more especially covered by this monograph on the Bushongo, a few great explorers, like Wissman, Wolf, von François, George Grenfell, and perhaps most notably the American missionary, Mr. S. P. Verner, have crossed Mr. Torday's paths, and owing to their writings we were not entirely ignorant of the existence of this remarkable "Bushongo" culture in central Congoland. The Bushongo—this seems a strange plural for a more or less Bantu people, but Mr. Torday is so accurate in other matters that we presume he has interpreted it correctly—were hitherto known as the Bakuba, and as such attracted markedly the attention of Grenfell and Verner. Mr. S. P. Verner, in a rather *décousu* book, which he published some years ago on his travels in Congoland, gave some very good descriptions of this aristocratic race or ruling caste, but it is possible that in his enthusiasm for them he somewhat exaggerated their physical approximation to non-Negro, Caucasian types. He made them out, apparently, to be lighter in skin-colour and more European in features than they are actually. Yet from Mr. Torday's photographs and Mr. Hardy's paintings one realises that there is some distinct infiltration of Caucasian strain in the Bushongo or Bakuba, and in such of the surrounding populations as those with whom they have mingled their blood. Livingstone noticed this more than sixty years ago in regard to the Baluba and

FIG. 3.—Native engaged in manufacture of vegetable salt.

Alunda, commenting repeatedly on their "Egyptian" profiles.

That the Bushongo brought with them at some unknown date an exotic culture into the heart of the Congo Basin, and that with their strain of Caucasian blood they further inspired the local negroes to evolve an art which in some respects is peculiar to central Congoland, cannot be open to doubt when all the facts and traditions collected by Mr. Torday are passed in review. At the present day the Bushongo speak a somewhat degraded Bantu language, much less purely Bantu than the beautiful speech of the Baluba, or than the Kongo tongue of western Congoland, or even the Bangala of the northern Congo. But in former times the speech of the ruling caste of the Bushongo was known as the Lumbila. This language ceased to be spoken about sixty years ago, but Mr. Torday was able to collect examples of it, and submit them to the writer of this review. These words of Lumbila

are repeated in the work in question alongside the degraded Bantu dialect now spoken by the Bushongo. It is at once evident that the Lumbila is not a Bantu language, though it undoubtedly possesses a few borrowed words of Bantu origin. So far as I have been able to compare the fragments of this tongue with other groups of African speech, I find the only clear indications of relationship to be with certain languages of the Shari Basin, and perhaps with that vague group of Sudanese tongues to which belong the non-Bantu languages of the Upper Mubangi. Mr. Torday points out on p. 43 that the Lumbila name for river is Chari (in modern Bushongo, Nchale), which certainly recalls the widespread term for lake or river which we find in Shari, Chade, Chada (both of them terms for Lake Chad and for the River Benue).

I have pointed out in my own work on "George Green and the Congo," that this central Sudan word for a great water has penetrated far into the Congo Basin, reappearing in the name Nzadi, often applied to the western Congo, and the Portuguese Zaire. According to tradition, when the Bushongo arrived in central Congoland from their northern home they were a naked people, accustomed to eat durra corn and other millet-like grains unknown to the forest regions. Their ancient nudity would ally them more to the central Sudan and Nilotic peoples, for, strange to say, however barbarous and savage may be all the peoples of Congoland, even the Pygmies, absolute nudity in the male is almost unheard of, and is reprehended. The word Bushongo, according to Mr. Torday, means the people of the "Shongo," and "Shongo" is apparently the name for the iron throwing-knife, which was brought by the Bushongo with them in their immigration, and which only pentrates into the more northern half of Congoland. This throwing-knife in its origin is only a modification of the wooden boomerang, and in its metal form seems to have originated in the Tibesti Mountains. Indeed, there is a good deal in the work under review, as well as in the reviewer's own researches, which tends to indicate a direct southward migration into the heart of Congoland from Kanem and Tibesti; and it is probable that from this direction comes the slight Caucasian infiltration of blood, which, as the Tibesti region of the negroid Teda or Tibu peoples, was probably Caucasianised from the direction of ancient Egypt, would explain the striking outcrop of Pharaonic face outlines occurring and recurring ever and again amongst the more aristocratic types in central and southern Congoland outside the great forests.

According to a Bushongo tradition, the first chiefs of the Bushongo (who are at present settled between the Sankuru and the Kasai) were white or semi-white, but the term white is constantly applied by the negroes to races of pale-yellow or reddish skin, like the Arabs and the Fula. Mr. Torday thinks that the southward march of the Bushongo may have been part of the same series of racial convulsions as the invasion of northernmost Congoland by the Azande (Nyam-nyam). The Bangongo and Bangende tribes, nowadays so much affiliated with the Bushongo, would seem traditionally to have arisen from a mingling north of the Sankuru River between the invading Bushongo and the pre-existing Basongo-meno, and there is obviously a relationship between the Bushongo and the Bashilele, and even an infiltration of Bushongo elements (the reviewer would add) amongst the Baluba and Alunda. Perhaps even the civilisation of the old Kingdom of Kongo, founded by a legendary hunter named Kongo, may have a Bushongo origin. It is interesting to note that a totally different Bakongo people exists in the vicinity of the Bushongo territory in central Congoland, several hundred miles separated from the better-known Bakongo of the region between the Crystal Mountains and the Atlantic Ocean. The original word Kongo seems to have meant a metal spear, and consequently a hunter, and may even be related to the term Shongo, applied to the throwing-knife.

An interesting point made by Mr. Torday was the apparent establishment of the fact that when the pygmy Batwa, of the dense forests, have been established for some generations outside these forests in the open country under the protection of the Bushongo, their stature sensibly increased, so that at last their descendants were indistinguishable in physique from the other short-legged, long-armed, prognathous forest negroes of nearly normal stature.

In a succession of chapters after the first (which deals with the origin and relationships of the Bushongo) is given a full account of the elaborate government and administration of justice amongst the Bushongo and allied peoples. The long list of court functionaries reminds one of Uganda and other equatorial African kingdoms. The social life of the Bushongo, their morality (which in some respects is very high—see the admirable moral precepts set forth on pp. 85–6), their ideas of property and inheritance, commerce, sports, dances, warfare, distinctions of relationship, and forbidden degrees of affinity in marriage, their sexual life, religion, magic, funeral customs, industries, and arts, domestic animals, agriculture, building, costume, mutilation, skin decoration (tattooing), folklore, and languages are fully described and illustrated. A great deal of space is given up to the description of the really wonderful arts and industries of the Bushongo and allied peoples—their wood-carving and their beautiful woven cloths, their metal-work (very elaborate), and pottery. The linguistic information concerning the Bushongo, Bakongo, Bangongo, Bangendi, and Basongo-meno languages, will be of great interest to students of the Bantu family. This work is, in short, splendidly complete, with one exception. It is ethnological rather than anthropological, and it would have been additionally interesting if Mr. Torday had been able to include photographs of the many types of skull that he has collected, and other pictures, measurements, and descriptions, showing more clearly the physical conformation of the various peoples he has otherwise described so minutely. From the various numerous photographs and pictures one is able to deduce to some extent what is not actually described in words—namely, the physical features of these races of central Congoland; and it is interesting to note here and there a type of physiognomy occurring which is also met with on the northern Congo and in the central Sudan, namely, quite a Caucasian type of face amongst the men, with a fairly abundant growth of beard and moustache, very bushy head-hair (except where this has been removed artificially), and little of the negro but the dark skin. H. H. JOHNSTON.

THE FRENCH ANTARCTIC EXPEDITION.[1]

ONE of the problems of most far-reaching importance in the Antarctic is the nature of the southern border of the Pacific, for while we remain in complete ignorance of its structure no theory of the formation of the Pacific, the greatest geographical unit on the globe, can be more than a provisional hypothesis.

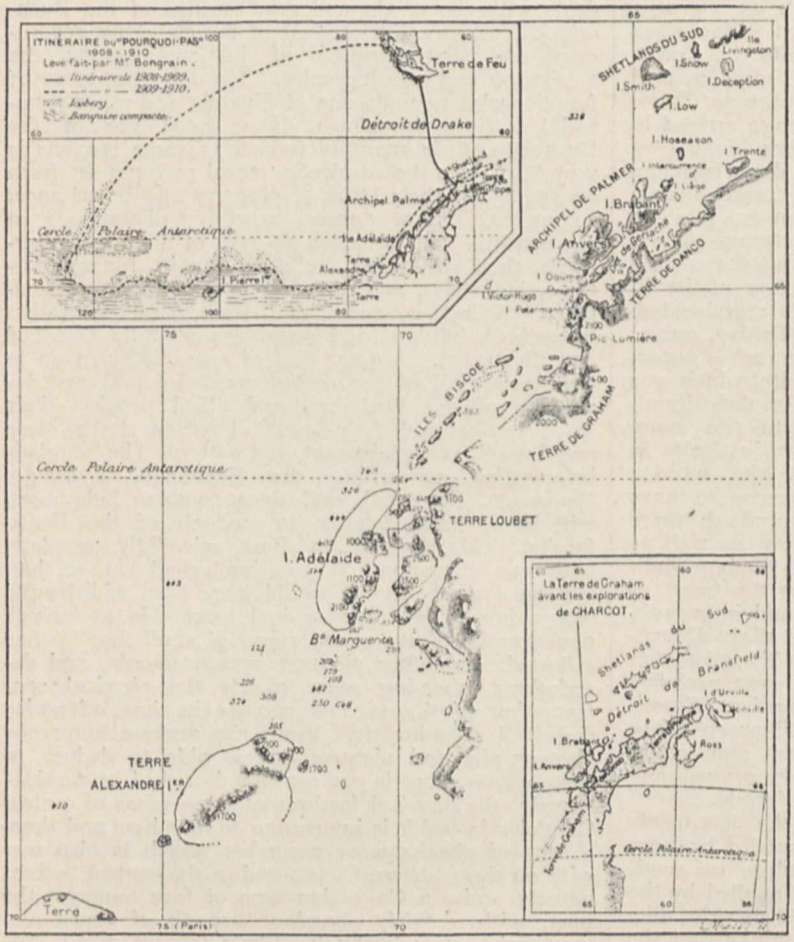
Cook's description of his view from his furthest south in the Southern Pacific suggests that he had

[1] Institut de France: Académie des Sciences. Rapports Préliminaires sur les Travaux exécutés dans l'Antarctique par la Mission commandée par M. le Dr. Charcot de 1908 à 1910. Pp. x + 104. (Paris: Gauthier-Villars, 1910).

reached the margin of an ice-clad land; but as he thought otherwise it would be rash to lay stress upon a different interpretation of the facts he described. The best clues as to the southern border of the Pacific have been obtained from Graham Land; but though the recent expeditions in that area have revealed the structure and character of the South Shetlands and of the north-western part of Graham Land, there has been no modern extension of geographical knowledge far to the south-west. The Peter I. Land of Bellingshausen, and the Adelaide Island of that stout-hearted whaler Bisco, remained the only sure evidence of the westward extension of the land.

Geographers accordingly waited with keen interest the return of Dr. Charcot's expedition, which forced its way for more than 50° westward into the unknown. A preliminary report of the results has been issued by the French Academy of Sciences, prefaced by a short summary by Prof. Joubin, of the Oceanographic Institute. Dr. Charcot describes the general course of the expedition. It left Punta Arenas, in Patagonia, on the *Pourquoi-Pas?*, on December 10, 1908. It spent the first summer in geographical and other work in Graham Land, to the west of the region so well explored by the Belgian and Swedish expeditions. It wintered on Petermann Island, one of the islands of the Palmer Archipelago, at the south-western end of Gerlache Strait. At the close of the winter it returned for stores to Deception Island, one of the South Shetlands, and was there generously supplied with coal by whalers of the "Sociedad ballenera Magellanes." The expedition thence started south-westward, and, passing Graham Land, pushed westward into the South Pacific. It passed to the north of Peter Island, and kept along the latitude of about 70° S. from 72° W. to 124° W. The end of the season and the approaching exhaustion of supplies compelled the badly damaged *Pourquoi-Pas?* to return to South America.

Dr. Charcot describes the western lands he explored as penetrated by a network of fiords filled with ice. The most important of the new lands explored is a group of islands which he calls Alexandra I. Land. Still further into the unknown he saw another land which he has left unnamed.



Course of the French Antarctic Expedition.

The results of the hydrographic, pendulum, astronomical and seismographic observations are summarised by M. Bongrain. The preliminary conclusions from the determinations of gravity at five localities differ somewhat from the theoretical results from Helmert's formula. The seismographic observations made on Deception Island are said to promise interesting results; the instruments recorded seismic storms at the winter quarters in March and September, 1909.

M. R. Godfrey contributes a report on the tidal observations, coastal hydrography, and the chemistry of the air; careful determinations of the nitrates and ammonia in the air were prepared at winter quarters. A short account of the observations on meteorology, oceanography, and atmospheric electricity is given by M. M. Rouch. The meteorological instruments were read every four hours, or more often while the ship was at sea or when more detailed records seemed desirable. The work on terrestrial magnetism and actinometry was undertaken by M. Senouque, who determined the magnetic elements at four stations—Deception, Petermann, and Jenny Islands, and Matha Bay. Dr. Gourdon describes the geological observations; he found no sedimentary rocks or fossils, but widespread igneous rocks similar to those previously recorded from the lands to the north-east. M. Jacque Liouville gives a summary of the zoological log of the expedition, which shows that a most valuable collection was made. Especial attention seems to have been devoted to parasitic zoology. The results of the dredgings during the summer voyage are described as having been very fruitful. M. Gain, the botanist, had a very limited field of work open to him on land, where he found some lichens, mosses, and the grass *Aira antarctica*; the plankton promises a rich harvest from the sea, while on shore M. Gain worked at bacteriology, and has brought back sealed preparations of fæcal matter for culture in Europe. By tying coloured badges upon some of the birds he was able to show that they not only returned to the same rookery, but to the very same part of it.

The results of most general interest were gained in the voyage into the South Pacific. The first impression is one of regret that the expedition could not follow the land in that direction, but the thick ice

kept the *Pourquoi-Pas?* too far to the north. The ice conditions suggest that there is land not far to the south behind the ice-packed sea. The work in south-western Graham Land is unquestionably of great importance. Adelaide Island is much larger than its discoverer, Bisco, thought, but Graham Land, instead of extending south-westward as a continuous land, breaks up into an archipelago, or makes a sharp bend to the south-east. The lands explored clearly belong to a volcanic Andean chain, of which the coast has been penetrated by a network of fiords; but owing to the inaccessibility of the land, its composition remains less known than its distribution.

The results of the Charcot expedition suggest that Graham Land either breaks up south-westward into an archipelago, or that in the neighbourhood of Adelaide Island it curves sharply southward, corresponding to the northward curve of South America on the opposite side of Drake's Strait. Dr. Charcot's expedition, therefore, adds fresh interest to the problem of Graham Land. All interested in Antarctic research will join in Prof. Joubin's hope that the necessary funds will be provided for the full publication of these important additions to Antarctic knowledge. J. W. G.

TUBERCULOSIS AND THE MILK SUPPLY.

ON the publication of the final report of the Royal Commission on Tuberculosis the view was frequently expressed that those in authority ought, long ago, to have taken precautions against the dangers arising out of the use of milk containing tubercle bacilli. To those who have followed the matter carefully this scarcely seems to be a very rational position to assume, as, up to the publication of this report, Koch's dictum, backed by the authority of his enormous prestige, held the field. It is now recognised that Koch's pronouncement on this question was the cause of the difficulties that arose immediately after he had spoken at the London Tuberculosis Congress, and there can be little doubt that these difficulties, then foreseen, led the executive of the congress to insist so strongly on the appointment of a Royal Commission. It was evident that inspection, the use of tuberculin, the destruction of tuberculous cattle, might all be ruled out as unnecessary, if Koch's thesis that there was no danger from the presence of the tubercle bacillus was to be accepted.

Now, however, that the commissioners have reported, and in no uncertain voice, that tuberculosis, especially in the child, may be the result of infection with tubercle bacilli conveyed in the cow's milk, it is essential that the question of regulations relating to milk and meat supply should be carefully reconsidered, and that, as the commissioners put it, "Government should cause to be enforced throughout the kingdom food regulations, planned to afford better security against the infection of human beings through the medium of articles of diet derived from tuberculous animals." Also that the supply of milk from a "recognisably tuberculous cow, irrespective of the site of the disease, whether in the udder or in the internal organs, should be prohibited," as the commission has demonstrated that infection of milk may take place, not through the udder merely, but by channels through which such infection has not hitherto been followed.

This report alters entirely the whole aspect of affairs. The President of the Local Government Board is now in a very strong position as regards the tuberculosis order issued in 1909, and his own Milk Bill already drafted. Indeed, the conditions are so far changed that it is absolutely necessary that some steps should be taken at as early a date as possible to ensure the passage of legislative measures dealing with the protection and improvement of the milk supply. Hurried or "panic" legislation would, however, be unwise; a careful consideration of the whole position is necessary. On one hand are the interests of the consumer, which, in this instance, must be looked upon as of paramount importance; whilst on the other the great financial interests of the cattle breeders and dairy owners (though of secondary importance) must be considered.

In the tuberculosis order issued in 1909, but not yet brought into force, it is enacted that every person having in his possession, or under his charge, (1) any cow which has, or appears to be suffering from, tuberculosis of the udder, indurated udder, or other chronic disease of the udder, or (2) any bovine animal which is, or appears to be, emaciated from tuberculosis, shall give notice to a constable of the police force. The local authority shall then cause to be made a veterinary examination of the suspected animal, and the milk from such animal shall be kept separate and shall be boiled or sterilised. If the animal is found to be tuberculous, the local authority shall notify the owner that it is to be slaughtered. Moreover, if the owner objects, special authority must be obtained from the Board of Agriculture to slaughter.

So much for the animals themselves; and, after all, this is the point at which the question should be attacked in the first instance. It is evident, however, that until considerable advances have been made along the above lines, milk containing tubercle bacilli will still find its way into our milkshops and dairies, and regulations at least as stringent or more searching than those already in force will have to be devised in order to protect customers against milk coming from tuberculous cattle. Inspection and biological examination will, for some time, be essential, and certainly should not be neglected, as in these, probably, we have the only effective means of safeguarding the milk supply against infection from tuberculosis. It may confidently be anticipated that those in authority have already under consideration these and other points, to be attended to and included in any new measure to be brought forward.

The question of compensation is one of considerable difficulty and delicacy. How is the honest trader to be protected without at the same time making it easy for those not quite so honest to benefit at his expense? It is suggested in the tuberculosis order of 1909 that if the animal after slaughtering does not show that it was suffering from tuberculosis, full compensation as agreed shall be paid, along with a further sum of twenty shillings. If the animal is found to be suffering from tuberculosis (not being advanced tuberculosis), three-fourths of the value as agreed shall be paid, one-half of the cost of valuation being deducted. If, however, the animal is suffering from advanced tuberculosis, one-fourth of the value shall be paid, or the sum of two pounds, whichever is the greater, one-half of the cost of valuation still being deducted. It is further ordered that all suspected animals shall be isolated at once and until seen by veterinary surgeons, whilst disinfecting and cleansing shall be carried out at the expense of the owner on all premises where tuberculous animals are found.

Then, of course, the question arises, From what source shall the compensation be made? Abroad, compensation has been paid out of an insurance fund to which various authorities and individuals make contributions. The seller of the animal, the buyer, the municipality, and even the State are, in various places, put under contribution, and in a case of this kind it certainly seems reasonable that there should be some such cooperation. The farmer who sells his cattle

should be prepared to pay something towards a fund that shall indemnify him for any loss that may result from the presence of tuberculosis amongst his animals. The milk dealer or butcher who runs the risk of buying a tuberculous animal, and thus of having to pay more for the food of the animal during life and of receiving a less price for the carcase after death, should be equally prepared to pay towards an insurance scheme. (Butchers' insurance associations—voluntary—have already been founded in this country.) The ratepayer, through the municipality, owes something to any scheme that protects him and his children from the dangers associated with the consumption of tuberculous milk, and even of tuberculous meat, whilst the State may well be called upon to contribute its quota towards the protection of the child, the young adult, or, in some cases, even the adults of more mature years, against the ravages of tuberculosis, one of the great factors in bringing about the diminution in the wage-earning power of the worker in the State. The whole question is no doubt now under careful consideration, and whilst it is inadvisable to press for any measures that have not been carefully considered, it must be urged that there shall be no unnecessary delay in bringing forward a Bill and putting into force a measure for the improvement of our milk supply and the protection of the consumer against infection, the reality of which has been so amply demonstrated by the Royal Commission.

SCIENTIFIC WORK IN INDIA.[1]

IN any large organisation a certain amount of subdivision is necessary to ensure economy in working, even though this may conduce to a want of connection and cooperation between the departments so formed; and when their work lies in scientific and technical fields the inevitable specialisation is likely to accentuate the evil of any such lack of cooperation, and lessen the advantages derived from the work in each. In India the Board of Scientific Advice was formed a few years ago in order that by its aid the scientific resources of the Government of India might be organised to the best advantage and their efforts concentrated on the solution of the problems which were the most urgent.

The Board held its eighteenth and nineteenth meetings in 1910, and the report for the year 1909–10 has just been published, in which contributions from the different services and departments are restricted to the scientific work coming under the various headings of the report, and do not deal with matters of departmental administration or detail. We have in consequence, within a compass of two hundred pages, a valuable summary of scientific work in India for the period under review, so far as it is covered by the departments which contribute to this report. In industrial and agricultural chemistry the work done has resulted in much knowledge gained of indigenous products and their technical applications. Reference is made to the report of a committee, appointed by the Asiatic Society of Bengal, on the adoption of a temperature of reference suitable for India, in which the temperature of 30° C. is recommended. This matter has been referred to the Royal Society for submission to the International Association of Academies in order that other countries in tropical regions may express their opinions.

The water requirements of crops have been investigated in continuation of work which has been in hand for several years, and the results are about to be published. This work and field tests at Cawnpore and Pusa have shown how great the value would be of an accurate method of determining the quantity of water which can move through soils under the influence of surface tension. Cottonseed oil was investigated in order to ascertain whether the acridity of the Indian oil could not be economically removed, and a large number of natural products were studied with a view to improving the final product. A large amount of observational work in solar physics was carried out, and advantage was taken of Halley's comet being favourably situated in April and May, 1910, to photograph the comet and its spectrum. In meteorology Mr. Field's experimental work with recording balloons resulted in more than half of the seventeen sent up in the monsoon season being recovered, but only one of those liberated in December was regained. In the present year, following that of the report, it is proposed to liberate two recording balloons weekly at Jhang in the Punjab, and to continue the search for relationships between the seasonal variations of weather in different parts of the earth, which has already produced instructive results.

In terrestrial magnetism a survey of the Andaman and Nicobar Islands is proposed as the work of the following year. Some of the geological work referred to has already appeared in the publications of the department, and an exhaustive memoir on the Triassic rocks of the Himalaya by Dr. C. Diener is about to appear. The map of the Raniganj coalfield has been revised, and much additional information relating to the underground correlation of the coal seams has been gained. Reports of coal in Sikkim were proved to be baseless, the rock being but a black carbonaceous shale greatly crushed. Advice on such matters as the suitability of building sites, irrigation dam sites, sources of suitable road metal, and the prospect of increasing a subsoil water supply by deeper boring was widely given.

In geodetic work operations were carried out in northern Baluchistan, Kashmir, and in Upper Burma on the lines of former years, but an innovation is the employment of secondary triangulation with 8-inch micrometer theodolites to fill in between the principal series instead of the third order network, which has hitherto been used. This improved grade of work will furnish permanent stations for the control of the periodic re-surveys which become increasingly necessary, and which are often required to be on larger scales than in the past. Gravity work was directed to testing the suitability of Hayford's method to the results obtained in India, and so far as work has gone his correction serves to intensify the anomalies in regions like the Indo-Gangetic plain.

In botanical survey work on the catalogue of the non-herbaceous flowering plants cultivated in the Royal Botanic Garden has been continued, the numerical index of the first 4000 plants being completed, and another 4000 being in the press. From Burma and southern India large accessions of material have been received by the Calcutta herbarium. Economic botany records a large amount of work done on the improvement of the wheat crop, not only in the field, but investigation has been carried into the mill and the bakehouse. The questions involved are of the greatest importance, and the results already obtained are of great value. Mycological studies of various plant diseases of tea in Darjeeling, of palms in Madras, of sugar in the Godaveri delta, are all instances of the value of scientific research suitably directed and coordinated.

The whole report presents a valuable survey of the application of science to many problems related

[1] Annual Report of the Board of Scientific Advice for India for the Year 1909–10. Pp. iv+210. (Calcutta: Government Printing Office, 1911.) Price R. 1 or 1*s.* 6*d.*

directly or indirectly to the inhabitants of India, and shows how much is gained by effective organisation and cooperation. We could wish that similar co-operation of scientific and technical work existed in all regions, as it already does in some, since it not only favours efficiency and economy, but also provides a useful summary of results obtained, which are often hidden in the administrative detail and statistics of an annual progress report, though they may appear subsequently in a detailed publication.

EARTHQUAKE STUDIES.

THE last two bulletins of the Imperial Earthquake Investigation Committee (vol. iv., No. 2, and vol. v., No. 1) are each from the pen of Dr. F. Omori.

The first relates to the vibrations of railway-bridge piers and trusses. The period of transverse and longitudinal vibrations of piers 82 feet in height was found to be from 0·2 to 0·4 second. As this is much shorter than that of a destructive earthquake which is from 1 to 1·5 seconds, the inference is that in a great earthquake these piers would be expected to fracture at their base.

The second memoir deals with the eruption of Mount Usu, in Yezo. This began at the end of July, 1910, and resulted, amongst other things, in the formation of about fifty craterlets parallel to a lake shore. The highest of these was about 700 feet. As these were formed, not only did the shore of the lake rise, but there was a rapid upheaval of ground to form a new mountain. This approximately reached to the same height as that of the craterlets, when its growth suddenly ceased. A curve of barometric pressure and another of earthquake frequency in the vicinity of the mountain, but prior to its eruption, shows that premonitory shocks began when atmospheric pressure was least, and that the first volcanic explosion occurred when it was at a maximum. The frequency of volcanic after-shocks does not appear to have followed that which is usually followed by the after-shocks of a large earthquake. Dr. Omori points out that there are many instances in Japan where volcanic eruptions have been preceded by numerous earthquake shocks and "jinaris" (earth-sounds). Whenever this is the case, tromometer and seismograph observations should give warning of an approaching outburst.

J. MILNE.

FIG. 1.—The Craterlets Group opposite the New Mountain, seen from the east. The cone at the extreme left end is the "Taka-Ana," and that at the right side is the "Fuji-Yama." To the right-hand side of the figure is shown the inside, or the dislocation plane, of the "New Mountain."

FIG. 2.—General view of Usu-san from the north-east. The Usu dome rises at the left-hand side with the E. Maru-yama at its right base. The "New Mountain" is at the right side of the figure.

THE LIBRARY AND THE SPECIALIST.

THIS is the age of the specialist. There is scarcely any branch of science in a review of which it would be inappropriate to remark that "the literature of this important section of the subdivision to which we allude is already assuming enormous dimensions." The published mass of scientific research is accumulating in ever-increasing volume. The investigator, especially when the circumstances of his life are such that he lives remote from intellectual centres, is generally exposed to the danger of working either along lines inferior to those already followed by predecessors in the same field, or in a direction which has been shown to lead to barren results. During his hard-earned leisure he may have been spending his energies upon work of research, only to discover at a later stage that he has been anticipated. The philosopher will murmur, "Comme les beaux esprits se recontrent!" The man of modest temperament will say resignedly, with one of Hermite's correspondents, "Je suis prédestiné, semble-t-il, à découvrir des théorèmes connus!" More ordinary mortals will exclaim, each with his own degree of vehemence: "Pereant illi qui ante nos nostra dixerunt!" In each case time has been wasted, and it may be that science has suffered.

De Morgan has somewhere said that the history of science is in the main the history of books and manuscripts. If this were true in the days of that accomplished bibliographer, to whose untiring efforts the student of the history of mathematics in the 'forties and 'fifties of last century was so profoundly indebted, it is even more so now if we consider the cosmopolitan character of the development in every department of intellectual activity. It is becoming more and more imperative that the work of investigators in any branch of science shall not be impeded by causes which, by a mere effort of cooperation, may be effectually and for all time removed. The organisation of scientific research has of late years been the text for many sermons from the leaders of opinion, and the problem of its most effective promotion is slowly and surely assuming that ultimate form which will secure the solution. We wish to direct attention to what some may consider a minor detail, but as it concerns the working specialist—and he is not always articulate—we make no apology for bringing once more to the front the relations between the libraries of the country and the investigator.

In NATURE (Feb. 15, 1906, p. 372) we referred to a paper published by Dr. Muir in the Proc. Roy. Soc. Edinburgh (Dec. 18, 1905), in which the historian of determinants indicated his reasons for the belief that "under existing circumstances mathematical research can only be pursued in Scotland with difficulty and uncertainty, and that research in mathematical *history* is practically an impossibility. . . . There can be little doubt that other subjects are in as bad a plight, and that the whole question of library aid is worth serious and prompt attention from all scentific men." In the current number of the *Quarterly Journal of Pure and Applied Mathematics*, on presenting his "Fifth List of Writings on Determinants," Dr. Muir returns to the charge, and laments that practically nothing has been done in the way of improvement, so far as London is concerned, for the last five years. He finds that the large *general* libraries—*e.g.* those of the British Museum, the Royal Society, South Kensington, University College, &c.—are "surprisingly well supplied with mathematical works and are reliably cared for." On the other hand, there is "no self-sufficient reference-library for mathematicians," and "the libraries that have a partial mathematical equipment are as far as ever from entering into cordial cooperation with one another for the purpose of providing a reasonable substitute." The library of the London Mathematical Society is "poorly housed, poorly cared for," and "has many of its serials imperfect." The library of the Mathematical Association is practically valueless, has no home of its own, and does not even possess a printed catalogue, though this blemish, we understand, is to be remedied. In all cases the main faults are redundancy and deficiency. One great failing is the imperfection and even the absence of series of mathematical periodicals. For instance, the only sets to be found in the country of recent volumes of the *Periodico di Matematico* with its supplements, of the *Journal de Mathématiques Spéciales et Elémentaires*, of the *American Mathematical Monthly*, *L'Intermédiaire des Mathématiciens*, and *Wiskundig Tydschrift* were after some search discovered in the hands of a private individual. As for the *Monatshefte*, *Rivista di Fis. Mat.*, &c., and *Math. is Phys. Lapok*, Dr. Muir had, we are inclined to think, to make a pilgrimage to the Continent to consult them for his purpose.

This is a state of affairs that is little to our credit. Surely the time has come to remove these impediments in the way of the working specialist! Until we possess a "self-sufficient" mathematical reference library it ought to be possible to do something to the point by proper cooperation between our libraries, general or otherwise. To diminish duplicates by exchange or gift, to complete imperfect sets of serials, to keep on hand an up-to-date list of serials in which they are deficient, with a list of the libraries where they may be found—this is the least that each library ought to do, and if the matter were properly organised it might be done in a few months, so far as mathematics is concerned. The longer it is delayed, the more difficult will it become to place within reach of the working specialist the mere tools of his trade. There is little doubt that in other branches of science than mathematics there will be many who will bless Dr. Muir for thus directing attention to this serious blot upon our *organisation* of scientific research. The matter appeals to all who are interested in the advancement of science. Miserably inadequate as are the funds at the disposal of the British Association for that object, we cannot help feeling that here at any rate a small grant in aid would be well spent, and would be productive of fruitful results.

FLIES AS CARRIERS OF INFECTION.[1]

THIS report contains further work on the importance of flies in the conveyance of disease parasites.

The first report, by Dr. Copeman, Mr. Howlett, and Mr. Merriman, deals with the range of flight of flies. In July last year Postwick, a small village five miles east of Norwich, experienced a plague of flies. No special conditions existed in the village for the breeding of the flies, and attention was directed to a refuse depôt about half a mile distant. The opportunity was taken to ascertain to what distance flies may travel and whether the flies in Postwick were derived from this refuse heap, and, if so, whether the flies were merely attracted to it from the surrounding country or whether they were distributed from it as a breeding centre. For this purpose flies were caught in various localities, marked by being shaken with coloured chalk powder, and liberated; subsequently some of the flies were recaptured. The experiments showed that the flies were distributed from the refuse

[1] Further Reports (No. 4) on Flies as Carriers of Infection. Reports to the Local Government Board on Public Health and Medical Subjects. (New Series, No. 53.)

heap as a breeding centre, and that they may travel as far as 1,408 yards from the place of liberation.

Mr. E. E. Austin contributes the second memorandum on the species of flies present at Postwick; the great majority consisted of the common house-fly. The part played by flies in the dispersal of the eggs of parasitic worms is the subject of the third report, by Dr. William Nicoll. Many experiments were performed, and it is shown that the ova of several worms may be conveyed by flies, the ova in some cases being ingested, in others merely sticking to the surface of the body. Those adhering to the body are generally got rid of within a short time, but when ingested they may remain for two days or more in the intestine. The habit of flies of feeding in turn on excrementitious material and on human foodstuffs obviously suggests that house-flies may play a part in the dissemination of infection of parasitic worms. Dr. Graham-Smith describes further observations on the distribution of bacterial infections by house-flies and blow-flies. It is definitely shown that both are capable of infecting fluids, such as milk and syrup, on which they feed and into which they fall. With house-flies gross infection may be produced for at least three days, and a smaller degree of infection for ten days or more. Blow-flies may carry the infection longer—up to three or four weeks.

The reports, in addition to the observations recorded, contain summaries of previous work on the subjects with which they deal, and form valuable contributions. R. T. H.

NOTES.

CONSIDERABLE progress has now been made with the arrangements in connection with the forthcoming meeting of the British Association at Portsmouth. Suitable meeting rooms have been found for nearly all the sections within about seven minutes' walk of the reception room. The programme of entertainments and excursions promises to be very attractive, and includes a naval display at Whale Island, steamer trips and coach drives in the Isle of Wight and in the South Downs, where visits will be made to Arundel Castle, Goodwood House, West Dean Park, and Parham Park. The following corresponding members and foreign representatives have announced their intention to attend the meeting:—Prof. Cleveland Abbe, U.S. Weather Bureau, Washington; Prof. Carl Barus, Brown University, Providence R.I., U.S.A.; M. A. Gobert, Brussels; Prof. A. A. Michelson, The University, Chicago, U.S.A.; Prof. W. Ostwald, Leipzig; Prof. Otto Pettersson, Stockholm; Prof. F. W. Clarke, U.S. Geological Survey, Washington; Prof. W. J. Humphreys, Mount Weather, Va.; Prof. H. Freundlich, Leipzig; Prof. Albin Haller, Paris; Prof. E. J. Cohen, Utrecht; Prof. R. Wegscheider, Vienna; Prof. Hans von Euler, Stockholm; Prof. P. Zeeman, Amsterdam; Prof. J. W. Spencer, Washington; Prof. Caullery, Paris; Dr. Johan Schmidt, Copenhagen; Dr. P. P. E. Hoek, Haarlem; Prof. H. Jungerson, Copenhagen; M. Chas. Lallemand, Paris; Dr. F. Graebner, Cologne; Prof. H. Webster, Nebraska; Dr. A. Goldenweiser, Columbia University, Missouri; M. A. van Gennep, Seine; Prof. N. Zuntz, Berlin; Prof. Behal, Paris; Prof. H. J. Hamburger, Gröningen; Prof. H. C. Cowles; and Prof. A. A. Noyes.

THE drought and excessive temperature of the present summer continues with great persistence, and if it had not been for the rains which fell generally over the country during the latter half of June, the season would have been practically rainless. The dry weather has embraced nearly the whole of England, although probably it has been most pronounced in the Midland and south-eastern districts, where the aggregate rainfall so far for the summer is only about 50 per cent. of the average. In Scotland and Ireland occasional rains have fallen, as shallow disturbances have skirted our northern and western coasts on their passage from the Atlantic. At Greenwich the aggregate rainfall since the commencement of July only amounts to 0·32 inch. The absence of cloud has resulted in an abnormal amount of sunshine, and the rays of the sun have been exceptionally fierce, and on at least three occasions this summer the black bulb thermometer at Greenwich has exceeded 161°. In the south-east of England the duration of bright sunshine for the first ten weeks of summer was 668 hours, which is 184 hours more than the average. The shade temperature has exceeded 80° at Greenwich on thirty days between July 1 and August 14, and 90° has been exceeded on five days. The shade temperature of 100° at Greenwich on August 9 is the highest authenticated reading in London since trustworthy records commenced in 1841, and is 3° higher than any previous reading at Greenwich, the previous record being 97·1° on July 15, 1881. There have in all only been three days since 1841 with the temperature above 95°; these were 96·6° on July 22, 1868; 97·1° on July 15, 1881; and 95·1° on August 18, 1893. The temperatures in other parts of London on August 9 were also a record, and the same occurred in many parts of England. A reading of 98° was recorded at Epsom and Canterbury, and at Raunds in the Midlands, 97° at Hillington, and 96° at Marlborough, Fulbeck, and Lincoln. In France and Germany the heat has also continued to be excessive. On Tuesday, August 15, there was a cooler air generally over England, and in London the highest temperature was 75°, which is the lowest day maximum for a month.

MR. C. E. ADAMS, of the Department of Lands, New Zealand, has been appointed astronomical observer at Wellington in succession to Mr. T. King, who has resigned.

MR. T. SOUTHWELL, scientific adviser to the Ceylon Company of Pearl Fishers, Ltd., and Inspector of Pearl Banks, Colombo, has been appointed (by the India Office) Deputy Director of Fisheries, Bengal.

THE council of the Royal Statistical Society of London has awarded a Guy medal in gold to Mr. G. Udny Yule "for his extraordinary services to statistical science, for his valuable contributions to the Transactions of the society, and for the special work done by him in the interests of the society."

THE geological and archæological collections made by the late Rev. E. Maule Cole, all the objects of which are connected with East Yorkshire, have been presented to the Hull Municipal Museum by Lady Philadelphia Cole.

THE appointment of Mr. F. W. Taylor, of Denver, Colorado, as Director of Agriculture in the Philippines, is expected to mark the beginning of the application of scientific methods to the cultivation of land in those islands. Mr. Taylor was professor of horticulture in the University of Nebraska from 1891 to 1893. He superintended the departments of agriculture and horticulture at the expositions at Omaha in 1898, Buffalo in 1901, and St. Louis in 1904. He has lately been occupied as an irrigation engineer.

THE council of the Institution of Civil Engineers has made the following awards in respect of students' papers read during the session 1910–11:—the "James Forrest" medal and a Miller prize to Mr. D. Hay (Birmingham), and Miller prizes to Messrs. D. A. Howell (Bristol), R. Bonner (Bristol), G. F. Walton (London), R. G. Parrott (Manchester), E. E. Farrant (London), A. C. Dean (Man-

chester), H. W. Coales (Birmingham), A. H. Meade (London), A. C. Swales (Leeds), and H. J. F. Gourley (Manchester).

In connection with the celebration of the tercentenary of the Authorised Version of the Bible (1611–1911), a special exhibition, illustrating the natural history of the Bible, has been arranged on the east side of the central hall in the Natural History Museum, Cromwell Road, London. Printed descriptive labels have been attached to the exhibits, which comprise all the animals, plants, minerals, and precious stones mentioned in the Bible. A guide book to the exhibition has been prepared, and is on sale, price 6*d*. (postage 2*d*.). The exhibition is open to the public free daily.

The Manchester Microscopical Society has arranged, as in previous winters, to provide through its Extension Section lectures and demonstrations of a popular character on scientific subjects. The lectures are arranged for delivery in and about Manchester. The cost, as a rule, is limited to lecturers' expenses, which in most cases do not exceed a few shillings. The work of lecturing and demonstrating is entirely voluntary and gratuitous on the part of the members of the society, but hire of slides, travelling, and out-of-pocket expenses are charged, and in some cases an additional small fee for the lecture is asked for. The list of lectures includes sixty-five subjects, most of which deal with the biological and geological sciences. Secretaries of societies desirous of including lectures on nature subjects in their syllabus may receive a copy of the lecture list on application to the honorary treasurer and secretary, Mr. R. Howarth, 90 George Street, Cheetham Hill, Manchester.

The Technical Museum in Vienna, which is nearing completion, was initiated by Austrian manufacturers, with the assistance of the State and of the city of Vienna, to commemorate the sixtieth anniversary of Emperor Francis Joseph's reign. The foundation-stone was laid on June 20, 1909, and the building, which is situated opposite the palace of Schönbrunn, covers an area of more than 20,000 square yards. The museum will demonstrate chronologically the development of industries and crafts, illustrate the technical achievements of the present day, and by periodical exhibitions stimulate and promote future progress. In other words, it is intended as an educational centre to spread a knowledge of science and technology from the point of view of national welfare. Considerable progress has been made in stocking the museum, and several large and valuable State collections have been secured already. The historical sequence in the development of pure and applied science is not yet completely shown in the exhibits available for the museum, and the authorities appeal to men of science, technologists, manufacturers, and craftsmen in all countries to assist them in procuring suitable objects for the museum. Everything pertaining to technical labour will be acceptable, principally tools, machines, apparatus, models, materials, methods of working, finished articles, as well as plans, designs, books, illustrations, and manuscripts. The names of donors will be recorded by inscription on the gifts and in a memorial book. Further particulars can be obtained from the office of the Technical Museum, Vienna, I. Ebendorferstrasse 6.

Mr. Noel Buxton, M.P., and Mr. J. H. Whitehouse, M.P., have issued a memorandum relating to the formation of an "Inshore Fisheries Parliamentary Committee," which has made certain proposals to the Board of Agriculture and Fisheries apparently with regard to the administration of the Development Fund. It is proposed that a sub-department of the Board, consisting of "Inshore Fishery Commissioners," should be established, and that this body should administer a grant of money for the purposes of local cooperative societies for purchasing boats and gear, and for insurance; credit banks; loans; the circulation of information, such as means of transport and distribution; the cultivation of shell-fish and the provision of foreshore allotments, and the policing of the territorial waters. The prosecution of scientific investigation is not suggested; and since the committee remarks that even the best of the fishery committees "are unable to prevent injury to the spawning beds," it is evident that it passes over the fishery research of the last twenty years. The objects of the memorandum are excellent, but it is quite certain that some of them cannot be carried out economically and efficiently without great familiarity with local conditions and a certain amount of scientific research; and this information, with the organisation for increasing it, already exists in the case of several of the better equipped fisheries committees. There are parts of the coasts of England and Wales where fishery research and regulation have never been adequately developed, and a good deal might be said in favour of applying the proposals of the Parliamentary Committee to these neglected inshore areas; but it is difficult to understand why all the organisation for local investigation and control, built up laboriously during the last twenty years by some of the district committees, should be ignored, and the problem of improvement of the inshore fisheries tackled again in apparently a *de novo* manner.

We learn from *The Japan Times* that the Imperial Academy of Japan has awarded a medal and testimonial to Dr. Kimura for his discovery of the term in the variation of latitude which is generally known by his name. This is the first award under a benefaction which the Academy owes to the Emperor. As at present understood, the complete expression for the variation of latitude at a station in longitude λ is

$$x \cos \lambda + y \sin \lambda + z,$$

where x and y are the rectangular components of the displacement of the pole on the earth's surface relative to its mean position. The third, or z term, which was discovered by Dr. Kimura and is the subject of the award, is annual in period and independent of the longitude of the station. Dr. Chandler therefore sought to explain it as a result of the mean parallax of the stars observed, but found on examination that not more than one quarter of its amount could be accounted for in this way. The nature of the term points to an apparent and unexplained oscillation of the centre of inertia of the earth with a semi-amplitude of 4 or 5 feet. The addition of two observing stations in the southern hemisphere, one in West Australia and the other in the Argentine, to the six international stations previously established in the northern hemisphere, has corroborated the objective reality of the phenomenon, which still presents, therefore, an extremely interesting problem in geophysics. On the occasion of the presentation to Dr. Kimura a lecture was delivered by Prof. Nagaoka, in which he recounted the circumstances in which the discovery was made. The observations made at Mizusawa, the latitude station in Japan under the charge of Dr. Kimura, were suspected of inaccuracy, but the most careful examination failed to reveal the source of error. Finally, Dr. Kimura was able to prove that the errors were not due to an instrumental or personal source, but arose from a cause affecting all the stations alike. He thus vindicated his accuracy as an observer, and discovered

what appears to be a very remarkable phenomenon at the same time. The circumstances are of a piece with the whole history of our knowledge of the variation of latitude; and this is perhaps natural enough, since it is entirely a question of residual phenomena only revealed by observations of the highest order of accuracy.

IN *The Athenaeum* of August 12 Prof. W. M. Ramsay reports a very interesting and important archæological discovery, which will hereafter throw much light on the religion of Asia Minor. This is the holy place of Men Askaenos at Pisidian Antioch. The site contained no temple, but only a great altar standing in an enclosure surrounded by a massive wall. The shrine has clearly remained in the state in which it was left by the Christians when they destroyed it in the fourth century. No other primæval sanctuary on a mountain top, dedicated to a known god and famous throughout Asia Minor, has ever been discovered. The sacred way with votive reliefs on the rocks, the wall of the precinct covered with votive dedications to Men Askaenos, the church built of materials collected from the shrine, the theatre of the Hellenistic or Roman period, present a combination of interesting archæological remains without parallel in this region; and the shallowness of the soil renders excavation particularly easy. It may be hoped that funds for the excavation of this unique sanctuary will soon be provided, and the work carried on by some of the scholars who have been trained by Prof. Ramsay in archæological research in Asia Minor.

THE third season's investigations, conducted at Avebury by the British Association under the superintendence of Mr. H. St. George Gray, commenced in April last. The results of the work supply further corroboration of the conclusions already arrived at that the "temple" dates from the Neolithic stone period. This is shown by the discovery of two worked red-deer antlers, a finely chipped flint knife, and fragments of prehistoric pottery. This last is formed of a coarse, thick black paste containing grains of various substances introduced to bind and strengthen the ware, such as pieces of burnt bone and tiny bits of charcoal. Its chief interest lies in the fact that it is ornamented on both faces, the impressions of twisted grass, or cord, and finger-nails being clearly defined. This pottery was found about 5½ feet below the surface. At a lower depth, but still below the Roman stratum, another form of vessel was discovered, ornamented in a herring-bone pattern, which was impressed by means of a notched implement of wood, bone, or antler, or by a shell with its natural ribbing. This pottery is identical with specimens found in the West Kennet long barrow, at Peterborough, on the Thames at Mortlake, and in General Pitt-Rivers's excavations at Handley, North Dorset. The date of the Avebury circle seems to be definitely fixed by these discoveries.

THE Hittite Excavations Committee, the honorary treasurer of which is Mr. R. Mond, Coombe Bank, Sevenoaks, has issued an appeal for assistance in archæological research in certain parts of Asia Minor and northern Syria. Much information has already been collected regarding Hittite civilisation by the excavations at Boghaz Keui, the capital of the great Hittite kings in the fourteenth and thirteenth centuries B.C. Numerous clay tablets have been discovered here which will throw welcome light on the relations of the Hittite Empire with Assyria on the east and Palestine, the Ægean, and even Egypt on the west. It is now proposed that excavations shall start on the great mound at Sakje Geuzi, which lies four days' journey eastward from Adana, near Tarsus, and on an ancient route between the east and west by way of Carchemish and the Cilician Gate. Prof. J. Garstang, who will take charge of the operations, has already made some preliminary excavations on this site, and has discovered a palace with sculptured portico which promises to contain most interesting material, possibly that bilingual inscription which would solve the riddle of innumerable documents.

The Scientific American of July 22 contains an appreciative notice, accompanied by a full-page portrait, of Prof. Henry Fairfield Osborn, who, it appears, takes his second name from the Connecticut town in which he was born in 1857. In the course of the article reference is made to the strong support accorded by Mr. Osborn to the tritubercular theory of the evolution of mammalian molars, and likewise to his investigations into the phylogeny of the titanotheres of the American Tertiary.

THE so-called British bird-fauna has just been augmented by another subspecies in the shape of the Alpine ring-ouzel (*Turdus torquatus alpestris*), of which, as recorded by Mr. M. J. Nicoll in *British Birds* for August, a specimen was shot at Guestling, Sussex, on May 23. This race, which ranges from central and southern Europe to the Balkans, differs from the typical form by having more white on the secondary quills, and the presence of large median patches of white on the feathers of the breast and chest, and of white streaks on the under tail-coverts. The more eastern *T. t. orientalis*, which ranges into Egypt, is intermediate in colouring between the typical and Alpine races.

No. 3 of the first volume of the Records of the Canterbury Museum, New Zealand, is devoted to a continuation of the account of the zoological results of the New Zealand Government trawling expedition of 1907, Mr. E. R. Waite dealing with the fishes, Mr. H. Suter with the molluscs, and Mr. C. Chilton with the crustaceans. In a summary of the results of the expedition Mr. Waite directs attention to their bearing on the supply of local food-fishes. One of the results is the marking out of areas suitable for trawling; and although there appears to be no evidence of commercial trawling having in consequence been undertaken on an extended scale, it seems that the favourable report as to the potentialities of the Chatham Islands for line-fishing has been effective in attracting capital to what it is hoped will prove a profitable venture.

WE have received copies of six guides to the Grange Wood Museum at Croydon and its various sections, written by the hon. curator, Mr. E. A. Martin. Unfortunately, at least some of these lack that accuracy and "up-to-dateness" which are of such prime importance in publications of this nature. On the first page of the Guide to the Back-boned Animals we find, for instance, the statement that the Chordata (in its restricted sense) includes the sea-squirts and the lamprey, instead of the sea-squirts and the lancelet. In a reference on the same page to the notochord, the author assumes his readers to possess more knowledge than they are likely to have acquired. On p. 8 the statement that the constituent bones of the chelonian shell articulate by means of teeth is misleading, while on the next page readers are led to believe that chameleons are restricted to N. Africa. The classification of both birds and mammals is quite obsolete; it is stated that there are only two kinds of monotremes, Edentata is misprinted Endentata, and the *horns* of antelopes are referred to as *antlers*. In the Shell Guide Lamellibranchiata is spelt with two m's, and Spondylus is included among gastropods; and, to take one example from the Fossil

Guide, we are told that Dolichosaurus was still in existence in the Chalk, whereas it is only known from that formation.

In part ii. of the Proceedings of the Zoological Society of London, published in June, Dr. W. N. F. Woodland has published a thesis "On the Structure and Function of the Gas Glands and Retia Mirabilia associated with the Gas Bladder of some Teleostean Fishes." The structure of these bodies is well illustrated by eight coloured plates, and an ingenious hypothesis is advanced to explain the remarkable conformation of the well-known rete mirabile duplex constantly associated with the gas gland (oxygen gland). The general theory put forward to explain the actual mode of production of oxygen by the gland—a very interesting physiological problem—is, we notice, almost entirely based upon the study of stained microscopic preparations, and thus lacks the essential support only to be derived from physiological experiment. The author, however, has recently investigated the physiological aspect of the subject at Plymouth, and has supplied an account of the results obtained in a further paper to be read before Section I at the forthcoming meeting of the British Association at Portsmouth.

Prof. Hans Driesch's essay "Die Biologie als selbständige Grundwissenschaft und das System der Biologie," almost entirely rewritten, has appeared in a second edition (Leipzig: Wilhelm Engelmann, price 1.20 marks). The book is issued as "Ein Beitrag zur Logik der Naturwissenschaften," and is a clear statement of the value of the interaction of philosophy and biology.

The new volume (xliii., 1 and 2 Heft) of the *Morphologisches Jahrbuch* (Gegenbaur) contains, among other memoirs, a detailed account of the spinal cord of the dugong, by Drs. Dexler and Eger. The simple segmentation of the body of the animal and its adaptation to aquatic life are found to be reflected in the cord, which is almost uniformly segmented, and exhibits no trace of thickening in the lumbar region; there is, however, some shortening in the cervical portion. The form, size, stainability, position, pigment, tigroid substance, nuclei, and processes of the nerve cells do not present any special peculiarities. Dr. Hans Bluntschli describes an abnormal pelvis of a female Java ape (*Macacus cynomolgus*), which exhibits differences from the normal similar to those shown by a human "Naegele pelvis." Dr. K. Ogushi contributes the first instalment—the description of the skeleton—of his account of the anatomy of the Japanese three-clawed turtle (*Trionyx japanicus*).

Prof. Raymond Pearl deals in the current number of *Scientia* with biometrical ideas in biology, their significance and limitations. He points out that the real purpose of biometry is the general "quantification" of biology, that the biometrical constants (mean, standard deviation, coefficient of correlation, &c.) are constant characters of the "group" (for instance, a species) as such, and that the shape of the variation curve for the particular group of organisms is a definite character for the group. Biometry furnishes, in fact, a valuable and refined extension of the descriptive method; but it must not be applied loosely; it is necessary to use in its application as much general "biological intelligence" in regard to the significance of the problem attacked, the validity of the assumptions made, and the applicability of the methods to the particular problem as would be exercised in an investigation by any other method.

The second Heft of vol. xcviii. of the *Zeitschrift für wissenschaftliche Zoologie* comprises three memoirs. Herr Rungius gives a detailed account of the anatomy and histology of the alimentary canal, larval and adult, of the water beetle *Dytiscus marginalis*. Dr. Gustav Fritsch describes the histology of the eye of a fruit bat (Pteropus) from Sumatra. The remarkable point in the structure of the eye is the presence of finger-like processes extending from the choroid into the middle layer of the retina. The author regards these as comparable to the pecten of the eye of birds, and attributes to them a nutritive function and the *rôle* of regulating pressure in the eyeball. Herr Kapzov has investigated the intimate structure of the cuticle of insects, and finds that it has a honeycomb appearance, due partly to variations of pressure during its formation, and partly to varying activity of the hypodermis cells which secrete it.

Among the articles in the July issue of *The Popular Science Monthly* is one by Mr. A. H. Thayer on concealing coloration, the writing of which was prompted, in the first instance, by certain statements in Mr. Roosevelt's recent book on African animals. Mr. Thayer holds that it is the rule for animals to be coloured like the background which most concerns their feeding and escaping attack; but the human observer, in order to experience the concealing effect of such marking, must look at the animals from the same level as their normal enemies; in many cases he must look *up* to them from near the level of the ground. The reed and sky markings of zebra and oryx make it difficult to distinguish them, in their usual surroundings, by night as well as by day. Prof. Montgomery advocates the expansion of the usefulness of natural history museums. He holds that they should be centres for instruction in taxonomic work, which can be better undertaken there than in university laboratories. Under such an arrangement, taxonomic collections and courses may well be abolished from universities. He also enters a plea for increased opportunities for research by the staffs of museums.

The July number of *Tropical Life* is devoted to an account of the rubber exhibition recently held in London. An important feature was the excellent quality and appearance of certain samples of Castilloa, Funtumia, and Ceara rubber. Castilloa rubber from Mexico was shown in block, sheet, and crêpe forms; Funtumia and Ceara were sent from the Gold Coast as "biscuit," as well as in balls. Specimens of Castilloa from Tobago, comparing favourably with sheet Para, received general commendation.

Noteworthy among the numerous diagnoses of new plants, chiefly from tropical Africa and Asia, published in the *Kew Bulletin* (No. 6), are the descriptions of two species of Impatiens from Malaya, communicated by Sir Joseph Hooker; *Impatiens peltata* is distinguished by its peltate leaf, and *I. Vaughanii* bears characteristic sepals. Another important determination is supplied by Dr. O. Stapf of a lawn grass, locally termed blue couch, that has found favour in some coastal districts in New South Wales. The author refers it to *Digitaria didactyla*, specimens of which he has also discovered from Madagascar and Tonkin. It grows more strongly than *Cynodon dactylon*, which is generally employed for lawns in the colony, and is said to possess other advantages.

Prominence is accorded to a contribution by the eminent zoologist Prof. E. Giglio-Tos in the *Botanisches Centralblatt* (July 15), in which it is claimed that the recent experiments with reciprocal hybrids recorded by Prof. de Vries, and briefly noted in these columns (Nature, April 13), provide striking confirmation of certain laws in

hybridism advanced by the author. According to one of these laws, crosses from reciprocal hybrids show a return to the characters of one of the original species, and these are the only crosses in which hybrid characters are not maintained. Another law states that when crosses are raised from a hybrid and one of the original parents, if a hybrid carrying the male character is crossed with the female parent, or *vice versa*, the hybrid characters are maintained; in the other alternatives there is a return to the characters of the parent.

IT seems reasonable to affirm that primitive or natural woodlands still exist in parts of Scotland, although the question does not admit of definite proof. Interesting evidence, based upon an examination of selected observational areas, is submitted by Mr. C. P. Gordon in the Transactions of the Royal Scottish Arboricultural Society (vol. xxiv., part ii.). He discusses three types of "Urwald," *i.e.* birch, Scots pine, and oak. On the ground of inaccessibility and condition of the trees, the birch woodlands on the shores of Loch Ossian and Loch Laggan, ranging to an elevation of 2000 feet, are considered to be primitive. Antiquity is claimed for the Scots pine forming Locheil Old Forest in Inverness-shire; although the trees have flattened crowns, the quality of the wood is excellent, and surpasses that of any imported Scots pine timber. Again, the shape and development of the oaks on Lochwood Moss in Dumfriesshire suggest that this forest is primitive; epiphytic growth of the common polypody and Usnea is here a striking feature. The article also contains notes on the ground floras observed.

THE example set by the United States in retaining a large tract of country as a sanctuary for wild life has been followed by several other countries, including Canada and Switzerland. Mr. J. S. M. Ward appeals in *The Builder* for August 4 that something similar should be done in England. The growth of towns and of small holdings, and the gradual conversion of England into a "Black Country," are causing the disappearance of the real wild country. Efforts should be made to save sanctuaries near our different towns, a matter which might be taken in hand as an extension of the town-planning movement. Forestry should be encouraged wherever possible; much land in private hands might become sanctuary to all practical purposes. Two or three sanctuaries already exist; Epping, though an accidental one, has been a great success in this direction, and so has the Brent Valley Bird Sanctuary of the Selborne Society. Mention should also be made of the work done by the National Trust and by the Commons and Footpaths Preservation Society. Many of the most beautiful spots in England have been saved by their joint efforts, and there are signs that these bodies intend to extend their work in the direction of the provision of sanctuaries.

THE number of new seedling sugar-canes available for planters is greater at the present time than ever before, and experiments are undertaken by the West Indian Department of Agriculture to serve as a guide to planters in selecting the most promising sorts for cultivation. In order to render the investigations applicable to a wide range of conditions, the location of the different experiment stations is chosen with the view of making each station, so far as possible, representative of the cane-growing district round about it, so that, as a whole, the stations supply a complete survey of the conditions under which sugar-cane is grown in the particular island. The report of the experiments conducted in the Leeward Islands for 1909–10 is now issued as Pamphlet 67 of the West Indian Department.

The Agricultural Journal of the Union of South Africa contains each month papers of scientific and of technical interest by officers of the Department. A report is published in No. 3 of the new volume showing that cotton can be successfully raised in the Cape Province. The cultivation is attracting a good deal of local attention, and the crop is satisfactory in quality; there seems the promise that cotton-growing may become a profitable industry. In No. 4 Dr. Theiler gives an interesting and complete summary of recent work on ticks and the part they play in the propagation of diseases in cattle; the particular diseases dealt with are biliary fever in horses, caused by *Piroplasma equi*; redwater in cattle, caused by *P. bigeminum*; gall sickness, or anaplasmosis, due to *Anaplasma marginale*; fevers, caused by *Piroplasma mutans*, by Spirochætes, and the East Coast fever caused by *P. theileria*; and heartwater.

THE annual report for 1909–10 of the Department of Agriculture, British East Africa, shows an encouraging growth of production and a steady influx of settlers with capital. The climate is very varied, and ranges from temperate to tropical within somewhat narrow distances; in consequence, a considerable variety of crops can be produced. Beans, coffee, maize, and millet have increased enormously in area, and in spite of the growing local demand there is a large balance for export. Rubber has likewise increased in amount, and a still further increase is foreshadowed in the future, as the plantations have not yet reached the tappable stage. Sem Sem is also a valuable and increasing crop. On the other hand, copra and wax have fallen off in value; but the decline in copra is not regarded seriously, because the cocoanut is now put to more economical uses. There is a large and growing export of hides, chiefly ox and goat, while ostrich farming, which has recently been introduced, promises to become an important industry.

MM. CLAUDE, FERRIÉ, and DRIENCOURT give in the *Revue générale des Sciences* for July 30 an account of the experiments made for the determination of longitudes by means of wireless telegraphy between Paris and Brest, a distance of about 600 kilometres, and afterwards between Paris and Bizerta, which are separated by about 1550 kilometres. Diagrams of the instruments and connections are given. In the experiments between Paris and Brest in July, 1910, comparisons by radio-telegraphic and telephonic signals gave the same degree of precision, the mean error being less than 0·01s. In the experiments with Bizerta at the end of 1910 suitable radio-telegraphic signals actuated by a clock at the Paris Observatory were received, so that coincidences could be accurately observed, and the differences between the mean comparisons of the same series were of the order of 0·01s.

IN the *Revue générale des Sciences* for July 30 M. Lallemand, the director of the Levelling Service of France, discusses the most suitable form for an international air-map, and proposes a system of marks to enable the aviator to determine his position. The Permanent Committee for Aërial Navigation of the Ministry of Public Works has adopted 1 : 200,000 as the most suitable scale, each sheet containing 1° of latitude by 1° of longitude; longitudes are to be reckoned from 0° to 360° in an easterly direction from the antimeridian of Greenwich; for the ordinary numbering of the parallels of latitude a continuous numbering from the South to the North Pole is proposed with the view of avoiding the change of sign on passing the equator. For local marks a rectangle containing a dot indicating the position of the place in the map sheet, and the number of

the map sheet would be painted on a house-roof or other suitable surface, and this is considered more practical than giving the name of the place. The projection employed is the same as that of the international 1 : 1,000,000 map.

ACCORDING to the *résumé* of communications made to the Société française de physique on July 7, M. M. Kernbaum has succeeded in showing that the "oxygenation" of water, which two years ago he proved could be obtained by allowing the ultra-violet rays from a mercury lamp to act on the water, can be obtained from sunlight. Since it is the ultra-violet rays which are effective, the action is most marked at high altitudes, but it is large enough to be easily detected at sea-level if the water is in presence of air.

IN a thesis submitted for doctor's degree in mathematical science at Geneva, M. Hermann Streele, of Neuchatel, dealing with the theory of mercurial compensation for pendulums, suggests a new form of pendulum in which the free surface of the mercury is near the middle of the column, the upper part resembling a barometer tube. This form, he claims, enables him to compensate theoretically both the actual changes of temperature and the error due to the want of uniformity of temperature in different parts of the pendulum chamber. He follows Herr Wanach (remembered as one of Prof. Albrecht's longitude observers) in condemning the old approximate formulæ of Lord Grimthorpe and others, but apparently fails to realise the great dependence of makers on "trial and error." He has not completed the theoretical study, as he ignores, for instance, any molecular temperature effect, and from the practical point of view he has omitted any mention of devices for keeping the atmospheric pressure nearly constant. No hint is given of any possible application of "invar" to mercurial pendulums, though its striking success in bimetallic compensation would seem to recommend a trial of this alloy for some part of the pendulum, if not for the actual stalk.

EXTENSIVE schemes of improvement of the docks of the Port of London, forming part of a more extended scheme resolved on some time ago, are now about to be carried out at a cost of four millions of pounds. It is anticipated that when these works are completed, they will be sufficient to meet the needs of the port for several years. The remainder of the proposed improvements will be deferred until the increase of trade renders them necessary. The works now to be put in hand include the construction of a new deep-water dock of sixty-five acres. It is anticipated that this will occupy five years, and the estimated cost is 2,150,000*l*. This dock will be constructed to take vessels of considerably larger size than those which now can find accommodation in the Thames, the depth being 38 feet and length of the lock 800 feet, or 250 feet longer than that of the present Albert lock. The East and West India docks are to have their approach widened to 80 feet, and depth increased to 31 feet, allowing the entrance of vessels up to 9000 tons. The South-west India dock and the London docks are to have new entrances constructed, and to be otherwise made to meet modern requirements. The water in the latter is to be increased so as to make it 4½ feet above Trinity high-water mark by means of a pumping installation.

A CLASSIFIED list of new books and new editions added to Lewis's medical and scientific circulating library, 136 Gower Street, W.C., during April, May, and June, just received from Mr. Lewis, is a useful catalogue of important works published during that period.

OUR ASTRONOMICAL COLUMN.

COMET 1911*b* (KIESS).—Observations of Kiess's comet, made by Mr. Stratton with the Newall telescope on July 22, 25, and 26, showed a head some 3′ in breadth, but without any sharply defined nucleus. Mr. Newall, in No. 4517 of the *Astronomische Nachrichten*, does not give the times of the observations, but states that the comet was visible to the naked eye.

Spectroscopic observations revealed a bright band at λ 516 in which the head was seen to be 5′ or 6′ broad, and the band could also be traced along the tail to a distance of at least 5′; bands were also seen at λλ 474, 516, and 564, and the continuous spectrum was recorded as very faint.

A note appended to the ephemeris given in No. 438 of *The Observatory* directs attention to the fact that on September 3 the earth will pass through the point traversed by the comet on August 7; a careful watch should be kept for cometic débris in the form of meteors.

BROOKS'S COMET, 1911*c*.—New elements and ephemeris for comet 1911*c* are published in No. 4517 of the *Astronomische Nachrichten* by Dr. Ebell. As the new positions, especially for the later dates, show considerable departures from those we reproduced in these columns on August 3, we give the following abstract from the ephemeris :—

Ephemeris (12*h*. *M.T. Berlin*).

1911	α (true) h. m.	δ (true) ° ′	log *r*	log Δ	mag.
Aug. 16 ...	21 22·0 ...	+39 33·5 ...	0·1932 ...	9·8632 ...	8·5
,, 20 ...	21 4·3 .	+43 6·8 ...	0·1747 ..	9·8324 ...	8·3
,, 24 ..	20 41·9 ...	+46 43·8 ...	0·1552 ...	9·8033 ...	8·0

This comet was observed by Mr. Stratton on July 25 and 26, and was found to have a bright nucleus which gave a continuous spectrum; the band at λ 516 in the spectrum could be traced faintly for about 2′ from the nucleus both towards the sun and in the opposite direction. The comet could be seen with a pair of opera glasses.

A large number of observations of position and brightness are recorded in the *Astronomische Nachrichten* (No. 4517) from Greenwich, Utrecht, Algiers, and many other observatories. At Algiers Dr. Gonnessiat found, on July 22, a 4′ or 5′ nebulosity having an eleventh-magnitude nucleus which was not central. Herr G. van Biesbroeck found that the magnitude of the comet seen with opera glasses on July 26, 27, and 29 was about 8·0.

ENCKE'S COMET, 1911*d*.—Dr. Gonnessiat's report of the rediscovery of Encke's comet appears in No. 4517 of the *Astronomische Nachrichten*, and states that the comet was a difficult object in the dawn. Perihelion passage takes place on August 19, and an ephemeris giving positions from August 24 to September 21 appears in No. 438 of *The Observatory*; for August 24 and 28 the positions are 10h. 44·5m., 5° 46′ N., and 11h. 16·1m., 1° 2′ N., respectively.

THE OBSERVATION OF METEORS.—Amateur astronomers not possessing efficient instrumental equipment cannot do better than devote their attention to the observation of meteors, about which students of cosmogony still require to learn many things.

For such observers the publication (*Observatory*, No. 438) of a letter written by the late Prof. Alex. Herschel to Mr. Denning in August, 1876, is full of interest and practical information. Those who had the pleasure of corresponding with Prof. Herschel will understand that it is impossible to describe a letter of his in detail in a confined space, but the amateur will find especially interesting the discussion of "trains." These phenomena are seldom properly described, and Prof. Herschel takes some pains to impress upon his correspondent the great importance and the almost infinite variety of the luminous phenomena attending a meteor flight.

BETA AND GAMMA RAYS IN SOLAR PHENOMENA.—From Dr. A. Brester, Jz., we have received an interesting monograph dealing with the theory that solar phenomena are produced by the solar emission of β and γ rays. Dr. Brester starts with the terrestrial aurora produced by

electrical radiations, and shows that the solar phenomena may be similarly explained. The presence of helium as a prominent solar element is taken as evidence of the presence in the sun of the radio-active elements from which the β and γ rays may emanate. The monograph is published by W. P. van Stockum et Fils, The Hague.

PAPERS ON INVERTEBRATES.

IN the Records of the Indian Museum for May (vol. vi., part 2), Dr. N. Annandale describes certain curious masses dredged in the Bay of Bengal, which on examination proved to be sponges associated with gregarious molluscs of the family Vermetidæ, the latter being embedded in the former. The masses, which were in a bad state of preservation, are of two types, one consisting of shells with serrated ridges embedded in moderately hard black sponges, and the other of smoother shells associated with stony sponges, ranging in colour from red to yellow. The ridged shell is *Siliquaria muricata*, and the associated sponge *Spongorocites topsenti*. The second type comprises two molluscs, *Spiroglyphus cummingi* and *Siliquaria cochlearis*, the associated sponges being two forms of *Racodiscula sceptrellifera*, which differ from one another in colour. When fresh, the masses of the second type must have had a brilliant appearance, the sponge being red or orange, the shells pink, and the soft parts of the molluscs yellow. Both the two sponges associated with the three Vermetidæ are found elsewhere growing alone.

In two issues of the Proc. U.S. Nat. Mus. (Nos. 1823 and 1826), Mr. Paul Bartsch catalogues the recent and fossil representatives of the molluscan genera Cerithiopsis and Bittium from the west coast of America; and in No. 1820 of the same serial Messrs. Dall and Bartsch describe several new shells from Bermuda, including some of the aforesaid Cerithiopsis.

Variation in certain Jamaican species of land-snails of the genus Pleurodonte (or Pleurodonta) forms the subject of a paper by Mr. A. P. Brown in the Proceedings of the Philadelphia Academy for February, 1911. Variation in the height of the spire indicates two waves of migration into the district from the north, the first being probably represented by an extinct race from near Somerset. In analogous cases the variation in the height of the spire has been attributed to difference of atmospheric pressure according to altitude, tall-crowned forms being found high up, and *vice versâ*. But, as Mr. Brown points out, this cannot be a *vera causa*, the diurnal oscillations in pressure at a given point being in some parts of the island more than equal to variation due to altitude. Moreover, in one at least of the mountain forms, increase in spire-height is accompanied by a diminution in the size of the shell. In the author's opinion, such variations are mainly controlled by local differences in humidity.

In the same serial for March, Messrs. Pilsbry and Ferriss continue their review of the land-shells of the south-western United States, dealing in this instance with those of the Grand Canyon and northern Arizona. The molluscan fauna of the Grand Canyon consists, with one exception, of northern Arizona types; but the canyon forms an impassable barrier to Oreohelix, of which distinct species are found on its two sides.

Certain features in regard to the vertical distribution in the San Diego area of the minute translucent crustacean *Eucalanus elongatus* (a relative of the better-known *Calanus finmarchicus*) are discussed by Mr. C. O. Esterly in vol. viii., No. 1, of the Zoological Publications of the University of California. Despite considerable hourly variation in the numbers taken in plankton, it does not seem that the species performs diurnal vertical migrations; and the reason for the numerical variation is therefore still unknown. The author is led to suggest that diurnal vertical migrations may have in part a protective object in many species, seeing that Eucalanus is adapted in other ways to life in the plankton.

How much remains to be done in connection with South African earwigs is made evident by the fact, as recorded by Dr. M. Burr in vol. x., part i., of the Annals of the South African Museum, that out of nineteen species from the districts south of Rhodesia, no fewer than seven proved to be new. One of these is assigned to Apterygida, a genus, as now restricted, previously known only by *A. alpipennis* of Central Europe.

The lug-worms (Arenicolidæ) of South Africa are discussed by Dr. J. H. Ashworth in vol. xi., part i., of the same serial. The special interest of this article is the record of the rediscovery of *Arenicola loveni*, a species hitherto known solely by a specimen from Natal preserved in the Riksmuseum at Stockholm, and described by Kinberg in 1866. An examination of the internal organs of this specimen, supplemented by others recently obtained by Dr. Gilchrist at Saldanha Bay, Cape Colony, shows that the reference of the species to the typical genus is correct.

The one article in vol. iv., No. 7, of Records of the Indian Museum is devoted to the description, by Mr. E. Brunetti, of nearly fifty new Oriental flies of the group Nemocera.

To *Biologisches Centralblatt* for July 1 the Rev. Father Wasmann contributes the first part of a critical review of Escherich's "Termitenleben auf Ceylon."

In vol. xxxiii., No. 4, of Notes from the Leyden Museum Dr. R. Horst revises the characters of the genus Notopygos, typified by an amphinomid worm from St. Helena described by Grube in 1855. The special feature of the genus is the dorsal position of the vent, some distance in advance of the terminal segment. Shortly afterwards Grube referred to the same genus a Costa Rican annelid, mentioning the presence of two dorsal cirri. In 1857 Kinberg, who was apparently unacquainted with the account of this second species, diagnosed the genus as having a single cirrus, making no mention of the dorsal position of the anus. He also referred two annelids, respectively from Tahiti and Panama, to the new genus Lirione, on account of the presence of a pair of dorsal cirri. Apparently the single cirrus specimens, which were from St. Helena, did not belong to Notopygos, of which Lirione is now shown to be a synonym. The genus is now known from St. Helena, Costa Rica, Florida, Bermuda, Malaya, the Amirante Isles, and Australia.

In No. 1846 of the Proceedings of the U.S. National Museum Mr. E. Kirk discusses the relationships, classification, and genealogy of certain "Eleutherozoic Pelmatozoa," in other words, of free-living echinoderms of the cystid and crinoid groups. "With the possible exception of the Holothuroidea, we may hold," writes the author, "that such eleutherozoic echinoderms as are known to us have been derived from statozoic ancestors. . . . In the case of the eleutherozoic forms we have one newly acquired set of tendencies superimposed upon another set. These secondary tendencies, induced as they are by a form of life widely at variance with that under which the first set operated, tend to vitiate the force of many of the primary tendencies, if not indeed to nullify some of them. . . . Such being the case, one's efforts to establish relationships among these aberrant forms are apt to be unsatisfactory at best. In many cases, however, the eleutherozoic Pelmatozoa stand so near the point of inception of their several lines that the problem is not greatly complicated by the presence of altered or superimposed structures." Nevertheless, the classification and grouping adopted in the paper are admittedly artificial and arbitrary.

THE FOSSIL ELEPHANTS OF RUSSIA.[1]

ALTHOUGH a fine series of elephant remains from Tiraspol, Government of Kherson, preserved in the Geological Museum of Moscow University, forms the basis of Madam Pavlow's monograph, the author has examined several other collections, such as one from Kouialnik, near Odessa, and a second at Kief. The Tiraspol elephant has been identified with that form of the mammoth distinguished, on account of the thicker plates of its molars, as *Elephas trogontherii*, and characteristic of the horizon of the Cromer Forest-bed. Madam Pavlow finds, however, that in the Tiraspol molars the plates are still thicker, and accordingly regards them as representing a new species—*E. wüsti*, or *wuesti* as it

1 "Les Éléphants Fossiles de la Russie." By Marie Pavlow. Pp. iii+60+3 plates. Nouveaux Mémoires de la Société Impériale des Naturalistes de Moscou, tome xvii, livraison 2. (Moscow, 1910.)

should be spelt—which is considered to connect the typical mammoth by means of *E. trogontherii* with the broad-plated *E. meridionalis* of the Val d'Arno and Forest-bed. Two molars from Tiraspol are stated to approximate respectively to those of *E. armeniacus* and *E. antiquus*, but it is scarcely likely that three more or less closely allied forms occur in one deposit. *E. trogontherii* is recorded from Nijni-Novgorod, *E. meridionalis* from Kowialnik, and the typical *primigenius* from a prehistoric station at Kievo-Kirillovskaïa. Finally, a molar from Tiraspol and a second from Bessarabia are respectively compared with those of the Siwalik *E. hysudricus* and *E. planifrons*.

The important part of Madam Pavlow's paper is, however, contained in the discussion as to the mutual relationships of the various species and races. After noting the resemblances between *hysudricus* and *meridionalis* on one hand and *antiquus* and *namadicus* (which some naturalists regard as inseparable) on the other, the author suggests that *meridionalis*, by an increase in the number and degree of compression of its molar plates, passed by means of *wüsti* and *trogontherii* into the mammoth, which died out without descendants. On the other hand, a thin-plated phase of the *meridionalis-hysudricus* group appears to have given rise to *antiquus* and *namadicus*, while the latter in turn produced the modern Indian elephant. The idea that *antiquus* was the ancestor of the living African elephant is considered improbable.

The main objection to these views appears to be the phylogenetic separation of the Indian elephant from the mammoth, the two being closely connected by the so-called *E. armeniacus*, which was probably the animal hunted by Thothmes III. in Mesopotamia. Moreover, the suggestion that *E. namadicus* (=*antiquus*) was the parent of the Indian species is unlikely on account of the peculiar form of the forehead in the extinct species. That the *meridionalis-hysudricus* line gave origin to the Indian elephant, and that the mammoth branched off from the same stock, perhaps, as Dr. Andrews has suggested, by way of *armeniacus*, is a far more probable supposition, and one that fits in with all the facts. In regard to the African elephant, there is a general tendency to connect it with *antiquus*, Dr. Andrews even going so far as to suggest ("Guide to Elephants in Brit. Mus.," p. 42) that the narrow-toothed form of the latter may have been the actual ancestor, or at all events nearly related to the ancestor, of the existing species, although in a previous passage (p. 39) he states that *antiquus* is unlikely to have given rise to descendants.

While venturing to dissent in some degree from her theoretical views, I may conclude by expressing appreciation of the value of the work of Madam Pavlow, as it is only by means of such investigations that we can hope to solve the riddle of the elephants. R. L.

WORK OF THE PHYSIKALISCH-TECHNISCHE REICHSANSTALT IN 1910.

THE subjoined notes, based upon the annual report of the above institution for last year, indicate a few of the more important researches, &c., undertaken.

One of the chief researches was the joint work carried out at the Bureau of Standards, Washington, in conjunction with representatives of the English, French, and American standardising laboratories, the most important portion of this work being the determination of the value of the E.M.F. of the Weston normal cell. This was found to be 1·0183 international volts at 20° C. within limits of 1/10,000, agreement being secured in this respect among the countries mentioned. The value given has therefore been accepted in Germany as from January 1 last.

A research on the specific heat of gases at low temperatures by the continuous-flow method has been made. In using this method, a measured quantity of energy C^2R is conducted electrically to a gas passing through a tube at a constant rate of flow. If the temperature-difference dt between inflowing and outflowing gas is known when the stationary state has been attained, as also the quantity of gas Q flowing through the calorimeter in a certain interval of time, then $\frac{1}{J} \cdot \frac{C^2R}{Qdt}$ is the specific heat of the gas provided no thermal loss takes place, J being the mechanical equivalent of heat.

In the course of the ordinary conductivity tests on copper carried out during the last few years, it has been found that with great approximation proportionality exists between temperature coefficient and electrical conductivity, *i.e.* that a very approximate formula was $\alpha_{15} \cdot c_{15} = \text{const.}$ (α_{15} temperature coefficient, c_{15} specific resistance in ohms m/mm^2 at 15° C.). The mean value for all types of copper tested at the Reichsanstalt since 1905, for the constant, is $6{\cdot}7_8 \cdot 10^{-3}$. The same relation seems to hold—of course, with other values for the constants—for aluminium and iron. A similar relation has been found by Dellinger at the American Bureau of Standards.

The investigation into the variation of wire resistances with atmospheric humidity has been continued, and further experiments made on coils hermetically sealed in accordance with the suggestion of the Bureau of Standards. Two coils were filled with petroleum and two with paraffin oil, and sealed up, measurements being made before and after sealing. The coils filled with paraffin oil have shown good constancy, while the petroleum-filled ones have not been so constant.

A comparison has been carried out between the German standard petroleum testers and four English testers, the result being that the flash-point as given by the English instruments is, on the average, 2° C. lower than with the German instruments, the same oil being used for both.

Some comparative tests have been made on Seger cones in the electric and the ceramic furnace, the results showing that the cones collapse in the ceramic furnace at much lower temperatures than in the electric furnace of the Reichsanstalt. A definite opinion as to the reason for this difference is not pronounced.

Investigations have been instituted into the change in length of hardened steel. The twenty sets of end rods, of 10, 25, 50, and 100 mm. length, forming the basis of the experiments, were again measured in November, 1910. The lengths of the great majority of test-pieces have become constant, four years after manufacture; the changes observed in the remainder are within small limits (fractions of a micron). The results are to be published shortly.

A series of tests have been made on the energy-loss in dielectrics. An experimental condenser was built up of ten plates of solid insulating material interleaved with copper-foil sheets, the capacity being from 0·004 to 0·01 mfd. A description of the method of testing is given, and the results up to now show that over a range of frequency 9 to 2000 periods the phase-variation in the case of some substances is only to a slight extent dependent on the frequency, while in the case of others the variation is considerable. Sometimes it was also noticed that the phase-difference depended on the voltage applied.

Numerous other researches more or less important in character were undertaken during the year, but space will not permit of describing them here. Those interested will find the report of the Reichsanstalt published in the *Zeitschrift für Instrumentenkunde* for April, May, and June.

E. S. HODGSON.

RECENT PUBLICATIONS OF ECONOMIC ENTOMOLOGY.

INSECT pests of trees and crops demand constant attention on the part of the expert, and a very voluminous literature is growing up round the subject. Few laboratories are more prolific in published papers than those of the Bureau of Entomology of the United States Department of Agriculture. Among recent papers, we note one by F. M. Webster on the alfalfa weevil (*Phytonomus murinus*, Fab.), a pest introduced from Europe or North Africa some six years ago, and now spreading somewhat widely in Utah, and another paper by the same author on the lesser clover-leaf weevil (*P. nigrirostris*, Fab.), an insect introduced probably fifty years ago, but not very common even yet; it suffers from at least two parasites, a small Tachinida and a fungus, *Empusa sphaerosperma*. The broad-nosed grain weevil (*Caulophilus latinasus*, Say) is described by F. H. Chittenden, and also the long-headed flour beetle (*Latheticus oryzae*, Waterh.); both are found

in stored cereal products, and may become serious pests if they succeed in establishing themselves. Two other pests infesting stored cereal products are also described, the lesser grain-borer (*Rhizopertha dominica*, Fab.), which is fairly common, and is cosmopolitan in its distribution, and the larger grain-borer (*Dinoderus truncatus*, Horn), which is more confined to tropical countries. The ravages of the codling moth (*Carpocapsa pomonella*, L.) in California are dealt with by S. W. Foster; two full broods of larvæ could be traced during the season, the first, however, being relatively small, and often overlooked. Treatment with a lead arsenate spray is recommended. The grape leaf-hopper (*Typhlocyba comes*, Say) an insect causing damage to vines in the Lake Erie Valley, is shown by F. Johnson to yield to a nicotine spray. Three pests on crops are dealt with: the timothy stem-borer (*Mordellistena ustulata*, Lec.), a pest which has recently been observed by W. J. Phillips; the sorghum midge (*Contarinia sorghicola*, Coq.), described by W. H. Dean; and the maize billbug (*Sphenophorus maidis*, Chittn.), by E. O. G. Kelly. The alfalfa caterpillar (*Eurymus eurytheme*, Boisd.) is dealt with by V. L. Wildermuth; it is very common, and does a good deal of damage in various localities. A very useful bulletin by L. O. Howard sets out various remedies against mosquitoes. The best mixture for keeping them off was found to be 1 part of oil of citronella, 1 of spirit of camphor, and ½ of oil of cedar; a few drops sprinkled on a towel and hung over the bed will keep mosquitoes away during the night. For the actual bite the most satisfactory remedy is said to be moist soap. Traps are described, and methods for the destruction of the insects over both large and small areas are set out.

Hydrocyanic acid has long been recognised as one of the most potent fumigating agents, but great practical difficulties are met with in its use, which so far have not been entirely overcome. If the concentration of the acid is too high the tree is killed, if too low some of the insects escape; further, the optimum concentration depends somewhat on the conditions. Thus there is almost an indefinite field of work for entomologists, and a stream of bulletins is issued on this subject. Among recent issues from the United States Bureau of Entomology are two by R. S. Woglum and one by C. C. McDonnell.

The work of the West Indian Department of Agriculture is published in the West Indian Bulletin, but summaries are also given in *The Agricultural News*, the fortnightly organ of the Department. In vol. xi., No. 2, of the bulletin H. A. Ballou gives a list of the insect pests prevalent during 1909–10, a corresponding list of the fungoid pests being prepared by F. W. South. This is the first occasion on which information of this nature has been collected, and it is proposed to repeat the reports each year in order to obtain some records of the increase or decrease of any given pests, and thus to determine the effectiveness of the preventive measures used for control. The value of such a plan is obvious, and it might with advantage be adopted in our own country.

Considerable interest attaches to the control of insect pests by natural parasites, and we note that in Barbados the hymenopterous parasite *Zalophothrix mirum*, Craw., was able to keep in check the black scale insect (*Saissetia nigra*, Nietn.), whilst in St. Vincent it was not so effective. Simple instructions are given in issues of *The Agricultural News* showing how planters may introduce the parasite among the insects, and thus increase its action; in No. 232, in particular, a summary of the whole subject is given. Active search for parasites of other pests is in progress by other departments; investigators were, for instance, recently sent from the United States to Panama to search for parasites of the citrus white-fly (*Aleyrodes citri*), of the cotton boll-weevil, and allied species.

A well-illustrated bulletin has recently been issued by P. L. Guppy on the life-history and control of the cacao beetle (*Steinastoma depressum*, L.), which for some years past has been a serious pest and a source of trouble to planters in Trinidad. Hitherto nothing definite seems to have been worked out in regard to its life-history, and its habits have only been superficially observed. Mr. Guppy's publication supplies much useful information on the insect.

WATER SUPPLY.[1]

THE question of water supply is in one aspect a scientific one, and in another aspect a political one. The source of all water supply is evaporation, which raises and purifies water which is taken up from the land and the sea, which after condensation is returned to us as rain, dew, snow and hoar frost, and these waters are to be found ready to our hand in springs, streams, lakes, and in the envelope of earth which is tapped by means of wells. In early days the water supply was a matter of hand to mouth. In the matter of water, at any rate, men drank water when they were thirsty—unlike the characters in Maeterlinck's "Palace of Happiness," who had, you will remember, the Luxury of Drinking when they were not Thirsty and of Eating when they were not Hungry. In the old days people, in relation to these ordinary articles of diet, acted upon the advice given in that old-world book "Sandford and Merton," and "only drank when they were dry." Yet even in the old days men in this country used water occasionally for washing, although the modern passion for baths had not developed in the dark ages. We find, however, that even in these early days there was a political aspect in water supply. The existence of springs in many cases determined the sites of cities. Many towns have been built on rivers partly because they were sources of water supply, but mostly when the rivers were navigable and afforded a highway for ships. Now, however, it is found that populations have increased to such an extent in certain localities, owing to the gregariousness of men and other political considerations, that the immediate sources have proved inadequate, and great towns in this country—like Rome in ancient days—have had to go a distance for their water supplies, and have had to construct great engineering works for the conveyance of water to the area of distribution. Water is at present collected and sold in England to a value of nearly 8,000,000*l.* annually, and when it is delivered at the house of the consumer it costs him about 2*d.* a ton.

Aqueducts, or channels by which water is conveyed along an inclined plane, were known to the Greeks, but there are no remains of those they constructed. The Roman aqueducts were amongst the most important of their great works, and the present supply of Rome is still carried by these artificial rivers, sometimes through passages cut in the hills, sometimes on arches bridging the valleys and carrying the water across the plains. One of these aqueducts is 62 miles in length. We in this country have had to go even further afield for our water sources. A large portion (56 per cent.) of the supply of Liverpool is brought from the River Vyrnwy, in North Wales, a distance of 68 miles. Leicester is 60 miles from the sources of the Derwent Valley Water Board supply; Birmingham gets its water from Radnorshire, a distance of 74 miles; and Manchester from Thirlmere, by means of pipes and aqueducts, a distance of 96 miles. Paris derives some of its water from the Champagne district through pipes and aqueducts 80 miles in length, and some from Vanne, a distance of 104 miles. There has, too, been a suggestion that London should draw its public water supplies from Wales, which would involve carrying the water about 200 miles. This scheme was first suggested by Mr. Bateman in 1867. He proposed to collect the rainfall on 204 square miles, and, by means of an aqueduct 173 miles in length, to bring 230 million gallons of water a day to London, and he estimated the cost at 11,400,023*l.* About the same time, too, there was a suggestion to carry the water of Ullswater and Hawswater, which it was said could supply 550 million gallons a day from an area of 100 square miles to the metropolis, supplying Liverpool, Leeds, Bolton, Bury, Blackburn, Huddersfield, &c., on the way. These great ideas were, of course, too large to be realised in these small times, and many of these towns have, since the suggestion was made, supplied themselves with water by means of comparatively small scale works instead of becoming parties in a national undertaking.

The difficulty of meeting the demands of such large towns is obvious, from the fact that it involves such great works and such heavy expense to secure an adequate supply.

[1] From a discourse delivered at the Royal Institution on Friday, March 17, by J. H. Balfour Browne, K.C.

To-day, the ratepayers of Birmingham are paying not only water rates, but contributing out of the ordinary rates 64,000*l.* a year to meet the heavy annual charges in connection with their Welsh scheme. Such a fact indicates that for places far from the sources of supply, and with wealth comparatively small to that of the great Midland towns, the difficulty of securing any supply for their future wants has become increasingly difficult, and may soon become impossible; and in this aspect the question of the future water supply of our populations becomes a significant political question, and because it is a matter of real importance to the health and trade of our great town populations, it has received no attention at all at the busy hands of our platform politicians. And yet, in my view, no matter is more worthy of serious consideration and attention, and none is more urgently practical, than the question of the future water supply of England. At one time England was able with its rich fields to feed its own populations, but, as trade prospered and populations increased, it was found impossible to produce food-stuffs sufficient for our people, and at present probably five-sixths of the total food of the people is imported from abroad. It is in this connection that current politics has taken in hand the problem how we are to continue to obtain these supplies from abroad; and while one school of politics thinks that the future is assured to us so long as the price of the loaf is not increased, another recognises the necessity of earning sufficient here to enable us to buy our food in other markets. But in relation to water supply we are in a worse predicament. We must depend for that on the rainfall of our own lands, and the improvident way in which our sources have been squandered in the past, the way in which the long arm of wealth has been allowed to appropriate sources which may not naturally or geographically belong to the community in question, the exhaustion of local sources, and the waste of underground water which takes place in connection with the mining operations of England, has much complicated the great question, and has made the future of Britain as to water supply both precarious and serious.

I have pointed out that the sources of supply are from springs, streams, and wells which tap the underground sources. There are in some quarters objections to rivers—full-grown rivers—as a source of supply, largely due to the fact that communities with insanitary rashness and short-sightedness have thrown their refuse and filth into streams, and made them the carriers of sewage. This matter was fully discussed recently in Parliament when the Great Yarmouth Water Company endeavoured to secure an additional supply of water to the town beyond that which it then drew from Ormesby Broad. We know, of course, that the rainfall in the Eastern counties is much less than in the west of England and Wales, and the company had been advised by most competent engineers that the most suitable source of supply was from the River Bure. The population above the proposed intake was very small, only one person to four acres, but still it could not be said that no sewage did find its way into the river. But even this insanitary indiscretion is condoned by nature, and rivers, especially rapid and turbulent streams, have a way of burning off effete matter which is put into its liquid charge. Whether this process of purification is absolutely effective or not is still a moot point, and chemists and bacteriologists are divided as to the safety in any case of drinking water which has been subject to sewage pollution. The great experiment of London has failed to convince some of these experts.

London derives the bulk of its water from the Thames. In the Thames watershed, above the Water Board's intake, there are at least 1,000,000 people and about 800,000 other animals. The London water is supplied to nearly 7,000,000 people. This is obviously a large experiment, for there are about as many people in Water London as in the two kingdoms of Norway and Sweden, about the same population as there is in widespread Canada. The water mains of London, according to the chairman of the Board, would reach from London to New York and back; and yet, notwithstanding the supply of river water, the health of London is exceptionally good. Indeed, there are some persons who seem to think that river water is really more wholesome than any other, and there is an interesting statistic produced in proof of this assertion. The death-rate of Great Yarmouth, which, as I have said, now takes its water from the Bure, is 15 per 1000; Chester, which is supplied from the Dee, 15·4 per 1000; and Greater London, which drinks water from the Lea and the Thames, has a death-rate of 13·3. But against this the death-rate of the great towns which have pure hill waters for their supplies are, in the case of Birmingham, 15·9; Manchester, 18·2; and Liverpool, 19·2. If statistics were absolutely convincing, the case for river water as against hill water would seem to be made out. But we must weigh statistics, and not allow them merely to count. It might almost as reasonably be suggested by anyone who was an opponent of municipal trading that the results were due to the fact that in the first three cases the water was supplied by companies and in the last three by corporations.

But, apart from any such questions, it is obvious that Thames and Lea water as supplied to London is far from being an unsatisfactory drinking water. But it is only fair to remember that just as in economics there is no such thing as "raw material," so in the case of our raw waters the water as delivered is in most cases a manufactured article.

It was always understood that mere sedimentation carried down a certain number of the germs which were contained in water, but the experiments of Dr. Houston and others show that millions of these germs in water artificially infected with cholera vibrios are dead at the end of a week's storage.[1]

It is in these circumstances that the Metropolitan Water Board has abandoned the idea of going to Wales for its supplementary water supply, and proposes, by a Bill in the present Parliament, to obtain power to construct a chain of reservoirs for the purpose of decanting the raw river water at Staines, and to spend 6,900,000*l.* on this great scheme which is to supply the wants of Greater London for the next thirty years—until, indeed, the population of the metropolis may be twelve millions.

But I was referring to the immense difficulty that any comparatively small town has in our days of securing a pure supply of hill water. So great is the difficulty that, as I have said, the Metropolitan Water Board has properly hesitated to go to Wales, having spent 47,000,000*l.* in the acquisition of the London water companies—the enormous difficulties of a Welsh scheme seem to have been too great even for the gigantic financial resources of London. It is not, therefore, a matter for wonder that a town like Great Yarmouth has to look to some near source of supply for the further wants of the town, and, as I have said, they were advised to have recourse to the Bure. There were the usual objections to river water, and in this case it was urged that the river which drains the Broads is in summer the home of a large floating population in house-boats and other craft. It was, on the other hand, said that the same objection might be made against the Thames, for the Thames above the intakes has, in a momentary lapse into poetic diction, been called "the water park of London." But here again the health of London was in evidence, and in the case of Yarmouth power was taken to prevent any house-boat anchoring within a considerable distance of the intake.

There was another objection urged to the taking of water from the Bure for town supply. When the wind was in the north-west the waters of the German Ocean were heaped up by the spade-work of the gusts, and when that happened at the same time as a spring-tide the waters of the Bure were held or backed-up, and it was said that, owing to the mixing action which takes place between sea and river water, the waters of the river at the point of intake would be salt or brackish. It was argued that it was ridiculous to supply a river water impregnated with chloride of sodium to two towns like Yarmouth and Lowestoft. But here science came to the help of the water company. The occasions when the north-west winds and the high spring-tide synchronised were of course very rare, and it was proposed by the Bill that whenever such an event took place and when there were more than 20 grains of common salt to the gallon (that is, in 70,000 parts) in the Bure water, the company should cease to pump from

[1] Dr. Houston has found, too, that even a week's storage of raw river water is an enormous protection against the "cultured" and "uncultured" bacilli of typhoid fever, and "that less than a month's storage is an absolute protection against typhoid fever."

the river, and supply the town only from the stored water of the Ormesby Broad. Sir William Ramsay, too, invented for the occasion a little instrument. It was a small glass cell, containing two copper plates. This was to be sunk in the river, and so long as the plates were in contact with the fresh river water no electric current passed between the plates. But when salt water was substituted for fresh, and it was sufficiently salt to have 20 grains of chlorine to the gallon, an electric current passed and rang a bell. If this little apparatus was placed in the river two or three miles below the intake, there would be timely warning of the uprush of the sea water, and it was explained that it could be made not only to ring a bell but to stop the pumping-engine. This apparatus was exhibited to the Lords' Committee, and, upon salt being added to the water, the bell rang.

It may be of some use if I say something about the sources and methods of supply. There is nothing very new about water supply. Even in deep wells we have been anticipated: Joseph's Well at Cairo is 297 feet deep, and some of the wells in China have gone to a depth of 1500 feet. In modern times we have in some cases been abandoning our well supplies. At one time almost the whole supply of Liverpool was drawn from wells in the New Red Sandstone. To-day she only draws 7·36 per cent. from wells—36·42 per cent. from Rivington and 56·22 per cent. from Vyrnwy. There is a well at Passy, near Paris, 1923 feet deep, and it delivers 5½ million gallons of water a day. In South Dakota there is a well which penetrates the earth's crust 725 feet and raises 11½ million gallons a day. In relation to the purity of such underground supplies, many of them in this country are derived from the chalk, and it is interesting to note the precautions which nature has taken to purify such supplies. It is found that such soils as chalk breathe air and expel gases just as the human lungs do. The breathing is long-drawn and irregular, and depends mainly on the barometric pressure of the atmosphere. But that such breathing takes place can be shown by the simple experiment of closing the folding doors over a chalk well and holding a lighted candle to the bucket rope-hole, and the sensitive flare will show the indraft or outdraft as the case may be; which varies, of course in intensity according to the extent of recent barometric changes. When water has to be got from underground sources, then a well has to be sunk, adits driven, a pump established, and the water raised to the clear water-tank. In some cases, however, nature not only does the purification of our water by its chalk lungs, but does our pumping for us, as in the case of an artesian well.

But not only have we been anticipated in the matter of wells; in aqueducts we are mere imitators of our predecessors, who even understood, it is obvious, the principle of the inverted syphon, as it is called, by means of which water is carried in pipes across valleys running down hill on the one side and up hill on the other; for Lyons, in France, was supplied long ago by means of lead pipes from 12 to 18 inches in diameter, 9 miles in length, and worked under a head of 200 feet. It is true that the favourite method of engineers before the nineteenth century, when cast-iron pipes came into use, was to cross valleys by bridge aqueducts, and this, apparently on the ground that the materials of their pipes (either trunks of elm-trees hollowed out, from which our word "trunk main" has survived to us, or lead) did not lend themselves to the conveyance of large volumes of water as the ordinary aqueduct did. The favourite system of supply in this country to-day is undoubtedly by means of a gravitation system, either from natural lakes like Loch Katrine or Thirlmere, or from artificial lakes—or, as they are called, "impounding reservoirs." These reservoirs, by means of a dam formerly formed of earth, with a core of impervious puddled clay, but now more frequently of masonry, catch and impound the water which falls upon the gathering ground. Of course, it is desirable to avoid a gathering ground which consists of cultivated land or upon which there is any considerable population. The best gathering ground is one composed of impervious rocks—for porous strata steal too much water—and covered only with mountain pasture or moorland. In many cases no objection is made to the existence of sheep upon the gathering ground; but Liverpool, in the case of its Rivington works, has purchased the whole of the gathering ground, and, after destroying and pulling down many of the farms and buildings, has kept a great part of the gathering ground free from sheep and let it to a sporting tenant. The largest gathering ground in this country dealt with by water works is the Birmingham gathering ground, which will collect the water from 44,000 acres, while the Thirlmere scheme of the Manchester Corporation has only a contributory area of 11,000 acres, and the Vyrnwy works of Liverpool Corporation only 22,000 acres.

Hundreds of dams have been built in this country to collect the waters from gathering grounds in connection with water supply to towns, or water supply to canals and waterways. The wall which impounds the water at Vyrnwy is 85 feet high. The Manchester Corporation, which had to deal with a natural reservoir, constructed a dam only 50 feet in height, but the masonry embankment at Caban Coch, the reservoir of the Birmingham Corporation, is 122 feet high above the bed of the river; and some of the other dams of that great scheme, when complete, will be 128, 120, 101, and 98. These walls, of course, have behind them immense quantities of water varying from 8000 million gallons, in the case of Birmingham, down to the very small number of gallons which run down a mill goit. The tensile strain or tear of such a mass of water as that at Caban Coch is enormous, and in that case the work is strong enough to bear such a strain up to 12 tons per square foot. The Bouzay dam, near Epinal, in France, which was bad in design and faulty in construction, gave way with the pressure of 1½ tons to the square foot.

On January 13 of this year a dam of a reservoir containing 250,000 cubic metres of water, which belonged to the Huelva Copper and Sulphur Company, Spain, owing, it is said, to a hidden spring under the masonry, gave way, and eleven people were drowned. That is near to-day, and affects us like a new wound. But even if none of us have memories which go back to 1840, tradition has told us of the bursting of the Bradfield Reservoir, which drowned the town of Sheffield, and put the country round for a distance of 12 or 14 miles under water. In that catastrophe 250 lives were lost, and property was destroyed to the extent of 327,000*l.* in value. The Holmfirth Reservoir, which had an embankment 90 feet high and 150 yards long, after heavy rains burst in 1854, and 100 people were drowned in that night, and property valued at 600,000*l.* was destroyed. In most of these cases, however, the calamity can be traced to the defective engineering skill which went to the construction, or subsequent carelessness in the maintenance. But many engineers would tell you that they have sleepless nights when one of these great cauldrons are filling with water for the first time—and people in the valleys below may well hold their breath until the stability of these great walls has been proved. In the case of the Bradfield Reservoir, the burst reservoir filled the Don Valley with a mad flood. In the town of Sheffield the water rose to the height of the roofs of low buildings. Dead cattle were carried down by the waters, and in some cases deposited on house-tops, and as in the days of Horace "fishes roosted in elms."

In the case of spring waters, these are collected where they issue from the earth from their underground recesses in protected tanks, and from these the water, which in many cases has been sufficiently filtered by nature, is conveyed to the clear-water tank, as in the case of surface water. But when, as in the case of surface water, nature does not produce a ready-made article, and the water is liable to surface pollution, then filtration is a necessity, and, as in many other cases, in this connection our ancestors were wiser than they knew. Indeed, experience is often more valuable than science, and is universally the foundation upon which all safe science is built. Sand filters have been used in Britain since about 1829. These filters are tanks from 6 to 8 feet deep. Over the floor drain pipes or channels lead to the outlet pipe, and over these we lay a layer of broken stones and gravel. These stones are laid to a depth of 2 or 3 feet, the larger stones being at

the bottom of the tanks, and the smaller bearing the 2 feet of sand, which was supposed to be the filtering and purifying medium. The water is allowed to percolate downwards at a certain slow rate, and the effect is to remove mechanically certain matters in suspension. For many years our chemical experts saw little or no value in sand filtration, because in chemical analyses they found little or no difference between the filtered water and the unfiltered raw water. But it was left to bacteriologists to find the real significance of sand filtration. We know now that after use a jelly-like deposit is formed on the top of the sand, and that that film has prevented the water from getting through the filters at the ordinary vertical rate of 4 to 6 inches an hour, or about 2½ million gallons a day per acre of sand. One ingenious engineer had the jelly scraped off the surface of his filter, and the water flowed more freely certainly, but there were within a few hours urgent telephonic messages from the bacteriological department announcing the arrival of thousands of bacillus coli, and that the water supplied by that company was not fit to drink. The fact is that it is the organic slime which is formed on the top of the sand, and which the sand is only useful in supporting, that is the effective agent in filtering the water, for the organic slime destroys the micro-organisms which are in impure water. It is in this respect that our ancestors, in using their sand filters, were wiser than they knew.

While the micro-organisms which cause cholera, typhoid, and tubercle are so rapidly conveyed to us by means of water, and then exercise their fateful activities, which bring us disease and death, there are beneficent bacteria which "come to succour us who succour want," and these are applied as a bastion or a defence against our enemies by means of the at one time despised sand filter. I think it was Napoleon who said that a wise general should not fight too often with the same enemy, for the enemy was apt to learn too much from his implacable foe. We have fought often with the bacillus of cholera and typhoid, and have learned of our battles. Nothing could be more tragic in the way of instruction than what took place at Hamburg and Altona in 1892. Both Hamburg and Altona are dependent for their water supply on the Elbe, but the intake for the Hamburg supply is above the town; the intake for the Altona supply is below Hamburg, at a place below the point where the sewage of that town, with its 800,000 inhabitants, is discharged into the river. The Hamburg supply had, therefore, a great initial advantage over that of its neighbouring town. But the cholera epidemic scourged Hamburg, and the Angel of Death passed very lightly over Altona. At Hamburg the deaths from cholera amounted to 1250 in 100,000, and at Altona to only 221 per 100,000 of the population. Where the division between the two towns was only the imaginary line down the centre of a street, and the houses on one side of the street, being in Hamburg, were supplied with the above-town water, and the houses on the other side were supplied by the below-town water, the cholera visited with fatal results the houses on the Hamburg side, while those on the Altona side were free from the disease in this new Passover.

These haggard statistics are to be accounted for only by the fact that the foul sewage-polluted water of the Elbe which was supplied to Altona was carefully filtered, while the comparatively pure water taken above Hamburg for the supply of that town was not. Altona had the protection of the micro-organisms in its sand filters. Hamburg had no such protection, and suffered accordingly.

A similar experience in relation to another water-borne disease—typhoid—has been put on record by the Massachusetts Board of Health. There in twenty years, from 1856 to 1876, the death-rate from typhoid in that State was 8·6 per 10,000 of population; in the years between 1876 and 1895, when private wells had been given up and a public supply of filtered water substituted, the death-rate was only 4·1 per 10,000, and between 1896 and 1899 the death-rate went down to 2·6 per 10,000. The State Board report says:—"The death-rate from typhoid fever has generally fallen as the percentage of the population supplied with public water has risen, for the reason that the majority of the deaths from this disease have occurred among communities and portions of communities not supplied with public water."

But an examination of our own Thames water at Hampton showed there were 1644 micro-organisms in twenty drops of water, and the water, after passing through the sand filters, was found to contain only thirteen such organisms in the same number of drops. The discovery of the 1644 germs was at the time so startling that the shares of one of the water companies dropped in value; and I think these 1600 did valiant duty in the arbitration which had to determine the value of the company's undertakings when they were being transferred to the Water Board.

But notwithstanding these startling vindications of sand filters, the great town of Chicago takes its water from Lake Michigan, which receives the untreated sewage of various towns having in the aggregate a population of more than two million people, and has not thought it necessary to subject its water to any preliminary purification before distribution. That town has, however, with curious inconsistency, diverted its own sewage from the lake, but it has undertaken that sanitary improvement only in connection with the commercial undertaking of the drainage and ship canal.

We know that one of the riddles of the politico-economic platform is, "What is raw material, and what is a manufactured article?" But we have seen sufficient to see that "raw water" is quite a rare commodity, and that most of our waters are manufactured articles. Even eastern countries like China and India have long "doctored" water with alum to get rid of clay by coagulation. But in this country not only do we get rid of the turpidity of water by sedimentation, but we purge the waters of micro-organisms, including pathogenic germs, by storing in large reservoirs, as well as by filtration. Very hard waters, waters containing lime and magnesia, are treated and softened by what is called Clarke's process. Everyone knows that chalk waters fur boilers and kettles, and that the bicarbonate of lime is precipitated by boiling; but Clarke's process consists of a chemical method which expels chalk by chalk, and is an ingenious application of science to the practical purpose of softening water which lengthens the life of boilers and saves soap. But, again, water may be too soft. Hill waters are sometimes too soft to be palatable. Water at Keswick is under half a degree of hardness; Loch Katrine water, 1 degree; Thames and New River water is about 14 degrees.

But it is found that distilled water, or soft lake or river water, acts with extreme rapidity upon lead, and many cases of lead poisoning have occurred in consequence of persons drinking waters which have been in contact with the lead of which distributing pipes are, for the most part, constructed. It has been said that sand filters remove the lead; but at present it is the rule to treat, or "doctor," these very soft waters, as is done at Sheffield, where, to overcome this difficulty, from half to (rarely) three grains of powdered chalk is added to each gallon of water with excellent results. It has been found, too, that loam or clay remove by merely carrying down organic or inorganic impurities from water; and it is certain that the precipitation of lime which takes place in Clarke's process has some effect in the same direction, although, from experiments made by Dr. Percy Frankland in connection with the Cambridge Water Bill of 1910, it does not seem to be a thoroughly effective method of purification. In connection with that Bill, a suggestion was made that suspicious waters—waters drawn from wells in the chalk in close proximity to certain villages—could be made perfectly safe by the chlorination of water; and it was stated that the ozone process which has been adopted in relation to certain waters forming part of the supply to Paris is also a useful and protective process in cases where waters are liable to organic pollution, and in which the danger-signal of bacillus coli is found. These instances are sufficient to show that water, to be potable, must pass through the hands, not only of the engineer with his filter and storage, but also through the hands of the chemist and bacteriologist: in fact, water, unlike the poet, is made, not born.

There is at the present time a good deal of sporadic information as to the water supplies and resources in various localities, and mining engineers have, from their experience, some knowledge of the subsoil or underground waters, for these, of course, are the enemy with which they have to contend in their operations; but there is no general survey to determine what are the supplies and what are the water resources of this country; there is no general knowledge as to the underground water supplies. We know that in many districts these are being pumped for supply; in many where mining is going on they are, with reckless economy, being pumped to waste. But what is required is a comprehensive knowledge both of the overground and underground reserve forces for water supply, and until that is prepared any legislation with regard to water supply must be merely hand to mouth, unscientific, and futile; and this seems to have been the wise opinion of Mr. Lithiby, of the Board of Trade, who gave evidence before the Joint Select Committee on the Water Supplies Protection Bill, which sat and reported during the last session of Parliament.

The necessity for the acquisition of such knowledge is emphasised by the proceedings and report of the Royal Commission which has been inquiring and reporting upon canals and waterways since the year 1906. No one can say that the investigations of that commission have not been exhaustive, although many may think that the reservations of Lord Farrer and three other commissioners seem to show that their labours will prove absolutely futile. But the commission has gone further, and proposes to improve the waterways of England, and great new or improved canals are to connect the Midlands and South Staffordshire with the estuaries of the Thames, the Humber, the Mersey, and the Severn. These four routes, which are, after all, only to be large barge canals, suited for barges of, in one scheme, 100 tons burden, and in another of 300 tons burden, are, in the report, referred to as the "cross," and if this gigantic scheme is carried out at an expense, according to Sir John Wolfe Barry's estimate, of, for the small scheme, 13,393,483*l*., or for the large scheme of 24,513,823*l*., certainly England would be financially crucified. But criticism of that imaginative proposal forms no part of my present purpose. It is only interesting to me to note that after the commission had adumbrated this idea, and ascertained approximately the cost of constructing the "cross," which, as I have said, would be a cross greater than England could bear, they bethought themselves how they were to get water for their canals—in the deplorable absence of the Alps—and they instructed an engineer to survey and inquire and to give them an estimate of the cost of getting the water. I have no doubt he did his work as well as he could. He found ready to his hand the admirable statistics as to rainfall which are collected by Dr. Mills, but complains, rightly enough, that "other questions connected with the national water supplies appear to receive less attention." Of course, it is quite an exception to find anywhere river gaugings, and the engineer in question says:—"This inquiry has shown the necessity, if such problems as those which the following reports attempt to solve are to be thoroughly investigated in future, of some public authority being charged with the duty of recording the flow of rivers, and of the proportion of the rainfall available or run-off in catchment basins overlying different geological strata in various parts of the country."

But this claim to water for canals, which, according to the reporter, would involve an expenditure of 1,194,000*l*., without including the cost of obtaining the power or the cost of water compensation, and is, of course, in addition to the sums estimated for construction by Sir John Wolfe Barry, raises again in an acute form the whole question of our national supplies, and points to the absolute necessity now of some systematic dealing with this great question. The nation is being forestalled by municipalities, and here is a suggestion that a Canal Board should lay a gigantic hand upon some of our sources of supply. The time for dealing with the matter is *now*; but, as in other cases, it is quite likely that the matter will be postponed until it is "too late."

SELF-LUMINOUS NIGHT HAZE.[1]

THERE is one phase of the night skies which does not seem to have received much or any attention. It is the occasional presence of self-luminous haze. This matter does not seem to be similar to the luminous night clouds, "die leuchtenden Nachtwolken," which were observed by O. Jesse and others some twenty-five or thirty years ago, and were found to be clouds at such great altitudes above the earth's surface (upwards of 50 miles high) that they received the sunlight long after or before the ordinary clouds. The observations of O. Jesse were printed in the *Astronomische Nachrichten*, Bd. 121, pp. 73, 111; Bd. 130, p. 425; Bd. 133, p. 131; Bd. 140, p. 161. In *Astronomische Nachrichten*, Bd. 140 (No. 3347), he gives a long list of altitudes, determined by photography, which range from 81 km. to 87 km. The mean value given by the observations from 1885 to 1891 was 82 km. (52 miles). These clouds were seen in the northern hemisphere only near the time of the summer solstice. In the southern hemisphere they were seen at the opposite season. From his papers it is clear that these sunlit clouds were in no way related to the present subject, and I only mention them to forestall any suggestion that they were similar to the ones seen by me.

The objects to be described here were apparently at the altitude of the ordinary higher clouds. They have been seen in all parts of the sky and at all hours of the night. In a paper on the aurora[2] I have previously directed attention to the frequent luminous condition of the sky at night. This feature long ago impressed itself upon me. Indeed, anyone who has spent much time under the open sky hunting comets, &c., will have been forcibly impressed with this peculiarity. In most cases this illumination has been due, evidently, to a diffusion of the general star light, perhaps by moisture in the air. This latter condition is present as a whitening of the sky, which gives it a "milky" appearance. At other times the sky is more or less feebly luminous; but the luminosity is different from the other condition, and is evidently not due to a diffusion of star light. In reality, the sky seems to be self-luminous. Sometimes the whole sky has this appearance, and at other times a large portion only. At times the illumination is so great that the face of an ordinary watch can be read with no other light than that of the sky. It is indeed seldom that the sky is rich and dark. In any determination of the total amount of the light of the sky the results must be uncertain, because of the great changes that so often take place in the amount of the illumination. The self-luminous condition frequently occurs when no ordinary indications of an aurora are present. It is, nevertheless, doubtless of an auroral nature, for Prof. Campbell has shown that the spectrum of the aurora is essentially always present on a clear dark night (*Astrophysical Journal*, 2, August, 1895, p. 162).

I have given an account[3] of the remarkable pulsating clouds of light that are seen here occasionally, which usually, but not always, have an easterly motion—generally south-east. They are mostly confined to the northern half of the heavens. There is another phenomenon that has been visible on a number of nights of last year, and also in the present year, of which I have seen no record. This consists, usually, of long strips of diffused luminous haze. I believe that this is really ordinary haze which for some reason becomes self-luminous. It is not confined to any particular region of the sky nor to any hour of the night. It always has a slow drifting motion among the stars. This motion is comparable with that of the ordinary hazy, streaky clouds that are often seen in the daytime. They are usually straight and diffused, and as much as 50° or more in length and 3° or 4° or more in width. In some cases they are as bright, or nearly as bright, as the average portions of the Milky Way—that is, they are decidedly noticeable when one's attention is directed to them. They apparently are about as transparent as ordinary haze. Sometimes, when seen near the horizon,

[1] From a paper read before the American Philosophical Society on April 21, by Prof. E. E. Barnard.

[2] *Astrophysical Journal*, 31, April, 1910.

[3] *Astrophysical Journal*, 31, April, 1910, p. 210, &c.

where they may be quite broad, they have strongly suggested the "dawn" or glow that precedes a bright moonrise. Their luminosity is uniformly steady.

The reason I refer to this matter as haze, and the reason I think it is only ordinary haze made self-luminous, is because on one occasion I watched a mass of it in the north-western sky which was slowly drifting northerly in the region of the great "dipper" of Ursa Major as daylight came on. These hazy luminous strips had been visible all the latter part of the night—new strips coming and going slowly, sometimes several being seen at once. As daylight killed them out I noticed, when the light had increased sufficiently, that there were strips of ordinary haze exactly the same in form and motion, and occupying the same region of the sky. I am sure they were the same masses that had appeared luminous on the night sky. My impression, therefore, is that these hazy luminous strips were only the ordinary haze which had for some reason become self-luminous. I am specially certain that these masses are not luminous as a result of any great altitude which might bring them within reach of the sun's light, for they were frequently seen in such positions that the sun's rays could never reach them. The sun or moon, therefore, had nothing to do with their illumination. It is also needless to say that they are not related to the pulsating auroral clouds which I have previously mentioned.

I have not noticed this luminous haze in former years, though it may have been present; and did it not seem unreasonable, one might suspect some relation between this condition of the atmosphere and the possible passage of the earth through a portion of the tail of Halley's comet on May 19, 1910.

It seems to me that these objects should be observed and a record made of the times of their visibility and their motion, &c. It would be valuable to have records of them from different stations to see if their luminosity is due to some general condition of the earth's atmosphere at the time. It is not probable that this luminosity is in any way due to local conditions. In the records here given, it is possible that on one or two occasions an aurora was also present, but I have tried to confine the accounts to what I have called, and believe to be, self-luminous haze. They were not seen previous to June 7, 1910.

[Prof. Barnard then gave details of observations made on various dates from June 7, 1910, to March 2, 1911.]

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

An advanced course of instruction on "The Systematic Design and Manufacture of Dynamo-electric Machinery" will be given at the City and Guilds (Engineering) College, South Kensington, during the forthcoming session, under the general supervision of Prof. T. Mather, F.R.S., professor of electrical engineering at the college. The course is to prepare men to take up positions as designers in electrical works. It will deal with present-day problems in design, construction, and testing, in a thoroughly practical manner. An experienced designer and draughtsman, specially engaged for the purpose, will devote his whole time to the drawing-office work in connection with the course. The course is intended for post-graduate and other duly qualified students, the number of which will be strictly limited. Application for admission to the whole course, or parts thereof, should be made by letter to the Dean, City and Guilds (Engineering) College, Exhibition Road, London, S.W.

The President of the Board of Education has appointed a departmental committee to inquire and report—(*a*) Whether it would be inconsistent with due regard to educational and hygienic considerations that the *minimum* standard of playground accommodation for new public elementary schools prescribed in the Building Regulations of the Board of Education—viz. 30 feet per head of accommodation—should be modified or adjusted according to the size, design, or situation of schools, the proximity of recreation grounds or open spaces, the density of population, the cost of land, or otherwise. (*b*) How far it is possible or desirable to define more precisely the standard of playground accommodation which the Board of Education will require under the Code of Regulations for Public Elementary Schools in the case of existing schools or to regulate the practice of the Board of Education in dealing with cases in which the playground accommodation is considered to be insufficient. The committee will consist of Mr. L. A. Selby-Bigge, C.B., principal assistant-secretary of the Elementary Education Branch of the Board of Education (chairman); Sir George Newman, chief medical officer of the Board of Education; Mr. J. C. Iles, H.M.I., divisional inspector for the North-western Division; Mr. F. H. B. Dale, H.M.I., divisional inspector for the Metropolitan Division; Mr. A. B. McLachlan, of the Local Government Board; with Mr. L. J. Morison as secretary.

The latest report of the U.S. Commissioner of Education gives some interesting statistics of the so-called land-grant colleges, established under the provisions of the Act of Congress of July 2, 1862, and receiving aid from the Federal Government from funds provided by Acts of Congress of 1890 and 1907. Each State received from the U.S. Treasury during the year ended June 30, 1910, the sum of 8000*l.* for the benefit of these land-grant colleges—commonly called agricultural and mechanical colleges—making a total of 400,000*l.*, exclusive of the sums paid for experiment-station purposes, expended by the Federal Government in aid of these colleges. There are sixty-eight of these institutions, sixteen of which are separate institutions for the coloured race. These colleges are in a period of rapid growth, shown by a marked increase in the number of instructors and students and the value of their property and income. The total number of instructors during the year in all departments of the sixty-eight colleges was 6665, of which 742 were women. The total number of students enrolled for the year was 80,646, an increase of 9·6 per cent. over the preceding year. The total value of the property held for the benefit of these colleges amounts to 23,568,600*l.*, an increase for the year of 910,000*l.* The total income from all sources, excluding the grants for experiment stations, was for the year about 4,180,000*l.*, an increase of some 459,000*l.* during the year.

The "Directory for Higher Education, 1911–12," issued by the Education Committee of the Staffordshire County Council, contains the regulations of the committee and details of schemes in operation throughout the county. Very complete provision is made for technological instruction, and among the subjects catered for the following may be mentioned:—Instruction in mining is provided by means of lecturers, whose whole time is devoted to the work, and their assistants. For this purpose the county is divided into two portions, comprising the North Staffordshire coalfields and the South Staffordshire coalfields respectively. Theoretical and practical classes in metallurgy and iron and steel manufacture are conducted in accordance with the regulations of the Board of Education and the City and Guilds of London Institute. Instruction is also provided in pottery and porcelain manufacture, boot and shoe manufacture, silk manufacture, and in wrought-iron work. In order to enable teachers in elementary and secondary schools to impart instruction in various branches of technical and manual training, the committee provides special classes at convenient centres. In localities where suitable instruction is provided already, classes in approved subjects are recognised by the committee, and with the object of encouraging the attendance of teachers at such classes, grants towards their railway fares are made. The work of the committee in rural districts falls under three heads: instruction directly supplied in special subjects, viz. agriculture, horticulture, hygiene, domestic subjects, and wood-carving and drawing; evening schools taught by local teachers, and earning a grant from the Board of Education; and experimental and demonstration plots.

The Charity Commission has given notice that it proposes to make an order establishing a scheme for the future regulation of the People's Palace in East London. The scheme sets forth that with reference to the administration of the East London College, in connection with

the Palace, by the Council, the charity and its endowments shall be administered by a body of governors fifteen in number. Of these the master and clerk of the Drapers' Company shall be two, the Drapers' Company shall nominate six, the Central Governing Body two, the County Council one, and four shall be coopted members. So long as university education is carried on by the Council in the present college premises, the governing body shall grant the use of them at a rent of 1*l.* per year. The scheme goes on to state that the Drapers' Company shall pay to the governing body the sum of 7000*l.* per annum. The company may, however, discontinue such payment on giving notice and, at the expiration of five years, paying for the purpose of the scheme the sum of 30,000*l.* If at the date whereon the payment of 30,000*l.* becomes due university education is being carried on in the present college premises, the money shall be applicable for the future maintenance of the East London College as may be directed by the Board of Education. So long as university education is carried on and the annual payment from the Drapers' Company is received, the amount is to be paid for the purposes of the East London College, and the scheme determines that the part of the endowment of the charity which is held for educational purposes consists of the present college premises, so long as university education is carried on there, the sum of 7000*l.* per annum so long as it is paid by the Drapers' Company or the 30,000*l.* to be paid by the company in the event of the discontinuance of the annual payment. The educational endowment is to be administered under the title of the East London College as a separate educational foundation for the promotion of university education.

WE learn from *The Pioneer Mail* that new buildings of the Poona Agricultural College were opened by Sir George Clarke, the Governor of Bombay, on July 18. The college at present consists of two large buildings, and another is in course of construction. In the main building all work except that relating to chemistry and physics will be done, the smaller one adjoining being devoted solely to these latter subjects. The complete course at the college lasts three years and includes practical farming, general chemistry, botany, agricultural engineering, veterinary science, agricultural climatology, entomology, and so on. During the course of his address Sir George Clarke said there is only one fault in the Bombay Agricultural Department: it is far too small, in comparison with the needs of cultivators and the vast magnitude of the task which it has undertaken. "If I were an Indian politician," he continued, "I should worry Government, in season and out of season, to spend more money upon the improvement of agriculture and the acquisition and spread of knowledge. We require much more research work because the problems of India are her own, and careful investigations carried on in other countries may be valueless in our special conditions. We want more demonstration farms where cultivators can receive an object-lesson by which the advantages of improved methods can be brought home to their minds. I should like to see many more lecturers employed in going about among villages to instil new ideas and to awaken interest. I think we should also establish rural schools where the elements of practical agriculture could be taught in the vernacular. The demands upon the Government are now so many and so insistent that we cannot do all we wish. If the nature and vast importance of agricultural work were more widely known, I am certain that our many wealthy and generous philanthropists would come forward to help. There can be no better proof of patriotism and no better way of promoting prosperity than the increase and development of the production of the land, which lies within our power if adequate means were available."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society.—Prof. J. H. **Poynting**: Small longitudinal material waves accompanying light waves. (Received July 26.)

All experiments on the pressure of light agree in showing that there is a flow of momentum along the beam. This flow is manifested as a force on matter wherever there is a change of medium. When the light is absorbed, the momentum is absorbed by matter. When the beam is shifted parallel to itself there is a torque on the matter effecting the shift. The momentum would therefore appear to be carried by the matter, and not merely by the æther. Though there is an obvious difficulty in accepting this view when the density of the matter is so small as it is in interplanetary space, it appears to be worth while to follow out the consequences of the supposition that the force equivalent to the rate of flow of momentum across a plane perpendicular to a beam of light acts upon the matter bounded by the plane. This rate of flow per square centimetre is equal to the energy density or energy per cubic centimetre in the beam. Of course, in experiments, only the average of the rate of flow during many seconds and the average energy per cubic centimetre in a length of beam of millions of miles is actually measured. But on the electromagnetic theory of light, which suggested the experiments and gives the right value for the pressure, this pressure is equal to the energy density at every point of a single wave.

Let us suppose that we have a train of plane polarised electromagnetic waves of sine form, the magnetic intensity being given by

$$H = H_1 \sin \frac{2\pi}{\lambda}(v - vt),$$

where H_1 is the amplitude of H. The electromagnetic energy per unit volume is $\mu H_1^2/8\pi$, and

$$\frac{\text{Energy in longitudinal waves}}{\text{Electromagnetic energy}} = \frac{\mu H_1^2}{32\pi\rho v^2} = \frac{1}{8}\frac{\mu H_1^2}{8\pi}\Big/\frac{\rho v^2}{2}$$

which is one-eighth of the electromagnetic energy divided by the energy which the matter would have if it were moving with the velocity of light in that matter.

This shows how infinitesimal is the fraction of the energy of the beam which is located in these waves of compression of the material.

The fraction is proportional to the intensity of the beam.

As an example, take a beam of the intensity of full sunlight just outside the earth's atmosphere, in which the energy flow is about $1{\cdot}4\times10^6$ ergs/sec. The energy density $\mu H_1^2/8\pi$ is therefore $1{\cdot}4\times10^6 \div v$. Put $v = 3\times10^{10}/n$, where n is the refractive index. The fraction is

$$\frac{1}{4}\cdot\frac{1{\cdot}4\times10^6\, n^3}{27\times10^{30}\,\rho}, \text{ or about } 1{\cdot}25\times10^{-26}n^3/\rho.$$

At the surface of the sun it would be about 40,000 times as much; say $5\times10^{-22}n^3/\rho$.

It is interesting to note that if a beam of light is incident on any reflecting or absorbing surface, and if the pressure of light is periodic with the waves, it must give rise to ordinary elastic waves in the material of frequency double that of the light waves.

EDINBURGH.

Royal Society, July 14.—Sir William Turner, K.C.B., president, in the chair.—Prof. F. A. **Forel**: Refractions at the surface of a lake, mirages, and *fata morgana*. In discussing mirages and refraction effects over the surface of a lake, one must distinguish between refractions in air over warm water and refractions in air over cold. In the former, with the warm layers below, the curve of refraction is concave upward; in the latter it is convex; and the horizon is, respectively, elevated above and depressed below its normal position. On a summer day, as the temperature of the air changes from being lower to being higher than the temperature of the water, there appears a phenomenon called by the Italian men of science the *fata morgana*. It has the appearance of a series of rectangles, as if some great cliff or the quays of an enormous city extended along the opposite side of the lake. The higher line of this striated zone coincides with the horizon of the refraction over cold water, and the lower line is continuous with the horizon of the refraction over warm water. The *fata morgana* is the fusion of the two types of refractions as the one succeeds the other.—J. Y. **Buchanan**: Experimental researches on the specific gravity and displacement of some saline solutions.

PARIS.

Academy of Sciences, July 31.—M. le Général Bassot in the chair.—R. **Radau**: The tables of the moon, based on Delaunay's theory. The solar perturbations of Delaunay, with some additional corrections suggested by Andoyer, may be considered as sufficiently exact from the point of view of practical astronomy, but there is still a lack of agreement with the observed figures as tabulated by Hansen. Means are suggested for further reducing the differences between the observation and calculation.—P. **Villard**: A self-recording electrometer with carbon filaments. A U-shaped carbon lamp filament, carrying a small cylindrical mirror made of a short piece of glass capillary tube silvered inside, forms the moving part of the electrometer. The sensibility of the instrument can be readily modified so as to be suitable either for use in an observatory or in a balloon.—Lecoq **de Boisbaudran** and A. **de Gramont**: The spectrum of gluanum and its bands in different sources of light. The wave lengths of the principal components of three bands (green, blue, and indigo) are given. The general similarity with the corresponding aluminium bands is pointed out.—Édouard **Heckel**: The genus Spermolepis of New Caledonia and its relations with the genus Schizocalyx.—M. **Javelle**: The Wolf comet (1911*a*). Observations made at Nice with the 76 cm. equatorial. Data are given for July 15, 20, 21, 22, 26, 27, 28, and 29. The comet appeared as a feeble nebulosity, about 10 inches in extent, and with a nucleus below the 14th magnitude.—M. **Esmiol**: Observation of the Brooks comet (1911*c*) made at the observatory of Marseilles with the Eichens equatorial of 26 cm. aperture. Data given for July 22. The comet appeared as a round nebulosity, 0·2′ in diameter, with a nucleus of about the 12th magnitude.—M. **Borrelly**: Observations of the Brooks comet (1911*c*) made at the observatory at Marseilles with the comet-finder. Data given for July 22 and 23.—A. **Korn**: An important class of asymmetrical nuclei in the theory of integral equations.—May Sybil **Leslie**: The molecular weight of the thorium emanation. An application of the apparatus used by Debierne (effusion through a small orifice) for the determination of the molecular weight of the radium emanation to the thorium emanation. The results show that the molecular weight of the thorium emanation is in the neighbourhood of 200.—Edm. **van Aubel**: Hall's phenomenon and the transversal thermomagnetic effect in graphite. Graphite shows Hall's phenomenon in the opposite sense to antimony, or in the same sense as pure bismuth, like the other varieties of carbon.—L. **Dunoyer**: Researches on the fluorescence of the vapours of the alkaline metals.—William **Duane**: The mass of the gaseous ions. Under the experimental conditions described in the paper, all the results obtained were opposed to the hypothesis of the existence of positive ions.—J. **Danysz**: The β rays of the radium group. The β rays from the radium emanation have yielded a magnetic spectrum of seven homogeneous bundles, the velocities of which have been exactly determined.—Eugène **Cornec**: The cryoscopic study of some mineral acids and some phenols. The method used consists in neutralising the acid or phenol gradually by a strong base and determining the freezing point for each mixture; the neutral point is indicated by an angular point on the curve.—H. **Pélabon**: The metallography of the selenium-antimony systems. The results obtained confirm the conclusions drawn in an earlier paper from a study of the fusibility curves.—M. **Jouguet**: Indifferent points.—F. **Bodroux** and F. **Taboury**: The action of bromine in presence of aluminium-bromide on cyclohexanol and cyclohexanone.—F. **Bodroux**: The action of anisaldehyde and piperonylaldehyde upon the sodium derivative of benzyl cyanide.—A. **Barillé**: The action of soda water upon lead, tin, and antimony. The causes of poisoning by chemical alteration. More lead and tin are dissolved by soda water from an alloy of tin and lead than from either of the pure metals, and this is true even for an alloy containing only 0·5 per cent. of lead. The author concludes that all the metallic parts of a soda-water siphon ought to be protected by enamel or similar means from contact with the liquid.—Marcel **Badouin**: Study of the action on the brain of the annular deformation of the skull of the Gallo-Roman period.—Maurice **Arthus** and **Boleslawa-Stawska**: Poisons and antipoisons. A criticism of the results of experiments by C. J. Martin and T. Cherry, on the interaction of a toxin and antitoxin *in vitro*. The authors' experiments with mixtures of cobra-venom and its antiserum lead to the conclusion that the neutralisation of the venom by the antivenom is practically instantaneous, and rather resembles the neutralisation of an acid by a base than a diastatic action. The same conclusion was arrived at when working with the venom of *Lachesis lanceolatus* and of *Crotalus terrificus* and their corresponding antivenoms.—M. **Mazé**: Researches on the formation of nitrous acid in the plant and animal cell.—Gabriel **Bertrand** and Arthur **Compton**: The influence of the reaction of the medium on the activity of cellase. A new distinction from emulsine.—E. **Voisenet**: A ferment causing bitterness in wine, a dehydrating agent for glycerol. An account of the isolation of a bacillus, capable of transforming glycerol into acrolein.—C. **Levaditi** and S. **Muttermilch**: The diagnosis of sleeping sickness by the examination of the attaching properties of the serum.—Jules **Welsch**: A depression of the Lower Eocene north of Blaye in Cosnac (Charente-Inférieure).

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