THURSDAY, FEBRUARY 4, 1909.

A SURGEON AND A PATHOLOGIST ON CANCER.

(1) *The Natural History of Cancer, with Special Reference to its Causation and Prevention.* By W. Roger Williams. Pp. xiv+519. (London: W. Heinemann. 1908.) Price 21*s*.

(2) *Lectures on the Pathology of Cancer.* By Dr. Charles Powell White, Pilkington Cancer Research Fellow. Pp. vii+83; 33 figures. (Manchester: University Press, 1908.) Price 3*s*. 6*d*. net.

(1) THE author of this volume has contributed extensively to the literature of cancer from 1882 onwards. Both from the scope and from the duration of his inquiries into the various manifestations of this disease in man, he would certainly seem to have earned the right to express opinions to which other students of the subject must give consideration. The volume contains an immense amount of material, partly the harvest of the author's own experience and partly culled from the literature of the subject. This rich collection of facts, with complete references to the original sources, while evidence of the wide reading of Mr. Williams, must also make the volume valuable in the limited spheres of which it treats as a book of reference for workers on cancer.

Unfortunately it has not been the author's desire to make the compilation and digest of much of the literature of cancer the main purpose of his book; indeed, in this field he has been forestalled by a masterly digest of the literature, which is at the same time an admirable history of the advance in knowledge of cancer, by Dr. Jacob Wolff, "Die Lehre von der Krebskrankheit" (Jena: Fischer, 1907). Rather would the author direct attention to what he is pleased to stigmatise as "the extraordinary concatenation of blunders with which the history of the experimental study of cancer is cumbered," and to the "stagnation of comparative pathology." These serious charges are made because Mr. Williams's "work has hitherto received no recognition from contemporary pathologists occupied with various will o' the wisps," and because his voice has been crying in the wilderness since 1888, when, by the publication of "The Principles of Cancer and Tumour Formation," he attempted to "repair Virchow's error, by laying the foundation of a modified cellular pathology, in harmony with modern biology."

The author is at his best when dealing with the clinical course and the pathology of the disease in man, of which, as a surgeon, he has ripe experience; but most of what he has to say of value appeared in "The Twentieth Century Practice of Medicine," vol. xvii., 1899. It is to be regretted that in the fields of general biology he exhibits that combination of imperfect knowledge and intolerance of the conclusions of workers in spheres outside his own, which, only too frequently, have been features of the contributions of a few other authors who during the past three years have settled the problems of cancer to their own satisfaction in almost equally bulky volumes.

Mr. Williams is obviously not equipped to deal with the natural history of cancer in the wider sense. Analogies between lumps of tissue in the higher plants and in the higher animals have no dangers for him in a chapter on "Tumours in Vegetable Organisms," at the end of which he refers the Acari to the order Insecta. On p. 205 he writes:—

> "It has recently been demonstrated by Boveri and Delage, that denucleated eggs of the sea urchin can be fertilised, when they give rise to the normal gastrulæ and larvæ; so that . . . the nucleus is not the sole vehicle of heredity."

Of course, Boveri's experiments led to quite the contrary conclusion. They demonstrated that the gastrulæ had the characters of the strange species introducing the male nucleus. Mr. Williams's prejudice in favour of his own case is well illustrated by his allusion to Darwin and Haeckel as "the great lieutenants" of Herbert Spencer, and by his bald statement (p. 357), "I also believe that acquired characters are hereditable." "The phenomena of parthenogenesis are of much interest, as representing a transition from sexual to asexual reproduction," is another positive statement of a dubious validity (p. 207). His main argument is that the frequency of cancer goes hand in hand with the average well-being. The inhabitants of Norway—among whom the death-rate from cancer is about the highest in Europe—are *therefore* pictured as the best nourished in Europe. Any Norwegian or Swede would have informed the author that his assumption is erroneous. Referring to the frequency of cancer of the skin of the abdomen in Kashmir (p. 36), where a charcoal oven is worn round the waist, he asserts that "the disease is probably more akin to keloid than to cancer, and, like the former, it is probably due to microbic infection." As a matter of fact, the disease is well known to be cancer of the skin, to form secondary growths in the adjacent lymph-glands, and to follow prolonged chronic irritation.

These and many equally erroneous dogmatic statements, together with the violence of his language when referring to work—biological, pathological, statistical and experimental—incompatible with the views Mr. Williams holds, show that he is unable to interpret his facts without prejudice. It is not surprising, therefore, to find that many of the major problems of cancer which still await solution are, for the author, matters no longer admitting of discussion. Indeed, in his preface he claims:—

> "I have devised a new method of cancer research—which may be called synthetic—whereby I have shown that there are modes of life, various habits and so forth which tend to prevent the incidence of cancer almost entirely in healthy stocks, and greatly to reduce its ravages even among the hereditarily disposed."

The volume contains not a particle of evidence to justify this claim, which is all the more deplorable in that the author goes out of his way time and time again to pour ridicule on the reasonably substantiated claims of other workers to have made some slow progress by the application of the experimental method, but who, more modest than himself, still remain *non magistri sed discipuli naturae* in regard to cancer.

(2) Dr. Powell White's volume is in many respects an antithesis to that of Mr. Roger Williams. A pathologist by profession, his aims and methods are entirely different. The volume does not profess to contain the whole pathology of cancer, and it is a model of scientific self-restraint. Unlike Mr. Williams, Dr. White extends a whole-hearted welcome to recent experimental work. In four chapters the author covers in simple language much that is of main interest in the present phase of investigation of cancer, the study of which he rightly insists may not be separated from that of tumours generally. To this end he classifies tumours according to their histological structure and relation to normal tissues, and dismisses a classification based upon embryological conceptions as unscientific and useless. He then proceeds to discuss the rudiment of origin, the mode of growth and extension, the clinical features, and the relations of cancer to organisms attacked. In the latter connection it is pointed out that in studying questions of metabolism in individuals naturally attacked, it is difficult to separate the effects of the cancer *per se* from those due to the disturbance of the organ affected. The author is no doubt aware that when cancer is implanted into normal animals this complication is got rid of, and the effects of cancer *per se* obtained pure. Mr. Roger Williams and Dr. Powell White agree that there does not appear to be any specific cancer toxin, and in conformity with modern conceptions "cachexia," or wasting, is regarded as a secondary accidental consequence, and not as a necessary antecedent or concomitant constitutional condition. Original and suggestive work is recorded on the occurrence of cholesterin, fatty, and other crystals in cancer and in the adrenal cortex, and it is hinted that cholesterin plays some part in the regulation of cell proliferation.

The longest chapter in the book is devoted to causation. The evidence for and against extrinsic and intrinsic causation is discussed. A congenital origin is discarded, and a parasitic causation rejected as being entertained mostly by surgeons and bacteriologists who do not appreciate the pathological and biological difficulties which the hypothesis involves, and because, while its upholders never think it necessary to answer the criticisms against it, they continue to bring forward the same old arguments in its favour. This may be too sweeping a criticism of all the work done on the hypothesis that cancer might be a parasitic disease, for, although negative, this work certainly cleared the air, and those who have participated in it have done perhaps more to prove one another wrong than many pathologists who have persistently played the part of scoffing spectators. Still, we entirely agree with Dr. Powell White that the term parasitism can be applied only to the biological behaviour of the cancer cell itself; any further analogy with the processes of known forms of infective disease is certainly erroneous.

The author considers that extrinsic factors long known to play a part in the causation of cancer are adjuvant, and not essential, factors, and in defining the intrinsic causative factors he comes to the conclusion that a tumour arises from a disturbance of a position of unstable equilibrium between the proliferative forces within the cell and the antagonistic influences of the neighbouring cells. In short, the author seeks his explanation vaguely in the continued removal or diminution of the influences which restrain proliferation, in a disturbance of what is defined as "physiological equilibrium." The phrase physiological equilibrium, when applied to the phenomena of cell life, is, however, just one of those phrases which, while appearing to define something, really defines nothing. It is merely a vague re-statement of the problem, and disregards the fact that the cell is really a very complex mechanism of the component parts of which and their inter-relations we are continually learning more. Dr. White alludes to the progress that is being made by the experimental study of cancer in mice, and incorporates many of the results as bearing upon cancer in man. Now that it is possible to study the life-history of the cancer-cell experimentally, we may hope that ere long Dr. Powell White's vague explanation may be replaced by some more precise definition of the mechanism responsible for the ceaseless proliferation of cancerous cells, in regard to which, and its relations to constitutional conditions of the body, already much that is new is being learned. The volume, which is the outcome of work generously endowed by Mrs. Pilkington and encouraged by Prof. Lorrain Smith, is well illustrated with statistical charts and photomicrographs, and its perusal must prove profitable to all who wish to be brought up to date in the biology of cancer. E. F. B.

MAN'S ANCESTRY.

Unsere Ahrenreihe (Progonotaxis Hominis)—kritische Studien über phyletische Anthropologie (Festschrift zur 350-jährigen Jubelfeier der Thüringer Universität Jena und der damit verbundenen Ubergabe des phyletischen Museums am 30 Juli, 1908). By Ernst Haeckel. Pp. iv+58; 6 plates. (Jena: Gustav Fischer, 1908.) Price 7 marks.

DURING the last four decades Prof. Haeckel has so often sketched a hypothetical genealogical tree representing the series of man's supposed ancestors, stretching right back to the remote Protozoa, that his name as the author of a treatise bearing the title at the head of this column will convey to most readers a very precise idea of the general nature and scope of the work.

The book, in fact, is a new edition of the familiar story of man's "phylogeny," brought up to date by the incorporation of many of the results of recent morphological and anthropological research, such, for example, as Semon's, Schwalbe's and Klaatsch's work. That it is embellished with a rich profusion of characteristic new terms is not surprising, when we remember that Haeckel has always been pre-eminently the godfather of the nomenclature of phylogeny.

Turning directly to his "phylema primatum," which is the main theme of the work, he believes that even in Cretaceous times there was a succession of small "mallotheria" (primitive placenta-bearing mammals or prochoriata), from the earliest of which the ancestors of the Marsupialia were derived, while the later members of the series became the progenitors of the Prosimiæ—the Lemuravida. The facts elucidated by the study of the comparative anatomy and embryology of the apes favour the hypothesis that the earliest (Oligocene or Miocene) platyrrhine monkeys constitute the connecting link between the Eocene Prosimiæ—Lemuravida—and the catarrhine phylum. He speaks of the phyletic unity of the latter (catarrhine phylum), and looks upon man as its highest branch. His succession of catarrhine ancestors of *Homo sapiens* consists of (1) the oldest cynocephali (Papiomorpha), represented to-day by such forms as the baboon; (2) the later cynocephali (Presbytomorpha), such as Nasalis; (3) the oldest man-like apes, such as the gibbons; (4) the later man-like apes, such as the orang and chimpanzee; (5) ape-men (*Pithecanthropus erectus*); and (6) primitive man (*Homo primigenius*).

He disarms the obvious criticism, which most zoologists will make of such a work as this, by repeating the oft-expressed assurance that his "suggestions regarding the phylogeny of man (and their obvious expression in the form of a genealogical tree) are not to be regarded as dogmatic axioms, but rather as *heuristic hypotheses*, intended merely to point the way in a field of research, which is as difficult and obscure as it is interesting and full of significance."

He has a considerable measure of justification for his claim that, in the great progress of anthropological knowledge in recent times, many statements regarding man's ancestry, which he put forward as little more than mere speculations forty years ago, have now been proved to be demonstrable facts.

The book contains a series of excellent illustrations of a cranium of *Homo sapiens*, compared with those of *Homo palinander* (an aboriginal Australian), a chimpanzee, a gibbon and a mandrill, and also a series of three corresponding stages in the embryonic development of nine different mammals.

G. ELLIOT SMITH.

AN ATLAS OF GEOGRAPHICAL EXERCISES.

Practical Exercises in Physical Geography. By Prof. W. M. Davis. Pp. xii+148; atlas of 45 plates. (Boston and London: Ginn and Co., 1908.) Price 3s. 6d.

THE laboratory steadily replaces the lecture room. The use of laboratory methods in elementary education has at length affected geography, and the former inadequate school exercises are being replaced by others over which the students must think for themselves. To help this change, Prof. W. M. Davis, the chief American prophet in the reform of geographical teaching, has designed an atlas of geographical exercises, accompanied by an explanatory text-book, and based upon his well-known geographical cycle. The atlas consists of forty-five plates, including at the end a few topographical maps of actual places, the usual charts to show the distribution of temperature, winds, and ocean currents, and six maps that give the outlines of each of the continents except Australia. The rest of the plates are ideal maps and sketches, which show the development of valleys, the growth of coasts and coastal plains, the characters of plateaus, the formation of residual mountains by denudation, and the structure of volcanoes. The sketch-maps all teach their lesson simply; there are not the irrelevant details with which Nature usually confuses her illustrations. A page or two of fancy pictures and maps are now inserted in most elementary atlases, but they merely illustrate geographical terms. Prof. Davis adopts this diagrammatic method for more advanced work, and his series of carefully planned exercises brings into due prominence the fundamental conceptions of physical geography. The maps offer excellent geographical exercises, and should be most useful where adequate time is devoted to geography.

Prof. Davis in his preface compares the use of ordinary maps for the first lessons on physical geography, to teaching elementary arithmetic from the books of a large commercial establishment. But this very comparison suggests a doubt whether these exercises could be widely adopted in British schools. Arithmetic is very unpopular with many school children, because they are not attracted by its logical progress, and they are discouraged by the apparent remoteness of its rules from the affairs of life. The effort is therefore made to teach arithmetic by the use of necessary every-day calculations, of which children can realise the practical value. Prof. Davis's system sacrifices the one advantage which ordinary geography shares with technical over purely academic education. To work through the whole of the exercises given in this book would occupy all the time allowed for geography in many elementary schools. The students would leave well prepared for the intelligent interpretation of maps, but they would not know the ordinary facts of political geography; whereas the study of actual instances, especially of local examples that can be checked by field observations, gives the children a keener interest in their work, an equally sound grasp of principles, and a store of useful facts indelibly impressed upon their minds.

In countries where school time is not used up by Latin and Greek, where modern languages are less important than they are in Europe, and public interest in education is not confined to the question of religious instruction, there may be time for students both to learn the geographical principles from such exercises as those of Prof. Davis, and subsequently to learn the necessary stock of facts. But as education is conducted in this country, the amount of time usually devoted to geography is so small that it is doubtful whether sufficient could be spared for Prof. Davis's exercises, though it is to be hoped that teachers will study them, and thus benefit by the last of his many contributions that have given life to geographical education.

J. W. G.

GRAPHICAL HYDRAULICS.

Water Pipe and Sewer Discharge Diagrams. By T. C. Ekin. Pp. 21. (London: Archibald Constable and Co., Ltd., 1908.) Price 12*s.* 6*d.* net.

OF all empirical formulæ devised for the solution of practical problems in natural science, hydraulic formulæ are perhaps the most involved and complex, and of all hydraulic formulæ it is doubtful whether there be a more formidable expression than the coefficient in Ganguillet and Kutter's formula for the flow of water in pipes and channels.

The general expression, and that which is now commonly recognised as furnishing the most trustworthy basis for the estimation of current velocity in such cases, is the equation devised by Chezy towards the close of the eighteenth century, viz. $V = C\sqrt{RS}$, involving the hydraulic mean depth (R) and the sine of the slope (S) in conjunction with a coefficient C.

As determined by the classical researches of Ganguillet and Kutter (the formula is more generally associated with the name of the latter only of the two eminent Swiss experimentalists), the coefficient takes the form:—

$$C = \left[\frac{a + \frac{l}{n} + \frac{m}{S}}{1 + \left(a + \frac{m}{S}\right)\frac{n}{\sqrt{R}}}\right]$$

in which *a*, *l*, and *m* are respectively in English units, 41·660475, 1·811325, and 0·0028075, and *n* is a variable depending upon the degree of roughness of the surface.

The labour involved in working out casually, and as necessity arises, a particular value from so cumbrous an expression is sufficiently obvious, and it is not surprising that a number of attempts have been made to supply some ready solution applicable to different data by the construction of curves and graphical diagrams.

The author points out that hitherto such curves have not dealt with gradients exceeding 5 per 1000, and that steeper gradients are often required. He has, therefore, worked out a series of curves giving the discharges of pipes ranging from 3 to 48 inches in diameter, and the velocities, when running full, on gradients from 5·28 feet per mile, 1 in 1000 or 1 per 1000, up to 79·2 feet per mile, 1 in 66·6 or 15 per 1000, and embodied the results in four large diagrams in which each discharge curve is the result of twenty-two separate calculations, and each velocity curve has been calculated for each point in which it cuts the discharge curve.

These diagrams are not strictly derived from Kutter's original formula, but from Flynn's modified statement of it, with *n* and S (=0·001) taken as constant throughout the series of curves, and $\sqrt{R}$ varying with each diameter of pipe. The coefficient of roughness of surface (*n*) has been fixed at 0·013, as most applicable to practical work under ordinary conditions. There are a number of cases, however, in which pipes calculated with this value give results either too large or too small, and with the view of making the diagrams apply to several coefficients of roughness, the author has calculated a series of constants, embodied in a separate table. There are six tables in all, forming an appendix, yielding detailed information respecting pipe flow and hydraulic data generally.

The compilation should prove of great utility to those engaged upon problems of water supply, sewage disposal, and practical problems of a kindred nature.

BRITISH OAK GALLS.

British Oak Galls. By E. T. Connold. Pp. xviii+169; 68 plates. (London: Adlard and Son, 1908.) Price 10*s.* 6*d.* net.

MR. E. T. CONNOLD has already given us a very valuable work on "British Vegetable Galls," but in that work, as the author states in the preface, the galls of the oak are not included, as he intended to publish a separate book dealing with them. This book has now appeared, and in every way it comes up to the standard of the larger work. A great feature of the book is the many life-like and excellently reproduced photographs of actual specimens of galls.

The oak is the abode of some five hundred different species of insects and other animals which subsist mainly on the leaves. Some are parasitic on the larvæ of the gall makers, and others are inquilines, which subsist on the tissues of the galls.

In his introduction the author touches upon some historical matters, and in chapter i. several very interesting and at present not fully understood phenomena in connection with the formation and colours of galls are discussed. Chapter ii., which deals with the characteristics of oak-gall growth, such as position, duration of growth, variations in shape, size and colour, &c., is also a very interesting chapter to the student of oak galls.

Chapters iii. and iv. deal respectively with the numerical aspect of oak galls and the Cynipidæ affecting the oak. The latter chapter is intended to present in a concise form such information as may be necessary for the collector or student who may not have ready access to other books which deal with these interesting and remarkable insects.

Chapter v. gives a short description of the genus Quercus, and especially of the British oak. In chapter vi. many useful hints on the collecting and mounting of oak galls are given. The rest of the book deals individually with the various species which cause oak galls. A synoptical table is given, also a table of the months in which the galls illustrated in the book may be found. A list of mid-European oak galls, with brief characteristics and position the gall occupies on the tree, is added, and will prove a great help to many. A useful index is also included.

This volume, the author tells us, is the outcome of fifteen years' study and practical research in the field. He is glad to say that he has been able to describe several galls not mentioned in any other English publication. Still, in spite of this great amount of time and study, the author does not claim completeness for his work. In the preface he says:—

"There is much more to be ascertained concerning the growth of oak galls, and one purpose of the following pages will have been accomplished if they are the means of inspiring somebody to further unfold the subject."

The volume is certainly a very welcome addition to the literature, and can be warmly recommended to those interested in insect life, as well as to proprietors, foresters and all others interested in the growth of the British oak.

PRACTICAL ASTRONOMY.

Cours d'Astronomie. By H. Andoyer. Second part. Astronomie Pratique. Pp. 304. (Paris: A. Herman and Sons, 1909.) Price 10 francs.

TO provide anything like a complete account of the methods of instrumental astronomy, whilst keeping the work within limits suitable for a course of university lectures, is not a practicable task. The second part of Prof. Andoyer's "Cours d'Astronomie" is much more bulky than the first part (which was devoted to theoretical astronomy), yet there is everywhere evidence that the author has been harassed by want of space, and is obliged to omit details which are often of the highest practical importance. He himself is keenly sensible of this limitation; again and again throughout the work he repeats that his treatment must be confined to a general indication of the methods, without entering into details.

The point of view of the work is thus necessarily academic, and differs somewhat from that of the practical observer; nevertheless, in the descriptions of instruments and accessories much interesting practical detail is given, which is not usually found in astronomical text-books. It is clear that great care has been taken that all such information should be trustworthy; in fact, the precision and accuracy which distinguished the first part of the course are again noticeable in this part. We may, however, point out one or two questionable passages; it is stated that the chronographic method is only used for meridian observations made at observatories (p. 63). It is difficult to understand why the author should have supposed that the method is thus limited; it is not so in practice. Again, we read that in determining differences of longitude of the great observatories, in spite of all precautions, and in spite of the skill of observers, "on est loin de pouvoir répondre du dixième de seconde de temps." Prof. Andoyer must have been misled into this generalisation through some exceptional discordances in one or two of the classical determinations of longitude. In recent determinations a much greater accuracy is normally attained.

The first part of the book deals with such subjects as interpolation, the theory of errors, and the method of least squares. Common accessory apparatus, including the graduated circle, micrometer and spirit-level, is next thoroughly discussed. Three instruments are selected for specially detailed treatment; these are the theodolite, the equatorial, and the transit circle. The theodolite is probably chosen because it is likely to be more familiar to the student than a more strictly *astronomical* instrument. It is doubtful, however, whether the theodolite serves as a good introduction to instrumental astronomy or well exemplifies its principles; and the same may be said of the equatorial when used for making absolute (as opposed to differential) measures. The fundamental principles of practical astronomy are not to be found in the development of the formulæ for a general type of instrument; its main problem is the design and use of specialised instruments, in which the mechanical errors are few, and can be as far as possible determined and eliminated. We feel that the treatment of the transit circle has suffered somewhat from the devotion of so much space and the priority accorded to the theodolite and equatorial, though it must be admitted that in his account of it the author has compressed a wonderful amount of matter into a concise form. Besides the three chief instruments, numerous others are briefly described; these include the zenith telescope, coudé equatorial, heliometer, siderostat, and cœlostat.

In most cases this short treatment appears to be sufficient (though we doubt if any reader will be able to picture to himself the coudé equatorial from the description given); but when the whole subject of astrophotography is likewise dismissed in half a page, some protest seems to be required. Surely this branch of astronomy has now attained a development and importance sufficient to secure for it a place in the text-books. It cannot be urged that the subject is unsuitable for inclusion in the university course; the theory of transformation of coordinates and the formulæ involved should surely appeal more to the mathematical student than the study of the small errors of a transit instrument.

Among the other subjects considered may be noticed an excellent chapter on the fundamental constants of astronomy. Although limitations of space preclude a detailed discussion of the methods of avoiding error, a very fair idea is given of the difficulties and uncertainties involved in the determinations. We are glad to see that in a complementary chapter an explanation of Gauss's method of determining an orbit from three observations has been included in the course.

A. S. E.

OUR BOOK SHELF.

Water Hammer in Hydraulic Pipe Lines. By A. H. Gibson. Pp. iv+60. (London: A. Constable and Co., Ltd., 1908.) Price 5*s*. net.

THE phenomenon of water hammer in pipe mains is one familiar to all who have had any practical experience in matters of water supply, either for domestic consumption or for power purposes. Indeed, it is safe to say that it comes within the observation of most people. There can scarcely be a householder who is not aware that the abrupt closing of a tap, or valve, produces a violent and perfectly audible concussion in a water pipe, though perhaps he may not realise that the shock, if repeated with sufficient frequency, is capable, in process of time, of producing rupture, unless the pipe possess a very large margin of strength to resist so considerable an excess over the normal pressure, or unless a relief valve be provided. This latter expedient is most generally adopted in all important installations, where the consequences of a sudden outburst would be serious, if not disastrous.

In the case of a phenomenon of such common occurrence, it is somewhat remarkable that there is quite a paucity of investigation into its features and effects. Most text-books on hydraulics content themselves with merely a passing reference, and make no attempt to elucidate any of the interesting and practical problems suggested by the subject. This omission Mr. Gibson has sought to make good by the publication of the results of a series of useful experiments which he has carried out in the engineering laboratories of Manchester University.

The experiments were made with the object of determining the actual rise and fall of pressure in a pipe line due to the gradual, or sudden, closing, or opening, of a valve. For this purpose a cast-iron pressure main was used, of $3\frac{3}{4}$ inches diameter, 560 feet in length, conveying water from an elevated tank, 107 feet above the laboratory floor. The results of four series of experiments are graphically represented, and these and other observations are tabulated in comparison with theoretical values obtained from a formula the construction of which is fully explained.

Mr. Gibson takes his subject-matter a step further, and includes a very useful little chapter dealing with the application of the principles established to the theory of turbine regulation. Altogether, this small volume is an exceedingly welcome recruit to the ranks of original experimental research literature in a branch of natural science which itself is of the greatest practical value to mankind.

Valve-gears for Steam Engines. By Prof. Cecil H. Peabody. Second edition, revised. Pp. vi+142. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 10s. 6d. net.

THIS book is intended to give engineering students instruction in the theory and practice of designing valve-gears for steam engines. Prof. Peabody has dealt with the subject in his usual able manner, and his methods are most lucid. The volume is divided into six chapters, with a good appendix. Graphical methods are used throughout, and the plates at the end of the book are remarkably clear.

The Stephenson link motion is dealt with in chapter iii. This gear has been so long in use that finality might be expected in locomotive practice as regards the correct lead of the valve in full gear; yet this is not the case. The late Mr. William Stroudley was a strong advocate of no lead in full gear, and he obtained remarkable results from his locomotives; others, again, follow the reverse practice.

Chapter iv. deals with the very interesting subject of radial valve-gears, of which, of course, the Walschaert is best for locomotive purposes, and is now being largely used in America in preference to the Stephenson gear, Continental practice having long adopted this course.

This is a revised second edition of the book, and the few changes that have been made have been in the right direction. We can truly recommend the work to all draughtsmen and engineers who have to deal with the interesting and intricate questions which arise when designing valve-gear.

The Bull of the Kraal and the Heavenly Maidens, a Tale of Black Children. By Dudley Kidd. Pp. xii+302. (London: A. and C. Black, 1908.) Price 6s.

MR. KIDD in his earlier works, "The Essential Kafir" and "Savage Childhood," exhibited an intimate knowledge of the social life of the Bantu race. The present book is more popular, being intended to describe a series of typical incidents in the life of a little boy. Mahleka, the "Bull of the Kraal," is the son of the Great Wife of the tribal chief, and his heir-apparent. In sketches of this kind, the work of a sympathetic observer of a semi-savage people, there is the risk, on the one hand, of assuming that any foreigner can fathom the deeper recesses of the native mind. On the other, there is the danger of dwelling on their virtues and ignoring the darker side of the native character. Mr. Kidd seems hardly to have avoided both these pitfalls. He sometimes reads into the mind of the Bantu child ideas foreign to it, and his account of the simple life in the kraal neglects the treachery and ruthless ferocity of the Zulu, which it is never safe for the white man to forget.

With these reservations, his story of this little Zulu boy is both amusing and instructive. The careful account of the games of children will be of value for the comparative study of the subject. The folk-tales collected by Mr. Douglas Wood in south-eastern Rhodesia are, on the whole, disappointing, and contain little new incident. More valuable than these are the scraps of folk-lore which the author loses no opportunity of retailing. Particularly interesting are the illustrations of sympathetic magic. Thus, when a child's hair is cut it is buried in damp soil to make it continue growing; rain-medicine is made out of porpoise flesh, and so on.

The value of the book is much increased by the drawings of kraal life by Miss A. M. Goodall, which are artistic and well selected.

Fruit Trees and their Enemies, with a Spraying Calendar. By Spencer U. Pickering, F.R.S., and Fred. V. Theobald. Pp. 113. (London: Simpkin, Marshall, Hamilton, Kent and Co., Ltd.) Price 1s. 6d. net.

THIS little book is written for the guidance of fruit-growers, perhaps the most intelligent and enterprising of all those who live by the cultivation of the soil. Although spraying has only come into use in England during the last few years, it has been taken up with great enthusiasm; unfortunately, however, the practical man has been in many cases without adequate scientific guidance, and has been left to the mercy of the enterprising advertiser.

The various insect and fungoid pests are described, and brief notes on their life-history are given. Their effect on the fruit or tree is then stated, so that the practical man may have no difficulty in recognising with what he has to deal: finally, recipes are given for making up the appropriate wash. The instructions are clear, and the practical man should have no difficulty in following them. Some of the washes will be new to many growers; they have, however, been tested by the authors, and found to work satisfactorily. Regard is also had to the cost of the operation, as is right in dealing with problems into which financial considerations enter to a large extent. We note that the authors direct attention to the failure sometimes following on fumigation with prussic acid; the proper conditions to ensure success still remain to be discovered.

All who are interested in fruit cultivation will find this book useful.

Die Fauna Südwest-Australiens. Ergebnisse der Hamburger südwest-australischen Forschungsreise, 1905. Edited by Prof. Dr. W. Michaelsen and Dr. R. Hartmeyer. Vol. ii., sections 1–4. (Jena: Gustav Fischer, 1907–8.) Price 12 marks.

A FURTHER instalment of reports on the fauna of south-western Australia, from materials collected by the expedition dispatched from the Hamburg Museum in 1905, has been issued, and contains four memoirs on groups of insects. The first section of this volume is by J. Weise, of Berlin, and describes the Chrysomelidæ and Coccinellidæ, of which the expedition obtained twenty-eight species, of which nine are new. The second section is by Dr. Bernhauer, and describes the Staphylinidæ, and founds eleven new species, one of which is the type of a new sub-genus. The third section, by Georg Ulmer, of Hamburg, describes the Trichoptera and Ephemeridæ, and includes a synopsis of the Trichoptera known on the Australian continent. This report is illustrated by a valuable series of drawings in the text. Five new species are described, and many larval forms. The fourth section, by F. Silvestri, describes the Thysanura, including fifteen species of Lepisma and one of Japygus. Twelve of the species are new, and one of them represents a new genus. The report is illustrated by ten plates.

The volume gives further evidence of the valuable additions to Australian zoology made by Prof. Michaelsen and Dr. Hartmeyer's expedition.

Lehrbuch der Muskel- und Gelenkmechanik. By Prof. H. Strasser. I. Bd. Allgemeiner Teil. Pp. xi+212. (Berlin: Julius Springer, 1908.) Price 7 marks.

THIS book is the work of one who has made animal mechanics a life-study. Prof. Strasser will be particularly remembered on account of his work, published some twenty years ago, upon the flight of birds and the swimming of fish.

The first section of his book—some seventy-three pages—is devoted to an admirable digest of the mechanical principles involved. It is illustrated by plenty of figures.

The second part is devoted to the skeleton, the mechanical prop; the movements at the joints; the different forms of muscle, the angles which the individual fibres make when inserted into bone, and muscle work.

The third section refers to the general problem of the joints and muscles, and deals with several static problems in the first case, and with locomotion in the second.

The author has treated the whole subject much as one would treat an ordinary physical problem, in all mathematical detail. He is to be congratulated upon his method and upon the way in which he has carried it out. We believe that there is no treatise in the English language which can be considered as quite on all fours with his book, and we can heartily recommend its study.

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.*]

Diurnal and Semi-diurnal Atmospheric Variations.

I HAVE read the remarks of Prof. Horace Lamb in NATURE, November 5, 1908, p. 24, and November 12, 1908, p. 47, where, although mentioning difficulties, he apparently accepts the suggestions of Kelvin, Margules, and Hann that the semi-diurnal wave of pressure can be explained by the fact that "the daily variation of temperature is not harmonic, and when analysed there is a definite component with a half-day period," and "on a rotating earth the period of free oscillation of the atmosphere lies very near to twelve hours."

In connection with this, I wish to direct attention to the fact that an analysis of the records of instruments carried by kites shows that the chief oscillation in temperature in the body of the atmosphere is a semi-diurnal one, and not a single oscillation such as is found near the ground.

In a discussion of the observations obtained with kites at the Blue Hill Meteorological Observatory, published in the annals of the Astronomical Observatory of Harvard College, vol. lviii., part i., 1904, I showed that the single diurnal oscillation of temperature nearly disappears within 300 metres of the earth's surface, and from 500 metres to 1500 metres only a semi-diurnal oscillation is distinctly apparent.

For the method employed the reader must be referred to the publication mentioned. The final results in degrees Fahrenheit were as follows:—

Normal Diurnal Temperatures at different Levels above Blue Hill.

Height in metres	A.M. 1	3	5	7	9	11	P.M. 1	3	5	7	9	11	Mean
	°	°	°	°	°	°	°	°	°	°	°	°	°
15	39·9	37·9	37·7	39·4	47·9	51·8	53·8	53·9	51·5	47·2	42·8	41·2	45·4
500	45·7	46·0	45·6	44·6	43·5	44·1	45·8	45·8	44·2	43·2	43·6	44·6	44·7
1000	40·4	40·4	40·5	40·4	39·8	40·1	40·5	40·4	40·3	40·3	40·0	40·0	40·2
1500	37·5	36·9	36·5	36·8	36·0	34·5	35·2	36·4	36·1	34·7	34·9	36·9	36·0

The harmonic values computed from the observations are as follows, the epoch in each case being midnight:—

Height	Harmonic values
15 m. ...	45·4+8·33 sin (234+x)+1·63 sin (73+2x)+&c.
500 m. ...	44·7+0·47 sin (13+x)+1·67 sin (18+2x)+&c.
1000 m. ...	40·2+0·09 sin (85+x)+0·35 sin (344+2x)+&c.
1500 m. ...	36·0+0·90 sin (47+x)+0·80 sin (0+2x)+&c.

These results show that the amplitude of the single diurnal period near the earth's surface (15 metres above sea-level) is 8°·3 F., but at 500 metres it has decreased to less than half a degree Fahrenheit, and at 1000 metres to less than a tenth of a degree Fahrenheit. At 1500 metres the range apparently increases somewhat, but this is perhaps owing to the small amount of data available at that height. The mean of all the daily ranges between 500 metres and 1500 metres, inclusive, is slightly less than half a degree. Furthermore, at 500 metres to 1500 metres the phase angle has changed nearly 180° as compared to that at the earth's surface, so that the maximum in the daily wave of temperature comes at night instead of during the day. The reversal of phase apparently takes place between 300 metres and 500 metres.

Turning to the values in the formula showing the semi-diurnal period, it is seen that at 500 metres and 1000 metres the amplitude is nearly four times as great as is the amplitude of the diurnal period, but at 1500 metres the two appear to be nearly equal. The maxima in temperature are about 3 a.m. and 3 p.m., not far in time from the semi-diurnal minima of pressure, while the minima of temperature are near 9 a.m. and 9 p.m., not far from the times of the semi-diurnal maxima of pressure.

In commenting on these results in the publication referred to, I say (p. 32):—"But the fact of particular interest is that the mean of the amplitudes of the semi-diurnal period from 500 to 1500 metres, thus including the larger portion of the lower atmosphere, is greater than the mean amplitude of the diurnal period. This fact is of interest in connection with the views of Lord Kelvin, Dr. Margules, and Dr. Hann concerning the cause of the semi-diurnal wave."

In 1905 Prof. Frank H. Bigelow, analysing the data obtained at Blue Hill more in detail and by a method somewhat different from my own, confirmed the existence of the semi-diurnal period of temperature in the body of the atmosphere. He says:—"The single diurnal period at the surface is replaced by a double diurnal wave at 400 metres, and this appears quite plainly in every month except July, where it is probably nearly extinct" (*Monthly Weather Review*, 1905, p. 55).

The existence of a maximum of temperature by day and a secondary maximum at night, with a diurnal amplitude of about 1°·3 C. at a height of 1200 metres above Hald, Denmark, has also been disclosed by W. Wundt in an analysis of the observations made with kites at that station (*Meteorologische Zeitschrift*, 1908, pp. 337–41).

Herr Wundt gives results for the year and for the autumn, the semi-diurnal period being most marked in the autumn, for which I find the following harmonic values:—

Height		Harmonic values
1200 m.	...	$A + 0{\cdot}37 \sin(228 + x) + 0{\cdot}13 \sin(229 + 2x) +$ &c.

In this case the amplitudes are in degrees centigrade, and must be multiplied by 1·8 for comparison with the results at Blue Hill. The amplitude of the single diurnal oscillation is nearly the same as the mean between 1000 metres and 1500 metres at Blue Hill, but the phase angle is nearly 180° different. The amplitude of the double diurnal period is a little less than half that found for Blue Hill. However, the method of obtaining the original data was not the same in the two cases.

HENRY HELM CLAYTON.

Readville, Mass., January 8.

A Method of Solving Algebraic Equations.

PROF. RONALD ROSS gave in NATURE of October 29, 1908, an article upon "A Method of solving Algebraic Equations." Without going into the matter itself, or into details concerning it, I beg to state that the above-mentioned process was published in Germany in 1894 in the two following articles by Dr. W. Heymann, professor an der Kgl. Gewerbe-Academie zu Chemnitz in Sachsen:—

(1) Ueber die Auflösung der Gleichungen vom funften Grade (*Zeitschrift für Mathematik und Physik*, xxxix., Jahrgang 1894).

(2) Theorie der An- und Umläufe und Auflösung der Gleichungen vom vierten, fünften und sechsten Grade mittels goniometrischer und hyperbolischer Funktionen (*Journal für die reine und angewandte Mathematik*, cxiii. Band, 1894).

Further publications relating to the same subject, and also by Prof. Heymann, are as follows:—

(3) Ueber die elementare Auflösung transcendenter Gleichungen. Mit Beiträgen zur Ingenieur-Mathematik (*Zeitschrift für mathematischen und naturwissenschaftlichen Unterricht*, xxix., Jahrgang 1898).

(4) Ueber Wurzelgruppen, welche durch Umläufe ausgeschnitten werden (*Zeitschrift für Mathematik und Physik*, xlvi. Band, 1901).

I would especially mention, as an article which deals at some length with the geometric explanation of the iteration-process:—

(5) Ueber die Auflösung von Gleichungen durch Iteration auf geometrischer Grundlage (*Jahresbericht*, 1904, *der Techn. Staatslehranstalten zu Chemnitz*).

The author has in this last work thoroughly explained the staircase procession and alternating spiral procession theories, and has also developed the technology of the process, which he further illustrates by a great number of practical examples. I would here direct attention to the fact that this method can be used with advantage in solving transcendant equations. Dr. Heymann has also especially considered in this work those spirals which do not immediately stagnate, but which do so after repeated revolutions; he divides them, therefore, into spirals of the first, second, third . . . *m*th kind.

GEORG SATTLER.

I AM much obliged to Herr Sattler for the information which he has been kind enough to give in regard to my article in NATURE of October 29, 1908, and also for sending me the paper by Prof. Heymann (No. 5) to which he refers. When I wrote my article I could obtain no information concerning previous literature on the method, but since then Mr. W. Stott, secretary of the Liverpool Mathematical Society, has assisted me very greatly with his knowledge of the history of mathematics and with the books in his possession. We are now engaged in making a thorough study of the history of the method, but the following brief account of our progress up to the present may not be out of place.

The method appears to have been discovered by Michael Dary, a gunner in the Tower of London, on August 15, 1674, and was communicated by him in a letter of that date to Isaac Newton (see the "Macclesfield Letters," Correspondence of Scientific Men of the Seventeenth Century, University Press, Oxford, 1841, vol. ii., p. 365). In this letter he indicates clearly that a root of a trinomial equation can be obtained by putting the equation in the form $z^p = az^q + n$, and then by approximating to the value by "iteration"—just as described in my paper. Subsequently he wrote a book called "Interest Epitomised, both Compound and Simple, whereunto is added a Short Appendix for the Solution of Adfected Equations in Numbers by Approachment performed by Logarithms" (London, 1677), but we have not yet been able to procure a copy of this work. Dary was a *protégé* both of Isaac Newton and of Collins. The former subscribed himself in a letter to Dary "your loving friend"; and the latter (to judge by the same "Letters," vol. i., p. 204) tried to advance him, and wrote of him:— "'Tis well known to very many that Mr. Dary hath furnished others with knowledge therein (arithmetic), who, publishing the same, have concealed his name; as, for instance, Dr. John Newton hath lately published a book of Arithmetic, another of Gauging; all that is novel in both he had from Mr. Dary."

I do not know the date when the great Newton first described his method of approximation, but fancy that it must have been done in his "Universal Arithmetic," written about 1669 (the method has been also ascribed to Briggs). The matter is of some interest, because Newton's method is a variant of Dary's—or rather both are special cases of a more general method. In approximating to the intersection of two curves by iteration we may employ either an orthogonal or an oblique geometric construction. The former is the method of Dary (as illustrated in my paper), the latter is the method of Newton, the angle of the oblique construction varying at each step and being taken as that of the tangent of one of the curves at the starting point of the step. Obviously the oblique process gives the quicker approach, and Newton's

$$(x_2 = x_1 - fx_1/f'x_1)$$

gives the quickest possible if we start sufficiently near the root. Newton was probably aware of this, and consequently did not elaborate Dary's method. Nevertheless, Dary's method is, with certain modifications, the more certain; and, at any step, we can pass from the one process to the other.

The subject now becomes divided into two, the functional theorem, that an iterated function may converge toward the root of an equation, and the converse theorem, that the root of an equation may be calculated by the iteration of a function. The next work which I have seen on the latter theorem is contained in the appendix to the third edition (1830) of Legendre's "Theorie des Nombres" (copies of the second edition may not possess the appendix). He calls this "Méthodes nouvelles pour la Résolution approachée des Équations numeriques," but begins with Newton's method (without acknowledgment) and continues with Dary's. Legendre's paper is curious. He gives the geometric representation of both methods, but omits entirely the "spiral process" mentioned in my paper. We cannot suppose that such a master was ignorant of that process, but must rather believe that he put it aside because he thought it inconvenient for practical calculation (which is not the case if suitable precautions are taken). In order to confine himself to the "staircase process" he puts the proposed equation in the form of "fonctions omales" (homalous), but with the result only that he must often obtain a very slow convergency. In order to extract the successive roots he makes no better suggestion than to divide out the first root already obtained, and the idea of starting the process alternately on the two curves in order to obtain one root after another seems not to have occurred to him. His paper is ingenious, but insufficiently generalised. Prof. Heymann has criticised it to the same effect.

Heymann mentions a number of contributors on the functional side of the theorem, Jakob Bernoulli, Gauss, Jakobi, Stern, Schlömilch, Schröder, Günther, von Schaewen, Hoffmann, Netto, and Isenkrahe. Possibly Babbage, Boole, Galois, and De Morgan may have done as much at an earlier date than some of these writers. De Morgan, in his article on the calculus of functions ("Encyclopedia Metropolitana," London, 1845, vol. ii.,

p. 316), gives a brief but complete summary, except that he does not mention the possibility of obtaining successive roots by starting alternately on the two curves. He also demonstrates the geometric representation, shows that $\phi^n(x)$ may approach "in regular succession to different limits," and notes the connection of iteration with many parts of algebra and the calculus.

More recently, Lémeray has a series of papers on the functional side of the theorem. In one of the earliest of these ("l'Intermédiaire des Mathematiciens," June, 1894) he considers in detail the conditions of convergence of $\phi^n(x)$, but thinks that the method is not generally applicable for the solution of equations (which is incorrect). In this and succeeding papers he gives ample geometric illustrations, including both the "staircase" and the "spiral" procession, but exhibits few examples. He deals at length with the "stagnating spiral" procession.

It will thus be seen that the first paper of Prof. Heymann mentioned by Herr Sattler has about the same date as the first paper by Lémeray. Many other papers have followed. According to Heymann, Isenkrahe described (1897) both the "staircase" and "spiral" process under those names (which have been used by me). Mr. Stott has found other references (which we have not yet been able to verify), especially Anostschenko (1901), Pellet (1901), and Bugaieff, who appears to have published a series of papers since 1896, covering the whole subject of successive approximation (in Russian).

The work by Prof. Heymann which Herr Sattler sends me (No. 5) is dated 1904. It commences by describing the process, with both forms of approach; discusses the determination of imaginary roots, hastening of convergency, Newton's method, expedients for calculation, and some of the literature of the subject; considers the "stagnating" spiral, and gives examples and figures, being thus the most thorough paper which I have seen on the equation side of the theorem.

It would seem, then, that the method has been known to many writers since the time of Dary and Newton, but none of them appears to have carried it much further than the more obvious deductions to be drawn from the original theorem, as shown in my note. I think, however, that some further developments, both on the theoretical and the practical side, remain to be considered, but it would be scarcely useful to mention them until we have been able to examine all the literature.

We shall be very glad to receive any further references on the subject. If an amateur may say so, it is extraordinary that so beautiful and general a method should have received so little attention in the text-books.

RONALD ROSS.

University of Liverpool, January 11.

A February Meteoric Shower.

FEBRUARY cannot offer the same attraction as January and April in regard to the occurrence of a meteoric shower of special importance; but large meteors are fairly abundant during the month, and though no exceptionally rich streams are in evidence, there are a number of minor systems in play, and these will well repay attentive observation.

For a great many years I have suspected a strong shower in this month, but have never thoroughly investigated it. Meteors have been prolific from the direction of the bright star α Aurigæ (Capella), and the dates over which the display extends appear to be from the 5th to the 20th. This year the moon will not much interfere with observation between February 10 and 25, and the sky should be carefully watched on clear nights for these Aurigids. They are brilliant, slow-moving meteors, and occasionally take rank as fireballs.

It will be important to determine the date of maximum and the exact place of the radiant. I found the position at $75° + 41°$ from various meteors seen from Bristol in the month of February in various years, but I have never watched the shower with sufficient thoroughness to learn much of its aspect or discover the epoch of its richest presentation; but I think it is decidedly a stream of rather notable character, and one which obviously needs further attention.

W. F. DENNING.

Women and the Fellowship of the Chemical Society.

IT has come to our notice that a report has been widely circulated and credited to the effect that the movement in favour of the admission of women to the fellowship of the Chemical Society is directly connected with the present strenuous agitation for the political enfranchisement of women. We, the undersigned women (actively engaged in chemical teaching and research), beg to ask for the hospitality of your columns in order emphatically to deny any such connection. The following facts, we venture to think, should conclusively prove the independence of the two movements:—

(1) Five years ago, when some of us petitioned the council of the Chemical Society to admit us to the fellowship, the agitation in favour of "Woman Suffrage" was not prominently before the public.

(2) The petition recently presented to the council originated within the Chemical Society itself, and was signed exclusively by fellows of the society. Moreover, we as a body have no knowledge of the political opinions and aspirations held by individual members; any such knowledge we should consider to be quite irrelevant, since the only link which unites us is a common interest in the science of chemistry.

We are glad to take this opportunity of recording our thanks to those fellows of the Chemical Society who have expressed themselves in favour of admitting women to the fellowship of the society.

Signed: MARY BOYLE, B.Sc., Lecturer and Demonstrator in Chemistry, Royal Holloway College; K. A. BURKE, B.Sc., Assistant in Department of Chemistry, University College, London; LOUISA CLEAVERLEY; MARGARET D. DOUGAL, Indexer of the Publications of the Chemical Society; C. DE B. EVANS, D.Sc., Lecturer in Chemistry, London School of Medicine for Women; E. ELEANOR FIELD, M.A., Senior Staff Lecturer in Chemistry, Royal Holloway College; EMILY L. B. FORSTER, Private Assistant to Prof. Huntington, King's College, London; IDA FREUND, Natural Science Tripos, Cambridge, Staff Lecturer in Chemistry, Newnham College; MAUD GAZDAR; HILDA J. HARTLE, B.Sc., Lecturer in Chemistry, Homerton Training College, Cambridge; E. M. HICKMANS, M.Sc.; ANNIE HOMER, B.A., Fellow and Associate of Newnham College, Cambridge; IDA F. HOMFRAY, B.Sc.; E. S. HOOPER, B.Sc., F.I.C., Assistant Lecturer and Demonstrator, Portsmouth Municipal College; EDITH HUMPHREY, B.Sc., Ph.D., Chemist to A. Sanderson and Sons; ZELDA KAHAN, B.Sc.; NORAH E. LAYCOCK, B.Sc., Demonstrator in Chemistry, London School of Medicine for Women; EFFIE G. MARSDEN; MARGARET MCKILLOP, M.A., Lecturer in Chemistry, King's College, Women's Department; AGNES M. MOODIE, M.A., B.Sc.; NORA RENOUF, Salters' Research Fellow, School of Pharmacy; IDA SMEDLEY, D.Sc., Assistant Lecturer and Demonstrator in Chemistry, Victoria University, Manchester; ALICE E. SMITH, B.Sc., Assistant Lecturer and Senior Demonstrator in Chemistry, University College of North Wales, Bangor; MILLICENT TAYLOR, B.Sc., Lecturer in Chemistry, Ladies' College, Cheltenham; M. BEATRICE THOMAS, M.A., Lecturer in Chemistry, Girton College, Cambridge; M. A. WHITELEY, D.Sc., A.R.C.S., Demonstrator in Organic Chemistry, Royal College of Science, London; SIBYL T. WIDDOWS, B.Sc., Head of Practical Chemistry Department, London School of Medicine for Women; KATHARINE I. WILLIAMS.

Fog and Rime on January 27–28.

THE great fog which enveloped the neighbourhood of London as well as a large part of England on January 27 and 28 was remarkable in rural and outer-suburban districts for the beautiful decking of the trees, even the tallest elms, with a great thickness of rime.

Here at Northwood, sixteen miles to the north of London, twigs and branches were heavily laden on their windward side—or rather that which faced the direction of the feeble anti-cyclonic air-flow. At night time, when the fog was very dense, one's hair and overcoat also received a thick deposit of hoar-frost. It is noteworthy that in central London the fog, being exceedingly carbonaceous, and pungent with SO_2, was too dry to deposit much ice or rime on the trees in Hyde Park, although the grass was thickly coated through terrestrial radiation. I have never seen much hoar-frost on the bare forest trees *without fog*, and I think that other observers will agree that the presence of fog is necessary for any great thickness to be formed. The dryness of the smoky town-fog as compared with the country-fog is well known, and this whether the temperature of the air is below the freezing point, as in the case in question, or above it. On the above dates at Northwood the fog dispersed for a couple of hours at mid-day, and the sun shone upon a fairyland in a sky of cloudless blue.

L. C. W. BONACINA.

Northwood, Middlesex, February 1.

Germination of the Broad Bean Seed.

THE text-book statements on the relation of the micropyle to the radicle are entirely wrong so far as I have been able to observe. If the testa be carefully removed it will be found to have two compartments, the larger one covering the cotyledons and the smaller sheathing the radicle. A fine bristle passed through the micropyle enters the cotyledon compartment. When the radicle emerges it does not pass through the micropyle, which is left intact, but the testa splits along two lines of weakness running from the tip of the radicle to its junction with the cotyledon stalks.

I noticed this about six years ago, and though I attach no importance to the mere fact, its interest is considerable from the point of view of nature-study in schools.

E. HEBER SMITH.

Episcopal Training College for Teachers, Dalry House, Orwell Place, Edinburgh, January 19.

"Vestiges of the Natural History of Creation."

IN "Vestiges of Creation," ninth edition, 1851, p. 113, it is stated that two independent investigators caused the production of "living insects" (*Acarus crossii*) by the prolonged action of a voltaic battery upon certain chemical solutions. The description is most matter-of-fact. The second experimenter seems to have sterilised his apparatus and solutions before use; yet it is said that the insects "were sometimes observed to go back to the fluid to feed, and occasionally they devoured each other." In Note 54 it is also stated that "after they have escaped from the solution they live in the neighbourhood, and readily breed."

I shall be much obliged if any reader can explain the above phenomenon, or say if the experiments have been repeated.

F. WYVILLE THOMSON.

Caledonian United Service Club, Edinburgh, January 28.

THE RADIUM INSTITUTE.

THE announcement that, on the initiative of the King, a Radium Institute will shortly be opened in London is of the greatest interest to the man of science and to the physician. The institute is intended not only for research work, but also for curative purposes, and it will have an organised medical department. The whole of the funds necessary to build, equip, and maintain a new establishment are being provided by Sir Ernest Cassel and Lord Iveagh. We are reminded that Lord Iveagh gave the munificent sum of 250,000*l.* to endow the Lister Institute of Preventive Medicine, so that his name will now be associated gratefully with two great endowments of science. The committee of the institute will consist of Sir Frederick Treves, Bart., G.C.V.O., C.B. (chairman), Sir William Ramsay, K.C.B., F.R.S., Sir J. J. Thomson, F.R.S., the Hon. R. J. Strutt, F.R.S., Sir Lauder Brunton, Bart., F.R.S., Sir Malcolm Morris, K.C.V.O., and two other members, one each to be nominated by Sir Ernest Cassel and Lord Iveagh.

The interest which the King is exhibiting in the inauguration of a scientific institution for further research work with radium, so that its powers may be utilised for the amelioration of human suffering, has led to the publication in the Press of the useful purposes to which radium may be put, and the inauguration of the Radium Institute will provide another example of the supreme importance to mankind of research work in science. The difficulty hitherto has been that so little of this remarkable body has been available for research. The trouble has been a financial one. Not long ago good specimens of radium bromide were obtainable for 5*l.* per milligramme, but recently the price has reached 16*l.* to 18*l.* per milligramme. It is obvious that in any case an enormous expenditure is required before a sufficiency can be obtained adequate for an institute, for the investigation of the properties of radium and its application for the treatment of disease. The necessary funds having now been provided, it will be possible to study radium from many points of view.

Radium is the most interesting of a group of bodies characterised by the property of spontaneously emitting radiations capable of passing through plates of metal or other substances impermeable to light. In 1896, Becquerel found that uranium compounds and the metal itself give off rays which cause changes in a photographic plate even when passed through thin plates of metal. Uranium was isolated from pitchblende so long ago as 1789 by Klapworth, and a little more than a hundred years later, in 1898, M. and Mme. Curie discovered that certain varieties of this mineral possess greater radioactivity than could be accounted for by the uranium they contained. They were led to investigate these forms of pitchblende, and succeeded in isolating two new elements, polonium and radium.

The discovery of radium and its investigation have opened up enormous fields of research, and the following brief account of what has been done will suggest the possibilities before the Radium Institute, especially if a considerable quantity of the element can be under investigation.

Radium gives off three kinds of rays, respectively called α, β, γ rays, which have various properties. The α rays are identical with the radiations of high velocity, carrying a positive charge of electricity, which are projected through a perforation in the kathode of a Crookes's tube. They have been called "canal rays" by Goldstein, and have been investigated particularly by Wien. They travel in the opposite direction to the current through the tube, and have the power of ionising gases. The β rays consist of negative particles, identical with the rays which are given off from the kathode and called "kathode rays." They have a velocity equal to that of light, and can be deviated by a magnetic field. The γ rays are similar to the X-rays. They are not deflected by a magnetic field.

These rays have different powers of penetration. This is estimated by interposing layers of aluminium. The α rays have the least penetrative power; according to Rutherford, they may be taken as unity, the β rays as of a penetrative power of 100, and the γ rays as of a penetrative power of 10,000. Practically the rays may be filtered by interposing layers of aluminium and lead. For instance, both the α and β rays are completely absorbed by a layer of lead only one centimetre thick, but the γ rays will pass through a layer of lead an inch thick. They are more penetrating than the X-rays.

The α and β radiations have the power of developing phosphorescence in certain bodies, notably zinc sulphide, the platinocyanides, and the diamond. All strongly radioactive substances emit light themselves and are phosphorescent in the dark room.

Alterations in colour occur in glass and certain precious stones; for instance, the diamond and the ruby, when exposed to radium. These phenomena are seen also in an X-ray tube, and are believed to be due to the β or kathode rays.

Chemical changes produced by radium are of great interest, and here, we believe, there will be found on further investigation a remarkable field for work. Oxygen is changed into ozone. Water is converted into peroxide of hydrogen. The radium emanation has also the power of re-combining hydrogen and oxygen to form water. It is believed that the α rays are the agents of these changes. The β rays convert yellow phosphorus into the red variety, and liberate iodine from some of its compounds.

The chloride, bromide, sulphate and carbonate of radium are known, but the metal itself has not yet been isolated. The element is believed to be dibasic, and resembles barium in its compounds. The atomic weight is about 226·7 (Thorpe). In 1900, Dorn discovered that radium constantly gives off an emanation. This emanation is a gas, and it can be pumped off. The emanation produces heat. One grain of radium is believed to emit about 80 gram-calorics in an hour (Precht). As radium is constantly giving off emanation it is undergoing decay, and there is reason to believe that this decay is exceedingly slow. A number of investigations have been made to determine its "life." The "life" of the emanation is less than four days. That of radium probably as long as 1750 years.

The spectrum of radium emanation has been investigated by several workers, and Ramsay and Soddy have observed its change into helium, but it is not yet certain whether other bodies are not produced.

One great problem which lies before the physicist in his work with radium and kindred bodies is the possible transformation of elements. It is believed that the gradual change of radium is in the direction of lead. The production of helium was detected by spectroscopic examination, and so far the work has chiefly rested on this form of observation, but there appear to be chemical evidences also. Several fascinating theories have been put forward to explain the evolution and devolution of elements, but at the present time all that can be done is the accumulation of facts.

Turning now to the medical aspects of radium, and naturally these appeal most to the general public, it may be stated that its field in therapeutics has been studied for some years, and its limitations are fairly evident. Radium kept in contact with the skin, or separated from it by clothing, has produced intractable burns, similar to those induced by excessive exposure to the X-rays. Cases of nævus, port-wine stains, and moles, both of the pigmented and hairy varieties, have been removed by it. Warts also rapidly disappear. So far the effects have been seen in superficial conditions. Rodent ulcer, a superficial form of skin cancer, has been cured by radium, just as it has by the X-rays, but there have been cases in which, by its greater penetrative power, no doubt, radium has succeeded where the X-rays have failed. The cure of rodent ulcer by radium has been proved to be lasting by a case shown recently at the Royal Society of Medicine, the cure having lasted for five years. What everyone wants to know is whether in radium we have the long-sought cancer cure. It is by no means likely, but it is not impossible. It is true that mouse-cancer can be removed by it, but cancer induced in mice is a very different thing from human cancer. Sir Frederick Treves points out that the power of radium to effect its cures is immensely increased by using a quantity. The Radium Institute, it is hoped, will be in possession of such a quantity that it will be able to give an answer to this all-important question of cancer cure. Above all things, it is important that the public should know that so far clinical work has been negative in cancer proper.

It might have been supposed from the articles which have appeared in the daily Press that very little work had been done in this country with radium as a curative agent, but that is not the case, considering the small quantity of the salts which have been available. Radium is best applied on a flat surface, and the difficulty has been to spread the substance evenly and coat it with a varnish that can be sterilised by heat or otherwise. The importance of this will be realised when the radium has to be placed in contact, or at any rate very close, to diseased surfaces. This difficulty has been overcome by Ganne.

All the early work with radium has been done with material obtained from pitchblende derived from Joachimsthal, in Bohemia. According to Strutt it is present in small quantities in several places, and that most likely to be now worked is in Cornwall, where there is pitchblende containing 48·5 millionths per cent. of radium, and also a cupro-uranite, which has no less than 120 millionths per cent.

THROUGH THE HEART OF LABRADOR.

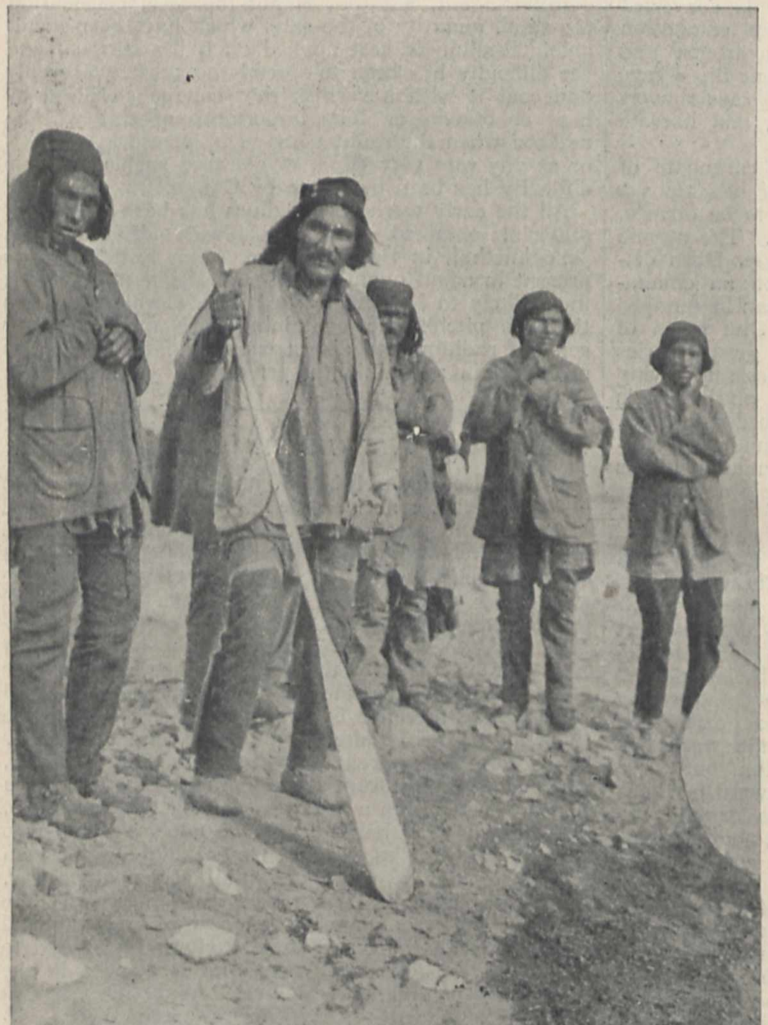
IN 1903 Leonidas Hubbard, jun., a young American journalist, conceived the idea of exploring Central Labrador and passing through the country by means of the water-way from Hamilton inlet to the shores of the Arctic Ocean at Vugara. Only one white man, the gallant Père Lacasse, has accomplished this journey if we except the wonderful pilgrimage of John McLean, who travelled up to the Arctic through Labrador and back to the St. Lawrence by a slightly different route. We know how poor Hubbard missed his way and travelled by a somewhat circuitous route to within sight of Lake Michikamats, and then, after being forced to retreat before the oncoming winter, perished miserably from starvation on the banks of the Susan River within a short distance of food and help. The hero of that journey and subsequent events was George Elson, who, with a Cree Indian, a Russian half-breed, and a young Eskimo, accompanied Mr. Hubbard's wife in the attempt to carry out the journey and the mapping of certain geographical features which the unfortunate explorer had failed to do. That the effort was successful is evinced in the interesting volume, "A Woman's Way through Unknown Labrador."[1]

With such skilled helpers it is plain that Mrs. Hubbard was a mere passenger on the trip, for she had to undergo no hardships worse than the bites of insects; but that she is a woman of no small courage is seen in a hundred ways, for it takes nerve of the 3-o'clock-in-the-morning variety, as the writer can testify, to shoot boiling rapids in a light 19-feet canoe, and the pluck she showed in pushing on, after reaching the height of the land at Lake Michikamats, where doubts as to the chance of reaching Vugara or even Davis inlet before the autumn freeze-up were freely expressed, was of no mean order. Then, too, the chance of missing the one annual steamer, with

[1] "A Woman's Way through Unknown Labrador. An Account of the Exploration of the Nascaupee and George Rivers." By Mrs. L. Hubbard, Jun. Pp. xvi+338. (London: John Murray, 1908.) Price 10s. 6d. net.

the prospect of a year of monotony and cold, did not deter this courageous lady, nurtured in the lap of cities.

The record of the journey as far as Lake Michikamats is somewhat tedious and not of much interest to experienced travellers. Too much is made of trivial incidents, and the humour of the writer is not of a high order. Only once is she allowed to wander a little way from camp, and the result is one of the poorest jokes on record. Chapter viii. is entitled "Scaring the Guides," and twelve pages are devoted to the *fun* of throwing her four excellent helpers into a state of fear, to say nothing of the loss of many cartridges, of which, by her own account, they had only a small stock, just to see how great a commotion would be made by her supposed loss. This might be amusing in the Thames Valley or on the St. Lawrence River, but it does not seem quite the right thing in Central Labrador.



The Nascaupee Chief and Men. From "Through Unknown Labrador."

Mrs. Hubbard's account of her first meeting with the trekking herds of Barrenland caribou is full of interest, and she was indeed fortunate to have witnessed a sight that some white hunters would give much to see. The author expresses the view that the deer are being decimated, and that in a few years only a remnant of the vast numbers will be left. With this view we do not agree. They may be killed off locally, and even desert some area for a number of years, a circumstance which gives rise to such statements; but the main body, in spite of ruthless slaughter at certain points and seasons, will live on. Every year at least 8000 to 10,000 caribou are killed in Newfoundland out of a rough total of 200,000, and yet those deer are on the increase, and every year numbers of tales are published that the deer are being exterminated. These come from districts which the erratic caribou have left temporarily, and to which they may return.

There is a delightfully feminine touch in Mrs. Hubbard's description of her first meeting with the deer and their alarming appearance:—

"When they saw us, the stags lined themselves up in the front rank and stood facing us with heads high in a defiant air. It was a magnificent sight. They were in summer garb of pretty brown, shading to light grey and white on the under-parts. The horns were in velvet, and those of the stags seemed as if they must surely weigh down the heads on which they rested. . . .

"I started towards the herd, kodak in hand, accompanied by George, while the others remained at the shore. The splendid creatures seemed to grow taller as we approached, and when we were within 250 yards of them their defiance took definite form and, with determined steps, they came towards us.

"The sight of that advancing army under such leadership was decidedly impressive, recalling vivid mental pictures made by tales of the stampeding wild cattle in the West. It made me feel like getting back to the canoe, and that is what we did. We and the caribou stood watching each other for some time. Then the caribou began to run from either extremes of the herd, some round the south end of the hill, others away to the north, the battle line of stags still maintaining their position.

"After watching them for some time, we again entered the canoes. A short paddle carried us around the point beyond which the lake bent to the north-west. There we saw them swimming across the lake. Three-quarters of a mile out was an island, a barren ridge standing out of the water, and as they swam they formed a broad, unbroken bridge, from mainland to island, from the farther end of which they poured in steady stream over the hill top. . . . The country was literally alive with the beautiful creatures."

The account, brief as it is, of the meeting with the Montaignais and Nascaupees is full of interest, and Mrs. Hubbard used her eyes and ears to some purpose in her short study of these wild people. It is a pity that there are not more ethnological notes of this kind in the book, for what we want to know of Labrador is not the common incidents of travel, experiences such as every schoolboy puts in his first book, but first-hand observations of its botany, mineralogy, zoology, and ways of the wild races. But if Mrs. Hubbard does not give us a very satisfactory or scientific study of Labrador, she leaves us with the impression of a charming and plucky little woman, whose devotion to her husband and his dreams is pure and true. All men approve of that kind of woman, and wish her and her book every success. Mention must be made of an excellent introduction by Mr. William Cabot, which summarises the work of previous travellers in Labrador; also of a good map by Mrs. Hubbard at the end of the volume, which will be of great service to future travellers.

J. G. MILLAIS.

A TROPIC ISLE.[1]

"IF a man does not keep pace with his companions, perhaps it is because he hears a different drummer. Let him step to the music which he hears." Our beachcomber is a squatter in search of the "simple life." He takes up a little island off the coast of Queensland, determined to make it his home and himself master of all the lore that is thereon. Dunk Island, as it is called, is situated about lat. 18° S., and, being really a part of Australia, with high hills and fringing reefs of coral, presents a picture which may well serve in miniature for any tropic isle of continental origin. The rainfall is abundant, and the jungle is a well-described medley of trees, ferns, and lianes, chief of them the climbing palm.

A little of the ground is cleared, the homestead is erected, the praises of the papaw and banana are sung. The beachcomber has enough and contends no more. Birds delight him and guns are taboo. However, civilisation will out, and a census is taken, social as well as numerical. The sagacious megapode hatches its enormous egg (12 per cent. of its own weight) in its own dung heaps. The swamp pheasant plays "hawk" to the fowls. The bee-eater and wood swallow make bee-keeping impossible. The eagle is a detective, deadly foe to snakes of land and sea. The nutmeg pigeon brings news twice a year from the outside world, and other pigeons perennially express their doleful remonstrances at the poor crops of figs on the banyan trees. Lastly, the sea birds have returned, and the owner has been driven off his own paths, annexed for their breeding fairs. There is, too, the Echidna, dainty morsel for the aged blacks, and the story of the snake and the nest eggs is charming. Of insects we desire to hear more.

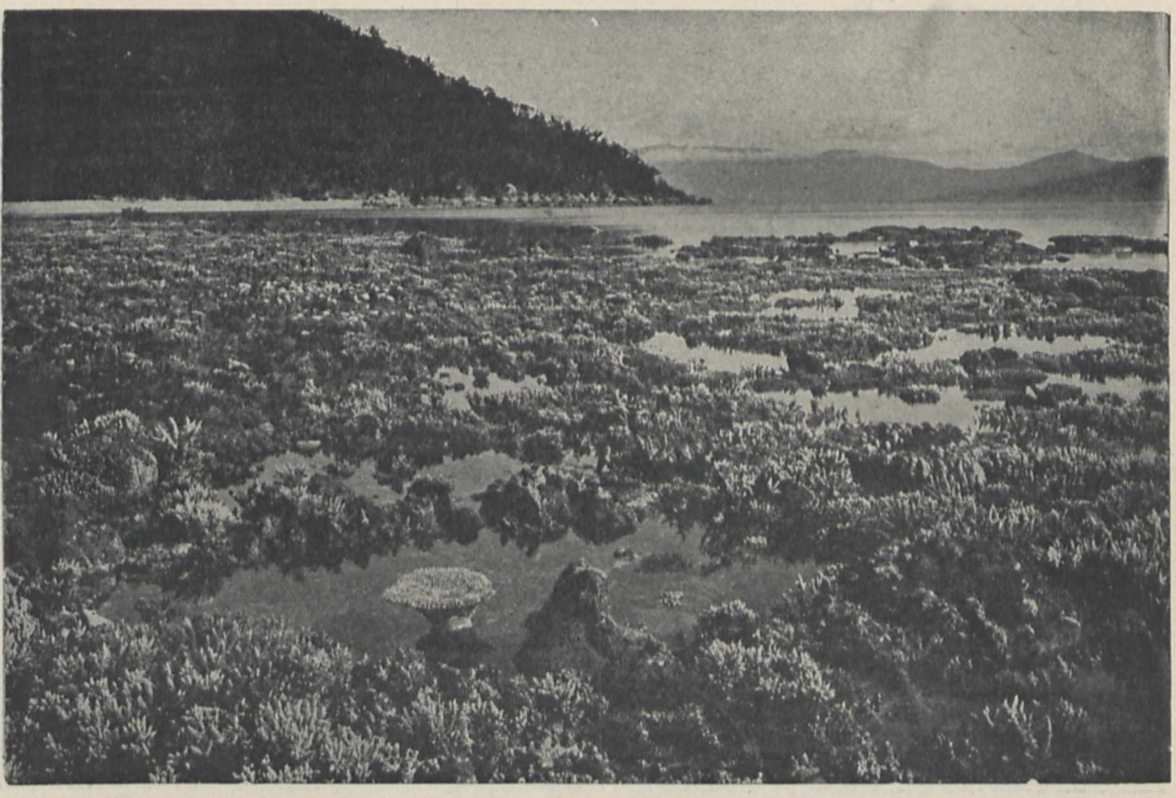


FIG. 1.—A Protected Coral Garden. From "The Confessions of a Beachcomber."

In one bay is a garden of coral, killed off by brown mud after a storm, but sprouting afresh from out the slimy mass. It is pictured as a July garden—the island is situated within the Great Barrier Reef—but yet the most cruel battlefield of nature. Corals grow over and smother all they can. Molluscs are murderers and cannibals. "No creature at all conspicuous is safe, unless it is agile and alert, or of horrific aspect, or endowed with giant's strength, or is encased in armour." The clam sits on the coral, and becomes embedded as it grows up around. Serpula is more successful, raising its anemone-like head well above the surface of the coral in a tube of lime. Fish are like gigantic butterflies hovering over flowers. Bivalves tunnel the coral, and sea-urchins grind to powder its limestone ramparts, gnawing off the crumbs of coral which fill up the greater part of their digestive organs. The *bêche-de-mer* is there too, and oysters of many kinds. Then there is the dugong in herds, frolicking in the water, human in its affection for its young. It is a seaweed feeder; it does no harm—but it makes good bacon. Is the love for all nature, so markedly professed, consistent with its destruction? The descrip-

[1] "The Confessions of a Beachcomber." By E. J. Banfield. Pp. xii+336. (London: T. Fisher Unwin, 1908.) Price 15*s.* net.

tion of its chase was surely written by one who loved "the sport."

We would freely acknowledge the literary charm, the wealth of metaphor, the artistic qualifications, and the excellent powers of observation of our beachcomber. At the same time we direct attention to some faults in his work, because we hope to see it pass into a second edition and become a classic for naturalists. In the first place a hundred pages are dragged in quite irrelevantly at the end on the characteristics of black boys, while the last gin on Dunk Island died in 1900. The chapters are unpleasantly broken up into sections, often absolutely disconnected. The studies of the interrelations of climate, of soil, of plant life, and of animal life are what make the works of our great naturalists of enduring value. Our author is peculiarly vivid and discriminating where he allows himself to draw such pictures, and we would have more of them. He has half-a-dozen islets at hand, and the varied coast of Queensland. Scientific terms and names should be carefully checked to ensure correctness. Lastly, an index is essential. J. S. G.

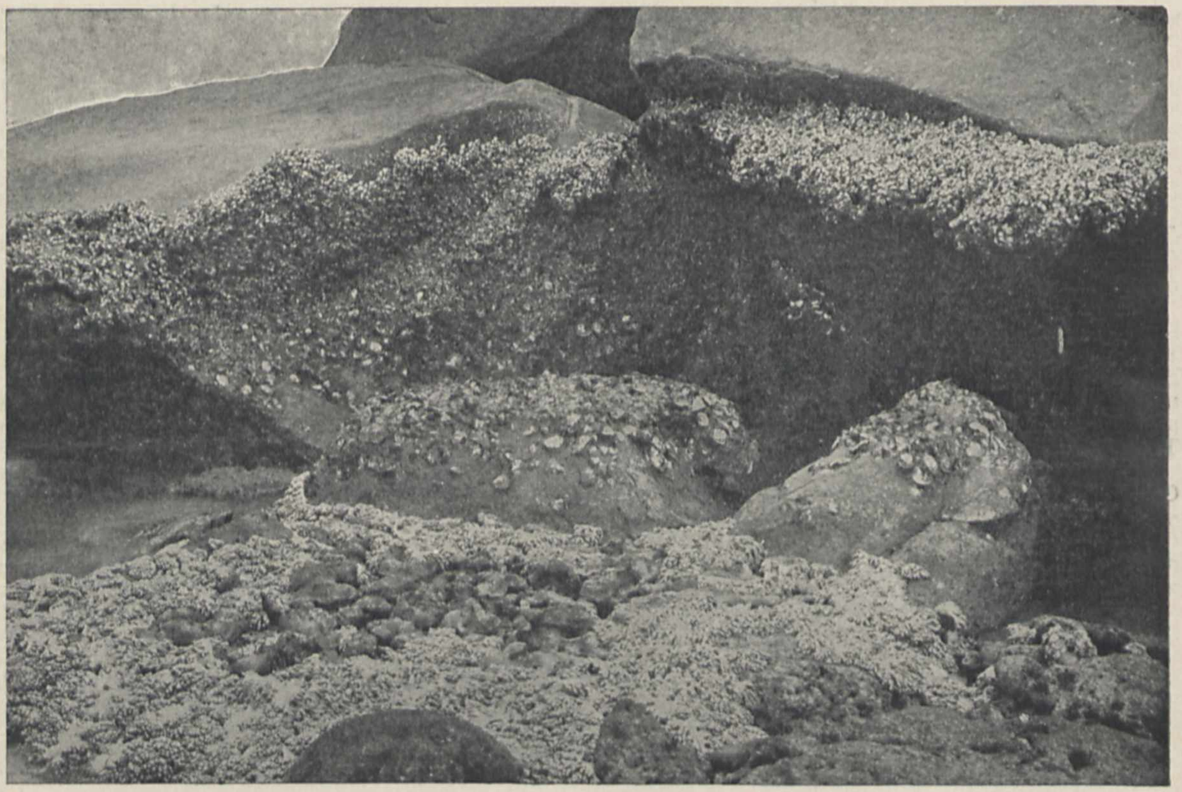


FIG. 2.—Alcyonaria (leathery Corals) and Oysters. From "The Confessions of a Beachcomber."

CHEMISTRY IN JAPAN.[1]

ALTHOUGH a very few Japanese, through reading works in Dutch, had been experimenting in chemistry some fifty years ago, it was not until about a third of a century back that the science began to be taught in Japan by experiment and by courses of lectures, and that soon after young men of that nation, already trained in chemistry, were to be seen, though rarely, in British and other European laboratories.

The circumstance most affecting the labour of a Japanese in studying chemistry and other sciences, at least in the earlier days, has been the necessity to acquire ideas through one or more foreign tongues—English, German, French, Dutch—as far removed in grammar from his own tongue as could well be. This fact does, indeed, add seriously to his labour in his younger days, but it is ultimately quite other than detrimental to his progress. For this labour is largely due to the necessity from the first of getting a clear notion of the meaning of terms, which, when obtained, should be a precious possession to everyone. So, too, it may be said of the apparent burden on the youthful Japanese of having to acquire facility in writing, and that, too, with a soft brush, the vast and elaborate script of his own language. For, whilst it is true that to do so takes years of school life, it is certain and quite obvious that the task gives such delicacy of touch and such deftness in the use of the hands as proves invaluable afterwards in the arts and in the laboratory.

Somewhat more than a year ago, the half-jubilee or twenty-five years' professorship of chemistry in Tokyo of Dr. Joji Sakurai was celebrated by his colleagues, pupils, and other friends. To enlarge upon Prof. Sakurai's career as a chemist not being the object of this communication, it suffices to say of him that he is no stranger in this country, that he is the author of well-known researches, that his influence as a teacher in Japan has been great, and that he is now the director of the Imperial College of Science in Tokyo, as well as one of the professors of chemistry.

The particular purpose of this article is to direct the attention of those interested in scientific development to an incident in connection with the jubilee which, though common enough in similar cases in Germany, seems quite remarkable in a country so

[1] Collection of Papers contributed on the occasion of the celebration of Prof. J. Sakurai's jubilee. Reprinted from the Journal of the College of Science, vol. xxv. (Tokyo, August, 1908.)

young in science as Japan. This was the proffer by Sakurai's chemical colleagues of a number of original papers, some ready and others nearing completion, to be published together as a festal number of the Journal of the College of Science in honour of the event. Together they form nearly half of vol. xxv. of the journal, the rest of the volume, it is of interest to state, consisting of a botanical paper in Latin by B. Hayata, entitled "Flora Montana Formosæ," and illustrated by forty-one exquisite plates. Prefixed to the copies of the chemical part of the volume which have been issued separately for presentation purposes is a biographical sketch of Sakurai, by Prof. N. Matsui, director of the College of Agriculture.

The contents of this publication are ample evidence of the striking and wonderful success, in the course of relatively few years, of Japan's venture into the field of chemical research. There are seventeen papers, touching nearly all parts of present chemical investigation, all of them of value as original contributions, some of very considerable value, and most of them fixing the attention. In abstract they are now appearing, or have already appeared, in European journals; any one of them would have been accepted for publication here or in Germany (two are in German). One was partly published at the time of the jubilee in the *B. d. deutschen chem. Gesellschaft.*

"The Viscosity of Dilute Alcoholic Solutions," by T. Hirata; "Die Anomalie der starkeneinwertigen Electrolyte," by M. Katayama; and "Coagulation of Colloidal Aluminium Hydroxide by Electrolytes," by S. Kawamura, are three examples of excellent work. Two other papers, "The Fusion Curves of the System, Naphthalene-phenol," and "The Fusion Surfaces of the System, Naphthalene-chlorobenzene-phenol," the post-graduate work of two of Prof. K. Ikeda's pupils, T. Yamamoto and H. Hirose, are also of high excellence. The paper by Prof. Ikeda himself, on "The Chemical Theory of Solutions," part i., which covers eighty quarto pages, is particularly worthy of attention. It is, in fact, a short treatise which, when part ii. can be added to it, should have publication in book form, so valuable does it appear to be. It is an exceptionally clear exposition of the subject in admirable English, showing marked originality of treatment, fully illustrated by curves, and mathematically discussed, altogether a most interesting paper.

"The Inversion of Cane-sugar," by Y. Osaka; "Complex Ferri-malonates," by M. Matsui; "Constitution of Elæomargaric Acid," by T. Kametaka; "Japanese Oils," by the same; "Ueber den Hauptbestandteil des japanischen Lacks," by Majima and Cho; "Oximes and Imides of Benzenedisulphonic Acids," by T. Suzuki; "Formation of *p*-Oxycarbostyril from *o*-Nitrobenzoylacetic Acid," by K. Matsubara; and "Molecular Re-arrangement of N-Benzylbenzaldoxime," by M. Kuhara, are also interesting contributions.

There is a paper by, like Prof. Kuhara, another well-known chemist, Prof. T. Haga, entitled "A Simple Method of preparing the Imides of the Aromatic Sulphonic Acids," which is a perfect little piece of work of its kind, admirably written. There are still to be noticed two papers by Prof. M. Ogawa which, from their subjects, will be of greater general interest than any other member of this group of Japanese papers, for they seem to establish the existence of two new elements among the metals, *nipponium*, and another not yet named. These papers recently appeared in full in the *Chemical News*. Mr. Ogawa was, two or three years ago, in London, working upon the new mineral, *thorianite*, placed in his hands by Sir William Ramsay. Some of this mineral he took back with him to Japan, where he has discovered other mineral sources of both these elements.

Besides the contents of Sakurai's jubilee part of the Journal of the Tokyo College of Science, other important chemical papers have, from time to time, appeared in that journal, and in English and German journals. But the appearance of this budget of papers on chemical research offers itself now as a striking proof of the remarkable progress which has taken place in the pursuit of chemistry by a nation which, thirty years ago, was nearly ignorant of any significant part of it. That in physics and in the biological sciences the Japanese have equally advanced under similar conditions is, of course, familiar to many of the readers of NATURE.

EDWARD DIVERS.

THE AGEING OF STEEL.

A MEMORANDUM, by Mr. C. E. Stromeyer, the chief engineer of the Manchester Steam Users' Association, just issued, deals with the important question of the ageing of steel, especially that used for steam boilers. It is now twenty-five years since mild steel began to come into use for boilers, and some definite conclusions have been reached as to its behaviour with time. Tensile and bending tests of steel, cut from boiler plates which have been in use for many years, show that the tenacity has remained practically unaltered, while the ductility, as measured by the elongation, has not been affected. It is known that even the best Lowmoor iron boiler plates become brittle with long-continued use, and it is important to know if this happens with steel plates, but no very definite conclusions appear to have been reached, although it was found that the effect of an injury, such as a chisel nick, or a serious deforming pressure, is not an immediate one, except as regards local alteration of shape, but that after the lapse of many weeks the neighbourhood of the injured region gets somewhat brittle.

A very complete account is also given of the causes which produce water-hammer in steam pipes, and the pressures reached in various cases are worked out in some detail, showing very conclusively the superiority of mild steel over cast iron for steam pipes, not only on account of its superior tenacity, but also by reason of its capacity to absorb sudden shock by its elastic and plastic deformation.

NOTES.

WE notice with sincere regret the announcement in the daily papers that Lord Rayleigh, who, accompanied by Lady Rayleigh, left England recently for a tour round the world, has been so ill in South Africa that he has abandoned a proposed visit to Australia, and will probably winter in Egypt. Later reports state that, though his lordship has been seriously ill, he is now much better.

THE one-hundredth anniversary of the birth of Charles Darwin will occur on Friday of next week, February 12. To celebrate this event the New York Academy of Sciences will hold a special meeting on the anniversary day at the American Museum of Natural History. We learn from *Science* that in addition to the presentation to the museum of a bust of Darwin—the presentation to be made by Mr. Charles F. Cox, president of the academy, and the acceptance by Dr. Henry F. Osborn, president of the museum—addresses will be given on Darwin's work in botany, by Prof. N. L. Britton; on Darwin's work in zoology, by Prof. H. C. Bumpus; and on Darwin's work in geology, by Prof. J. J. Stevenson.

WE regret to see the announcement that Mr. W. H. Hudleston, F.R.S., past-president of the Geological Society, died on January 29 at eighty years of age.

PROF. LOUIS MANGIN has been elected a member of the Paris Academy of Sciences, for the section of botany, in succession to M. Van Tieghem, who was elected permanent secretary recently.

DR. ALEXANDER W. PAVLOW, privat-docent in geology in the University of Moscow, has been elected foreign secretary of the Imperial Society of Naturalists of Moscow, and Prof. E. Leyst the curator of the scientific collections of the society.

REUTER correspondents report the occurrence of the following earthquakes during the past few days:—*January* 27, *Messina*.—A strong shock of earthquake, preceded by rumblings and lasting three seconds, was felt at 8 a.m. *February* 1, *Montreal*.—Three distinct earthquake shocks were experienced early this morning, but no serious damage was done.

A REUTER message from Khartum states that Prof. Sayce has discovered the true site of the ancient city of Meroë, about three miles from Kabushia station, near Shendi, which is half-way between Khartum and Atbara. Due west of the Pyramids, near Kabushia, he found on January 16 the great wall of the inner defences and the remains of the Temple of Ammon mentioned in Strabo; also part of the Avenue of Rams, leading up to the temple, and a statue of a king, life size, besides scarabs, seals, pottery, &c., which date from B.C. 700 to A.D. 300.

M. HENRI POINCARÉ was officially received into the French Academy on January 28, succeeding to the place vacated by the late Sully Prudhomme, the poet. An eloquent eulogy on M. Poincaré was pronounced by M. Frédéric Masson, the historian, who, professing ignorance of M. Poincaré's great work in physics, mathematics, and astronomy, proceeded to give an appreciative estimate of Poincaré, the man, accentuating the promise of his boyhood and youth which has been so abundantly realised during manhood.

AT the general monthly meeting of the Royal Institution on February 1, the treasurer announced that the sum of 10,000*l*. has been anonymously and unconditionally placed by a lady at the disposal of the managers for the purposes of the institution. A resolution was passed expressing grateful appreciation of the donor's munificence and discernment, and accepting the gift as a timely and noble recognition of the good public works the institution has done in the past, and is still doing, in the acquisition and diffusion of scientific knowledge, and as an incitement to maintain and extend its usefulness in the unique position which it has occupied for more than a century.

WE learn from the *British Medical Journal* that the French Congress of Scientific Societies will be held this year at Rennes. Among the subjects proposed for discussion are:—the relations of sociology and anthropology; alcoholism—the evil, its causes and remedies; tuberculosis and the means of avoiding contagion; high altitude and seaside sanatoriums; methods and disinfection against contagious diseases, and the results obtained in towns, rural districts, and establishments in which disinfection is practised; the water supply of towns—the contamination of subterranean lakes; leprosy and pellagra in France; the part played by insects, and especially the common fly, in the dissemination of contagious diseases; hygiene of the school child.

A CONVENTION which will include all branches of medical electricity will be held in London on July 5–9 at University College. The exhibition will include all classes of electrical and physical apparatus for medical treatment. It will be held contemporaneously with the convention, and it is hoped that it will give a stimulus to the manufacture of X-ray and other apparatus. Delegates will be present from America and the Continent, and representatives of the various foreign Governments will be invited to take part in a discussion as to the best means of providing apparatus and training for the Army and Navy. The papers and debates will be in English. Papers in French and German will be accepted provided a *résumé* of such papers is sent in English. All papers will be reported either *in extenso* or in abstract in the Archives of the Röntgen Ray. Communications referring to the congress should be addressed to Mr. Ernest Schofield, organising secretary of the X-Ray Convention, 11 Chandos Street, Cavendish Square, London, W.

A SPECIAL point of view of the new Patent Law was referred to by Prof. G. H. Bryan, F.R.S., in a letter to the *Standard* of January 14. Prof. Bryan says the new Act "means that British labour is to be employed in exploiting the brains of German professors subsidised by the German Government, and that the position of the English brain-worker is to be even worse than it has been in the past. There are hundreds of scientific workers in this country who would be only too glad to make and develop discoveries that would bring English industry up to the same high level that has been reached in Germany. Unfortunately, however, their only chance of employment lies in teaching students to pass examinations for salaries often considerably below a living wage, when not one out of a hundred of these candidates will be either competent or in a position to develop any new discovery." While sympathising with Prof. Bryan's plea for increased opportunities for research by men competent and anxious to undertake it, we think he overlooks the probability that British capitalists will learn through the new Act the value of scientific work in promoting industrial developments. The German manufactories introduced into this country as a consequence of the Act should be a striking object-lesson of the connection between scientific research and industrial progress.

AT the first International Congress of Refrigerating Industries, held in Paris last October, the proceedings at which were described in NATURE of October 22 last (vol. lxxviii., p. 644), it was decided to hold the next congress in 1910 at Vienna, and to form an international association, which would give participating countries opportunities of continuing the work begun last year. A meeting was held in Paris on January 25, when delegates were present from thirty-nine countries other than France, with a view to sanction statutes prepared by a specially appointed committee. Some discussion took place as to the seat of the international association, which one of the statutes submitted fixed at Paris. Eventually, according to the *Times* Paris correspondent, all delegates, with the exception of those from Germany and Austria, approved the statutes. Meanwhile, the Germans and Austrians are to consult their Governments, and it is still likely that unanimity may be secured. In the contrary event, the question of holding the second congress at Vienna in 1910 will require some reconsideration.

THE summary of the weather for the week ending January 30, issued by the Meteorological Office, shows that a touch of real winter was experienced during the period. Over England the mean temperature for the week was from 7° to 9° below the average, and in all the English districts the sheltered thermometers fell below 20°. In the south-west of England and in the Midland counties the lowest temperature was 13°, whilst at Llangammarch Wells the temperature on the grass was 2°. The week was everywhere very dry, and, indeed, the rainfall for the whole of January was much below the average over the whole of England. In London the aggregate rainfall for the month was 0·7 inch, which is less than one-half of the average. At Bath the total measurement was 1·02 inches, which is 1·56 inches less than the average, and at Portland Bill the measurement for the month was only 0·73 inch, which is 1·58 inches less than the normal. At Valencia the deficiency of rain for the month was 2·64 inches. In parts of Scotland the rainfall was in excess of the average. There was a deficiency of sunshine in Ireland during January, but in other parts of the British Isles there was generally an excess.

A REPORT issued by the honorary secretaries of the Aërial League of the British Empire states that the league is making good progress. So soon as possible it is hoped to circulate an official journal and establish a school or college of aëronautics. Arrangements are being made for lectures to be given in all important centres of population in order to interest the public in aërial flight. The purpose of the league is to secure and maintain for the Empire the same supremacy in the air as it now enjoys on the sea; to disseminate knowledge, and spread information, showing the vital importance to the British Empire of aërial supremacy; and to urge these matters upon the nation and upon public bodies and public men throughout the Empire by constitutional means. The league will not favour any one type of airship or any industrial interest. We are in sympathy with the desire expressed in the report that the British nation may take an honourable share in the development of means of aërial navigation. We trust it will be recognised fully by the executive officers of the new league that there is little hope of success of a lasting kind unless the methods of science are adopted from the beginning. The hearty and active cooperation of those men of science who have studied the questions connected with the problem of aërial flight should be obtained at the outset, and their knowledge must be used in determining the forms of activity of the league if national progress in aëronautics is to be secured.

THE record of a trip through the Vedda country of Ceylon, by C. G. and B. Z. Seligmann, forms the subject of the opening and longest article in the number of *Spolia Zeylanica* for December, 1908. Some difficulty was at first experienced in ascertaining whether any pure-bred, cave-dwelling Veddas remain, but, after encountering some half-bred tribes, who dressed (or rather undressed) for the part when the arrival of visitors was signalled, the travellers were finally successful in meeting with the objects of their search, several of whom were interviewed. It is less satisfactory to be informed that the numbers of such folk now appear to be comparatively small. Good descriptions are given of the caves these tribes inhabit. Very curious is the discovery that certain beads worn by some local tribes, by whom they are regarded as semi-sanct, are of Venetian manufacture, and date from the sixteenth or seventeenth century.

THE second number of the Memoirs of the National Museum, Melbourne, is devoted to a monograph, by Mr. F. Chapman, of the Silurian bivalved molluscs of Victoria. Eighteen per cent. of the collection has been identified with species found in other, and frequently widely sundered, areas, the distribution of these ranging in Great Britain through the Wenlock and Ludlow groups, although the German forms occur in the Lower and Middle Devonian. The American types are found in their own home mainly in the Middle Devonian, although one belongs to the upper division of that period. "From this," observes the author, "the inference may be drawn, that since both in Western Europe and Australia the species made their first appearance in the Upper Silurian, the point of dispersal would probably be situated mid-way between those places, provided the conditions were equal, and that there were no barriers to their migration."

THE zoological portion of the imposing building in Singapore known as the Raffles Museum is in the main devoted to the Malay fauna, of the representatives of which a very extensive series of specimens appears to be displayed in the public galleries. To illustrate and explain this collection, the authorities of the museum have just published a guide-book, drawn up by Dr. R. Hanitsch, the director, which is entitled to take high rank among works of this nature. It is, in fact, a concise and popular compendium of the leading elements of the Malay fauna, and ought, therefore, to be of considerable interest to naturalists generally, as well as to the class for which it is primarily intended. The guide is illustrated by twenty-one plates, reproduced from photographs mainly taken by two local gentlemen. While a few of these are devoted to the building itself, the great majority depict the specimens in the collection; these serve to show that in the classes of mammals and birds the series boasts some very fair examples of modern taxidermy, among the most striking being the groups of anthropoid apes and Carnivora.

Now that attention is centred on Slav politics, the essay by Mr. F. P. Marchant on the Slavonic languages, which appears in No. 53 of the Journal of the Anglo-Russian Literary Society, is certainly timely. It discusses the relationship of the languages spoken by the race, which is divided into an eastern and a western division, the former including Russians (Great, Little, and White), Bulgarians, and Serbo-Croats; the latter Poles, Cecks, Moravians, and Lusatian Wends. The writer, while discussing the inter-relation of these forms of speech, denies that the so-called Palæo-Slavonic is, as has been assumed by some writers, the mother tongue. Another difficulty is the absence of a common syllabary, which can hardly be met by the adoption of the Russian (Cyrillic) alphabet for the whole group. There is a certain but limited degree of affinity between the various subdialects. A Russian scholar in Warsaw or Prague will understand shop-signs and street directions provided he knows the compounds of Latin letters representing certain consonants, and he may occasionally catch the drift of the conversation of persons passing him in the streets. Cecks are sometimes able to understand Russian, but Russians seem generally to fail to understand them. In short, proficiency in one Slavonic tongue does not, we are told, lead to the mastery of others, and the theory held by some Russian students that they know all about other Slav languages is said to be a patent fallacy. It is obvious that this difficulty of intercommunication is a decided bar to that political combination which is now so often suggested. It is much to be regretted that the limited facilities of intercourse between the Slav countries and western Europe have so long prevented the valuable scientific and literary work of these races from gaining the recognition which it deserves. It may be hoped that our recent political rapprochement with Russia will lead to more study of this important linguistic group, in which much useful work has been done by those scholars whose achievements are recorded by Mr. Marchant.

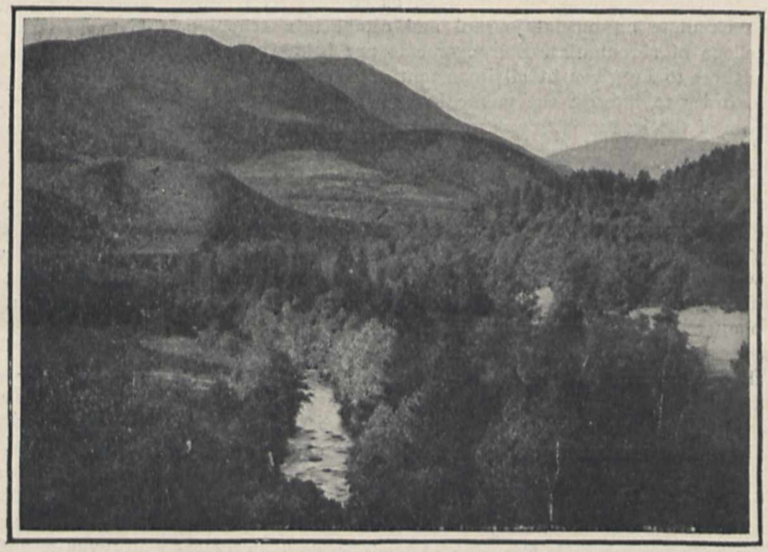
IN connection with heliotropic sensibility, Dr. P. Fröschel contributes to the *Sitzungsberichte der kaiserlichen Akademie der Wissenschaft*, Vienna (vol. cxvii., part ii.), an account of a preliminary experiment to ascertain the presentation period, *i.e.* the shortest time for which a light stimulus must be applied to produce a reaction. The presentation period naturally depends upon the intensity of the light. The author finds that the curve expressing the ratio of the intensity to the presentation period takes the form of a rectangular hyperbola. Working with cress seedlings, a discernible curvature was induced in so short a time as two seconds by a light of 200 candle-power.

A NOTE on the manufacture of ngai camphor from the composite shrub *Blumea balsamifera* is contributed by Mr. P. Singh to the Indian Forest Records (vol. i., part iii.). This variety of camphor is manufactured by the Chinese, and receives from them its designation "ngai." The investigation was prompted by the abundance in certain forest lands of the species noted and *Blumea lacera*, another species emitting a camphoraceous odour. Ngai camphor would not provide a substitute for the ordinary camphor derived from *Cinnamomum camphora*, but has a high value of its own, because the Chinese use it as a medicine and for ritualistic purposes, also in the preparation of fine qualities of Chinese ink.

THE new catalogue of microscopes and accessories published by Messrs. W. Watson and Sons, High Holborn, gives full details of their extensive series of microscopes, ranging from the "Van Heurck Grand Model," supplied with various ingenious devices for regulation, to simple types, low-priced but of guaranteed workmanship, suitable for schools. A new model, the "Standard" is announced, in which the fine adjustment is fixed to the side of the limb instead of at the back; also a new portable instrument, that folds up for packing, has been designed. Owing to the success of the new 1/6-inch semi-apochromatic objective with a large working distance, a 1/12-inch oil-immersion objective has been computed on similar lines. The museum exhibition microscope and the Porro erecting prism for dissecting work are ingenious novelties.

IN a third part of his studies in root-parasitism, published in the botanical series (vol. ii., No. 5) of the Memoirs of the Department of Agriculture in India, Mr. C. A. Barber deals with the haustoria of *Cansjera Rheedii*. Compared with the types *Santalum album* and *Olax scandens* already described, Cansjera resembles the former, whence the suggestion arises that the genus should be truly assigned to the Santalaceæ. The small, irregular haustoria are supplied with numerous lenticels and covered with warty excrescences, while the corky tissue forms a characteristic white sheath. Internally the haustorium consists of cortical cells, from which the contents pass towards the seat of activity, a transitional region where vascular tissue is formed, and a central core, the source of the penetrating and glandular tissue. For the various points of detail in connection with the method of penetration, the development of an endodermis, and other features the reader must refer to the original.

THE fifth part of the fourth volume of the Transactions of the Perthshire Society of Natural Science (1908) contains a number of reproductions from photographs illustrating Mr. H. Coates's presidential address on the glaciation of the county. One of these pictures is here given. The activity of the society extends beyond Perthshire, and the Rev. G. Knight writes on the natural history, geology, and antiquities of Duror, Argyllshire, from the mollusca of Loch Linnhe, through "kentallenite," to Allan Breck Stewart, "a soldier of fortune, a spendthrift, and a prodigal." Mr. G. F. Bates describes the igneous rocks of Glen Lednock, the picturesque valley opening north from Comrie; the successive points in the landscape will be pleasantly recognised by those who have passed over by this route to Loch Tay. Though the paper professedly deals with microscopic details, it is really an account of an excursion, and from this point of view we should like to learn more of the inter-relations of the rocks, especially at their margins, in the field. In an area like this there can be no real distinction between igneous and metamorphic gabbro, such as the author implies on p. 233. Dr. Shand describes crystals of grossularite from Corsiehill Quarry, including a new hexakisoctahedral form. Dr. Lyell directs the attention of members to the mycetozoa to be found near Perth.



View looking up the Sma' Glen from its mouth, showing mounds of fluvio-glacial deposits. Photo. by Mr. A. S. Reid, reproduced in Macnair's "Scenery and Geology of the Grampians."

IN the *Cairo Scientific Journal* for November, 1908, Captain H. G. Lyons states that the Nile flood of that year was one of especial interest; the height reached by the river and the volume discharged were above the average for the first time since 1898, although the level was a good deal below the highest recorded at Aswan during the last forty years. This result was due to heavy rainfall in Abyssinia in July, September, and the early part of October. Captain Lyons considers that one of the most promising lines of attack upon the problem of the

Abyssinian rains and the Nile flood is the investigation of the upper air in the monsoon region of the Sudan, whereby the velocity and direction of the air currents at different levels may be determined. The results of observations hitherto made by means of pilot balloons are now being prepared for publication, and will probably show in what direction further efforts should be made. The problem "concerns not Egypt alone, but all countries which depend upon the rainfall of the monsoon winds which flow from the Indian Ocean."

THE Humber Conservancy has recently been making experiments with a buoy for lighting the channel of the river in place of the gas buoys or vessels now in use. This buoy has been placed at the disposal of the Conservancy by the International Marine Signal Company. It consists of a generator tube containing carbide, which is floated in a flotation chamber 8 feet in diameter. The gas is generated by the water entering the lower end of the generator and attacking the carbide. This causes a slight gas pressure, which forces the water away from the carbide, stopping the further generation until the gas is used in the lantern, when the water rises again and more gas is made. There is no moving mechanism in the buoy, which draws about 9 feet; the focal plane is 9 feet above water-level. The light is of 340 candle-power, and can be seen at a distance of more than a mile. It shows a flash of about five seconds, and a dark period of four seconds.

OF the many screen-plate processes of colour photography on a single plate that have been proposed and worked at since the Lumière firm, of Lyons, produced their autochrome plate, a very short time ago there was only one, the "Thames" plate, that had reached the commercial stage. We learn from the *Times* that another, the "Omnicolore" of Messrs. Jougla, is now on the French market. We believe that this plate has compound lines, alternating green and red, separated from each other by narrower violet lines. By the use of transparent colours, much more light may be transmitted than in the case of the starch-grain screen of the autochrome plate, with a corresponding gain in brilliancy and shortness of exposure. The new plate has aroused much attention on the Continent, and experimentalists in this country are looking forward to its introduction here.

THE December (1908) number of *Ion, a Journal of Electronics, Atomistics, Ionology, Radio-activity, and Raumchemistry*, contains six articles and reviews of seven books. The whole of the articles, of which two deal with applications of the electron theory to the properties of the elements, appear to have been translated from the German by persons unacquainted with the English scientific equivalent of many common expressions. Thus we read about "balls of electricity," "a negative charge unit," "spherical plane," "Peltiere-" and "Halle-effects," "eutechticum," &c. Print and paper are good, and the diagrams show a great improvement on those in the November number.

IN the December (1908) number of the *Physical Review* there is an abstract of a paper communicated by Mr. W. P. Boynton to the New York meeting of the American Physical Society in October, on the specific heats of gases. In it the author emphasises the following as a more rational method of treating the subject than is to be found in the standard text-books. If the specific heat of a gas at constant volume be multiplied by the molecular weight we get a quantity we may call the molecular heat. The fraction of this which is due to the translational motion of the molecule is equal to $3/2\text{-}(\gamma-1)$, where γ is the ratio of the two specific heats of the gas. The product of the molecular heat by this fraction may be called the "translational molecular energy," and ought, according to the kinetic theory of gases, to be a constant for all gases. For forty monatomic and polyatomic gases and vapours considered by Mr. Boynton, it differs from 3 by less than 3 per cent. in forty-five cases.

MESSRS. TOWNSON AND MERCER have sent us their new double condenser. We have tried this apparatus, and find it a very efficient condenser. It has two double tubes inside the condensing cylinder. The vapour to be condensed is split up into two streams, and passes through two narrow tubes, consequently there is very efficient cooling. The apparatus contains two of these tubes, with two separate inlets and outlets, consequently two distillations can be carried out at the same time with one piece of apparatus. Also two reflux operations can be conducted at the same time. This, however, can only be done if the flasks are of very small size, because otherwise the necks will be too far apart for the tubes to fit in. As a double condenser for distilling two products at once the apparatus is fairly convenient; but for carrying out two reflux operations at once it is not of great use, first, because the flasks must be small, and, secondly, owing to the rigidity of the apparatus. The condenser was designed by Mr. W. H. Rawles.

BULLETIN No. 68 of the New Mexico College of Agriculture contains a well-illustrated account of the injurious insects commonly occurring in the region served by the college, with methods for destroying them and for protecting crops against their attack. The instructions are clear and to the point; the bulletin affords a very good example of the work done for farmers by the American colleges.

THE current number of the *Journal of Economic Biology* contains an account, by Mr. Graham, of certain hitherto undescribed insect pests affecting cocoa in West Africa. One damages the trees by perforating the bark, and so produces "gumming." Another burrows between the bark and the wood of the branches, arresting the flow of the sap; it has caused a great amount of damage in cocoa plantations of South Ashanti. The cultivation of cocoa has only recently been introduced in this district; the weevil seems originally to have infested the indigenous Papaw tree.

THE first number of a new monthly technical magazine has appeared under the title *Leather: Technical and Practical*. It appeals specially to all workers engaged in the leather industries, is edited by Mr. M. C. Lamb, and published by the Leather Trades Publishing Co., 143 Holborn Bars, London, E.C. The dependence of technical processes upon the principles of science is recognised fully, as the titles of some of the articles sufficiently show. Prof. H. R. Procter writes on some unsolved problems in leather chemistry, Mr. S. A. Gaunt gives an account of chrome liquors and their application, and Mr. J. L. van Gijn provides notes on liming of hides for sole leather.

PARTS iii. and iv. of vol. xi., and part i. of vol. xii., of "The Proceedings and Transactions of the Nova Scotian Institute of Science, Halifax, Nova Scotia," have been received. The three books deal respectively with the sessions 1904–5, 1905–6, and 1906–7, but have only just reached us. Containing as the books do full and original papers on the geology, botany, and zoology of Nova Scotia by local observers, in addition to researches in chemistry and physics conducted at Dalhousie University, Halifax, they serve as a convenient record of scientific activity in Nova Scotia. The earliest volume contains an interesting paper, by Dr. A. H. MacKay, on phenological observations in Nova Scotia and Canada during 1904, from which it appears that more than 300 accurate and full schedules of observations were sent in from as many public schools in Nova Scotia, and were referred in groups to a phenological staff for examination, selection, and compilation. This utilisation of the energy of young students of science throughout the province is a hopeful sign for the future of scientific research in that part of the Empire. The same number contains a full account of the edible wild plants of Nova Scotia by Mr. Walter H. Prest, and several papers on the geology of different areas in the province. During the session 1905–6, the flora of McNab's Island, Halifax Harbour, was described by Dr. John H. Barbour, and a catalogue of the birds of Prince Edward Island prepared by Mr. John MacSwain. The fungi of Nova Scotia are being studied by Dr. A. H. MacKay, and a first supplementary list appears in the first part of vol. xii., which also contains notes on the mineral fuels of Canada, by Dr. R. W. Ells. Mr. H. Jermain M. Creighton, of Dalhousie University, contributes numerous papers to these Transactions, among which we notice that on the influence of radium on the decomposition of hydriodic acid.

FROM the Carnegie Institution of Washington, Washington, D.C., we have received a useful pamphlet giving the titles, descriptions, authors' names, &c., of the publications of the institution. The editions of each work are generally restricted to 1000 copies, and bound in cloth, and the prices quoted in the present list refer to the cloth-bound works. The different works treat of a wide range of subjects, among which astronomy, biology, and physics are well represented. All communications respecting these works should be addressed to the institution as above.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN FEBRUARY:—

Feb. 6. 22h. 12m. Jupiter in conjunction with Moon (Jupiter 3° 53′ S.).
12. Saturn. Major axis of Ring = 38″·18, minor axis = 4″·49.
,, 10h. 54m. Minimum of Algol (β Persei).
15. 7h. 43m. Minimum of Algol (β Persei).
,, 8h. 43m. Mars in conjunction with Moon (Mars 0° 1′ N.).
,, Apparent diameter of Mars = 5″·4, Jupiter = 41″·0, Saturn = 15″·2.
19. 9h. 49m. to 13h. 9m. Transit of Jupiter's Satellite III. (Ganymede).
22. 7h. 29m. Saturn in conjunction with Moon (Saturn 2° 52′ N.).
24. 14h. 42m. to 18h. 36m. Transit of Jupiter's Satellite IV. (Callisto).
26. 13h. 5m. to 16h. 26m. Transit of Jupiter's Satellite III. (Ganymede).
27. 6h. 47m. to 7h. 31m. Occultation of 105 Tauri (mag. 5·8).
,, 12h. 42m. to 13h. 31m. Occultation of η Tauri (mag. 5·2).

JUPITER'S EIGHTH MOON.—A telegram from Greenwich, published in No. 4299 of the *Astronomische Nachrichten* (p. 47, January 22), announces that Jupiter's eighth satellite was photographed there on January 16. From two photographs it was found that the daily motion was −16s., +1′, and that the magnitude of the satellite was 17·0. The position determined from these photographs is in close accordance with the Cowell-Crommelin elements.

THE PROBLEM OF SEVERAL BODIES.—In an address delivered before Section A—Astronomy and Mathematics—of the American Association for the Advancement of Science, Baltimore, 1908, the chairman of the section, Prof. E. O. Lovett, gave a valuable *résumé* of the recent progress made in the solution of the problem of several bodies. An abstract of this address now appears in *Science* (No. 733, p. 81, N.S., vol. xxix.).

Commencing with Whittaker's formulation of the classic problem of three bodies, Prof. Lovett proceeds to enumerate, very briefly but very clearly, the results of various attempts to obtain particular solutions and their generalisations. The paper is too comprehensive even to summarise here, but some idea of the thorough treatment the subject receives may be gathered from the fact that it refers to no fewer than ninety-three workers who have contributed to the solution of the problem, and in each case gives sufficient information to enable the reader to see which particular part of the subject each worker attacked.

AN ECCENTRIC VARIABLE STAR.—In No. 4299 of the *Astronomische Nachrichten* (p. 47, January 22) Miss Mary W. Whitney directs attention to the unusual variations lately exhibited by the variable SS Cygni. Since October 3, 1908, the star has varied almost continuously, although irregularly, and at minimum has not fallen to its usual limit; the lowest minimum recorded was about mag. 10·8, the highest mag. 10·5. The maxima, too, have differed from those usually looked for, the brightest being mag. 8·9. The light curves, though irregular, have been rather of the anomalous than of the usual type.

THE MINOR PLANET PATROCLUS (617).—A bi-daily ephemeris for the minor planet Patroclus, of the Jupiter group, is continued by Herr V. Heinrich in No. 4299 of the *Astronomische Nachrichten* (p. 45). This ephemeris extends from January 4 (opposition took place on January 6) to March 19, and the probable magnitude is given as 12·9.

An observation made by Prof. Wolf on January 9 gives a correction of −0m. 39s., +3′·3, to the ephemeris position, and shows that the photographic magnitude is less than 13·0.

DETERMINATION OF THE APEX AND VERTEX FROM THE STARS IN THE PORTER CATALOGUE.—From an analysis of the proper motions of the 1340 stars given in the Porter catalogue, Herr S. Beljawsky has obtained values for the positions of the apex and vertex respectively, which he publishes in No. 4291 of the *Astronomische Nachrichten*. The analysis was made by dividing the catalogue stars into thirty regions, and the final values obtained are:—apex, A = 281°, D = +36°; vertex, A = 266°, D = −24°.

COLOURS OF STARS IN GALACTIC AND NON-GALACTIC REGIONS.—Continuing his investigations of the relationships existing between star colours, spectral class, magnitude, &c., Mr. Franks made an analysis of the colours and magnitudes of 3630 stars, given in the Revised Harvard Photometry, between the north pole and declination 25° S.

As a result of this analysis he finds that the distribution of white and of coloured stars is not symmetrical; there is a striking preponderance of white stars in the galactic, as compared with the non-galactic, regions.

Mr. Franks interprets this result as showing an undoubted physical connection between the colours of stars and the galaxy, and suggests that the latter is probably the newest and most vigorous part of the stellar universe (Monthly Notices, R.A.S., vol. lxix., No. 2, p. 106, December, 1908).

POPULAR ASTRONOMY.—Evidence of the increased interest taken in astronomy by the general public is to be found in the fact that several daily papers now devote space to astronomical news.

From this point of view it is interesting to note that the *Daily Telegraph* of January 27 contained a map of the February sky, with notes on the objects which may be observed; this article is the first of a monthly series. We also remark that the *Yorkshire Weekly Post* is publishing a series of articles by Mr. J. H. Elgie, who in a recent issue directed attention to the possibility of a connection between solar activity and earthquake phenomena.

SCHOOL-WORK AND AFTER-LIFE.

THE problem of bringing school curricula for boys and girls into closer relation with their probable after-school activities has been discussed at recent educational conferences, and I wish to direct attention to three particular cases of the problem:—(1) technical training of boys before apprenticeship to a trade, or attendance at technical institutes; (2) scientific training of boys between ages sixteen and eighteen, preliminary to a medical or engineering course; (3) science teaching of girls with a view to domestic application of the principles and skill acquired.

L.C.C. Conference: Junior Technical Schools.

(1) A session of the London County Council Teachers' Conference was devoted to the subject of junior technical schools for boys. The attendance was large—more tnan 2200 applications for tickets admitting to the conference having been made to Dr. Kimmins, who was responsible for the organisation of the meetings—and the chair was taken by Mr. F. C. Ogilvie, principal assistant-secretary at the Board of Education for Technology and Higher Education in Science and Art. The chairman said that the present need was a clear statement of accomplishment. The question of the leaving age and the different necessities of localities made the determination of the curriculum a wide problem, so that there could not be a sealed pattern of a junior technical school. Mr. T. Luxton described the system adopted at the Hull Technical Institute, where the boys were admitted after twelve years of age and stayed for two and a half years. Two-thirds attended the commercial side, the remainder the engineering and science side. More than 90 per cent. of the boys came from the elementary schools, and the net effect was to lengthen their school life by about two years.

Mr. F. Jeffery gave an account of the methods adopted at the Stanley Technical Trade Schools, Norwood. Experience at many technical institutions had shown that when a working lad or man returns from a fatiguing day's work he has little energy left to go to a higher school, and the founder of these schools recognised that technical education must begin at an earlier age. Being himself a technical manufacturer, he became convinced that much could be done to develop the originality and skill of boys by taking them *at a compulsory school age* and giving them a taste for practical science and mechanics. He said:—"If we can so prepare our boys that they will be coveted as apprentices by our technical manufacturers, I am sure this will raise the standard of our work." Boys are admitted between twelve and thirteen years of age, and devote half their time to general subjects and half to workshop practice. This system has the economical result that the teaching staff for 300 boys is only that required for 150 in each division, or, in other words, the total teaching staff is not increased by the addition of workshop instruction. The system of fees is unique. The fee for the first year is one shilling per week; those "students" who make satisfactory progress are elected "junior scholars," and pay no fees for the second year. In the third year they may be elected "scholars," and will then be paid a small consideration for their mechanical work if it be of commercial value. Mr. Jeffery claimed that the class-room studies did not suffer in quality, though somewhat restricted in range. His Majesty's inspector reported:—"One justification of the special feature of the school, in devoting half the working time to practical workshop instruction, is seen in the keenness and vigour with which all the work is carried on, and the evident interest which the students take in their studies."

After giving a useful account of the details of this valuable educational experiment, Mr. Jeffery stated the aim of the school to be that of preparing lads to be skilful, scientific, and artistic mechanics, and to make them anxious to continue their studies at polytechnics so as to become skilled artisans fitted for good positions in their industries. When such a result has been achieved, schools of this type are likely to become an integral part of the educational system of the country. Then the status of the British artisan and the standard of his work will be raised.

Mr. R. Bunting would leave trade schools to the polytechnics. The ordinary day school should give such a general education that the children would be prepared to take *immediate* advantage of the special facilities offered by the regular trade schools. From a recent analysis of a record which he had kept of the boys leaving the Acland School (Kentish Town) during the past five years, he found that the boys of greater mental power were also more capable in all intelligent motor exercises, including manual work. Lads liked manual work; such work was specially valuable in cases of slow development, leading to a marked increase in their general mental development concomitant with their growth in skill.

It was well that a conference of teachers should discuss this problem, and it is all to the good that they are endeavouring to link the work in the schoolroom with the after-school employments of their boys, but personally I am convinced that the time is ripe for legislation which should make it illegal to employ young persons unless they are working in the capacity of learners of industry. A recent Act has established this principle for Scotland—why should England lag behind?

Preliminary Scientific Instruction of Medical and Engineering Students.

(2) The General Medical Council refuses to recognise the leading secondary schools as places where the preliminary training in chemistry and physics may be given to medical students, notwithstanding the fact that the Conjoint Board of Physicians and Surgeons grants such recognition. It is alleged that the council wishes the students to learn "medical chemistry" and "medical physics." As already reported in NATURE of January 21, the Public Schools Science Masters' Association condemned the action of the General Medical Council, as boys have been removed from school in consequence of the non-recognition stated above, although it is not clear that this non-recognition by the General Medical Council is of the slightest practical consequence. During the debate the wider issue was raised as to whether a boy intended for a scientific profession should leave school at seventeen or remain another twelve or eighteen months and devote his main energies to science studies. Prof. Armstrong spoke in favour of compelling all boys to leave school at seventeen, but the majority of those present were of the opposite opinion. Nothing was said about the boys who reach the age of seventeen without reaching the position in the school appropriate to that age; but, unfortunately, such cases are far from rare, and it is, in the writer's opinion, very dubious policy to keep such youths longer at school; transplanting offers the better chance of growth; but for the abler and more industrious the age of seventeen is a critical period in mental development. At this epoch the boy has begun to feel his feet, to take his stand on general scientific principles, and sees before him an inspiring and unlimited vista of future study. Is it advisable to remove him at this moment from the instructor whom he understands, and who understands him? Is it prudent to exchange the individual tuition with constant questioning and supervision, the homely apparatus which does not obscure the idea and purpose of its construction, for the large classes, the diminished or evanescent tutoring, the elaborate lecture appliances of the technical college? Moreover, it is necessary to consider how far the youth is matured in character, as the possibility of a wrecked career is not negligible when a youngster has to be sent from a boarding-school and a country home to live as a medical student in London or in a great industrial city.

On the other hand, it has been urged, and Prof. Armstrong stated this view as a result of his personal observation, that character is strengthened by removing the youth of seventeen from too tender tutelage, and that the prolongation of such tutelage hinders the growth of resourcefulness, initiative, and relf-reliance. To the writer it seems necessary to distinguish between two parallel courses:—(*a*) public school followed by Oxford or Cambridge; (*b*) town school followed by day college, with residence at home. The transfer from school to college may perhaps be a year earlier for (*b*) than (*a*). It is worth pointing out that high academic distinctions often bring a rich reward in later years, and that to shorten the course before the degree is to pit a man against competitors a year older.

As regards "medical chemistry" or "medical physics," it should be stated, clearly and with emphasis, that we want students to be grounded in the fundamental principles of chemistry and physics, and that "medical physics" is an utter delusion. A competent teacher will use such illustrations as will bring his teaching into close relation with the interests and ambitions of his pupils, whether medical, engineering, or other. Only in this sense can we allow any branch of science to be "medicated."

Domestic Training and Science for Girls.

(3) The Incorporated Association of Assistant Mistresses in Public Secondary Schools devoted the afternoon of their twenty-fifth annual meeting to a discussion of the science curriculum for girls. Miss Laurie (Cheltenham Ladies' College) read a paper dealing with the principles to be followed in planning a science course. They wanted to train children in scientific method and management; they should not cram facts, but develop faculties. Much depended upon proper grading of experimental work, and it was important to use simple apparatus. There was a danger of providing technical education without a scientific training. This led to the British workman being beaten by the German.

Miss Wood (Leeds Girls' High School) described a course of "science applied to domestic life" which had been carried out at Leeds. In addition to laboratories for chemistry and physics, the school possessed a "kitchen laboratory." Her object was to make common things and ordinary phenomena the very centre of the teaching, to develop scientific principles, and inculcate the scientific habit in the closest possible connection with the facts of everyday life. The household, and above all the kitchen, abounded in things and problems that could be made the object of simple scientific inquiry; their study stimulated the interest of girls. For a home task Miss Wood had set high-school girls to clean the flues of the kitchen range, light the fire, and arrange to have the water hot. In that sort of way the cooperation of home and school was secured.

During the discussion which followed several speakers feared the danger of making scientific instruction too utilitarian; the domestic training might be acquired at the expense of, and not in addition to, the training in exact thinking.

So great a majority of girls will become better and more efficient women by acquiring domestic knowledge and skill, and the spread of such acquirements is so important to national physique, that there can be little hesitation in encouraging domestic training in our girls' schools—it being obvious that in very many cases the home cannot meet the need; but in actual laboratory work the choice of subject and method must have unity of aim. Which is to be the dominant ideal in the teacher's mind? Some experience of girls' schools, and a careful observation of the plan pursued in some of the most successful technical classes, lead me to suggest that it will be found best to develop a *science* course, using domestic phenomena for illustrations wherever suitable, to be followed in the last year by a course frankly and directly aiming at *domestic* training, parallel with, or in place of, the science course. This would mean that science and domestic training would be correlated, but have separate places in the time-table.

G. F. D.

A PROPOSED NORTH POLAR EXPEDITION.

AT the meeting of the Royal Geographical Society on January 25 Captain Roald Amundsen read a paper explaining his plans for a proposed north polar expedition. Mr. Amundsen urges the necessity for another crossing of the Arctic Ocean, not merely in order to gain further knowledge of the ocean itself, but to study the general problems of oceanography with the greatly improved methods which have come into use since the date of the *Fram* expedition, under the favourable conditions of an ice-covered sea, which gives a fixed undisturbed surface from which to work. He brings forward in his paper many interesting examples of the progress which has been made during the last twelve years in improving the apparatus and methods of deep-sea investigation, and many arguments in support of his contention that the polar ocean offers unequalled opportunities for settling vexed questions connected with the cause of currents, the effects of tidal action, the reciprocal action of plants and animals at various depths, and so on. A thorough examination of Nansen's old ship, the *Fram*, has shown that the vessel is, or can easily be made, as sound as ever, and fit for another voyage similar to that of the famous expedition of 1893–6.

The plan of the expedition is stated as follows:—"With the *Fram* equipped for seven years, and a capable crew, I shall leave Norway in the beginning of 1910. We shall make for San Francisco round Cape Horn, taking in coal and provisions at the former place. We shall then shape our course for Point Barrow, the most northerly point of North America, which I hope to reach by July or August. From this place the last news will be sent home before the real voyage begins. On leaving Point Barrow it is my intention to continue the voyage with as small a crew as possible. We shall then make for the drift-ice in a direction north by north-west, where we will then look for the most favourable place for pushing farther north. When this has been found we shall go as far in as possible, and prepare for a four or five years' drift across the Polar sea. Throughout our voyage up to this point, I intend to make oceanographic observations; and from the moment the vessel becomes fast in the ice, a series of observations will be begun, with which I hope to solve some of the hitherto unsolved mysteries. What I expect to find in the unknown part of the Polar sea I will say nothing about at present. Some people have put forward theories of great masses of land, others of small. I ought perhaps also to have put forward my theory, but think it wiser to refrain from doing so until I have investigated matters at closer quarters."

THE GEOLOGICAL SOCIETY OF GLASGOW.

THE jubilee of the Geological Society of Glasgow was celebrated on January 28, when a conversazione was held in the University of Glasgow. An address was delivered by Sir Archibald Geikie, K.C.B., president of the Royal Society, and now the senior member of the Glasgow society. Prof. J. W. Gregory, F.R.S., the president, said the Geological Society of Glasgow has been fortunate in its roll of distinguished members. For twenty-two years the late Lord Kelvin was its president. The name which has been longest on the list of members is that of Sir Archibald Geikie. In 1862 he read to the society a paper which occupied three-fourths of the first volume of the Transactions, and at once lifted British glacial geology on to a new plane.

Sir Archibald Geikie, during the course of his address, said it was not until some fifty years ago that the number of men following a geological bent grew large enough in Glasgow to call for the formation of a geological society. It is a curious fact, he said later, that some of the earlier writers on Scottish geology were foreigners, some of them having been attracted to this country by the fame of the wonders of Staffa and the Western Isles. One of the earliest and most celebrated of these visitors was the Frenchman Faujas de Saint-Fond, who in the year 1784 travelled from the south of France to see the marvels of Fingal's Cave. On his way back from the West Highlands Faujas de Saint-Fond passed through Edinburgh, and met there the illustrious James Hutton, who, he tells us, "was at that time engaged, in the calm of his study, writing a work on the theory of the earth." Little could the French traveller have divined that "this modest philosopher," as he called him, would in after years be universally acclaimed as one of the great founders of modern geology. In the year 1819 there appeared the monumental "Description of the Western Islands of Scotland," by John Macculloch, in which was given an excellent account of the Clyde islands. Contemporary with Macculloch was another observer to whom Scottish geology stands deeply indebted, Ami Boué. After taking his degree in Scotland Boué went to Paris, where for a time he employed himself in preparing his "Essai géologique sur l'Écosse," which saw the light in the year 1820. A few native inquirers began to make their appearance during the closing years of the eighteenth and the early decades of the nineteenth century as pioneers in the investigation of the details of the local geology. First came David Ure, whose excellent "History of Rutherglen and East Kilbride," published in 1783, stands out pre-eminent for the fulness and faithfulness of its descriptions. Afterwards came Andrew C. Ramsay. After referring to the work of John Craig in Lanarkshire, Montgomery in Renfrewshire, Prof. Thomas Thomson in Glasgow University, and James Bryce, Sir Archibald Geikie said that of all the influences which conspired to raise in Glasgow an interest in the geological history of the district he was disposed to give the foremost place to that of James Smith, of Jordanhill.

THE WINNIPEG MEETING OF THE BRITISH ASSOCIATION.

A CIRCULAR has been prepared containing information of interest to members of the British Association who propose to attend the meeting to be held in Winnipeg, Manitoba, Canada, in August next, under the presidency of Sir J. J. Thomson, F.R.S. A representative local executive committee and officers have been appointed to conduct the local arrangements, which will include some interesting excursions and facilities for a tour through the Western Provinces to the Pacific Coast. The weather conditions during the latter part of August and the beginning of September are favourable in the Western Provinces of Canada, whilst in Winnipeg, situated 760 feet above sea-level, the days are warm, though not oppressively hot, and the nights are invariably cool. On account of August being the busiest month of the year in bookings to America, no reduction on minimum steamship rates will be made to members of the association, but superior accommodation may be granted, on the return voyage, at the ordinary minimum rate. The journey to Winnipeg, the meeting, and return home will take about thirty-two days. There will be a western excursion from Winnipeg to Regina, Moose Jaw, Calgary, Edmonton, Vancouver, and Victoria, and return to Winnipeg; members who take part in this excursion will require ten more days, thus making a six weeks' visit. Special fares are expected to be in force on the Canadian railways, amounting probably to a single fare for the return journey, from Montreal to Winnipeg, provided the party numbers not less than fifty; as also from Winnipeg to Vancouver, or for any side-trip made by individual members. The estimated personal expenditure of each member attending the meeting from Great Britain is a minimum of about 38*l*., and an average of about 65*l*. The additional expense of the western excursion will be about 25*l*. Any member of the association who contemplates an extensive journey of exploration or for other scientific purposes, fishing, hunting, &c., is invited to communicate with the local secretaries of the British Association, University of Manitoba, Winnipeg. Expert advice and assistance will be given to any group of members who propose to avail themselves of this opportunity. A list of hotels and lodgings will be issued by the Winnipeg executive officers, to whom application should be made, early in July.

Members who propose to attend the meeting should send in their names to Mr. H. C. Stewardson, assistant treasurer of the British Association, Burlington House, London, W., not later than May 31, by which date members should, if possible, complete their arrangements with the steamship companies, as all the best accommodation on steamers sailing in August is booked some months ahead. An illustrated handbook of preliminary information, issued by the Winnipeg executive committee, will be forwarded from the office of the association on receipt of 2½*d*. for postage.

MECHANICAL FLIGHT.[1]

Present Position.

THE recent records made by Messrs. Wright, Farman, Delagrange, and Bleriot, together with the gradual accumulation of testimony in favour of mechanical flight, have finally disabused both the public and experts of the notion that aviation is a dream.

Many engineers from time immemorial have tackled the subject without success, and there was every reason for the sceptical attitude which has prevailed until the last few years. It is now evident that mechanical flight was impossible before science and engineering skill in the nineteenth century had so perfected the heat engine that considerable power was obtainable with but little weight. The present improved aspect of affairs must not, however, blind us to the fact that much has yet to be done. The most successful machines now in existence show serious defects, cannot be manipulated in troublesome weather, and have every part so light that at all times they are on the brink of collapse. It rests with mechanical engineers to design a stronger machine without losing efficiency. In the course of this paper the author proposes to indicate certain points in which improvement is desired, and at the same time he has endeavoured to include a sufficiency of the theoretical and experimental knowledge available on the subject to enable a would-be aviator to construct a simple type of machine.

It cannot be too strongly realised that existing information is defective, and a few words as to research may be useful.

Necessity for Research.

It will be shown in the course of this paper that the whole question of mechanical flight depends upon a knowledge of the manner in which air reacts against solid bodies moving through it. A large number of researches have been made during the past 150 years, but even yet exact information is lacking on the majority of points.

Furthermore, mathematical analysis has not been sufficiently developed. A few great mathematicians (including Lords Kelvin and Rayleigh) have devoted some attention to the matter, but the author is not aware that any mathematician worthy of the name has considered it worth while to make an exhaustive study of the question, although it must be recognised that the recent advances in the theory of hydrodynamics form useful auxiliaries to the study of aërodynamics.

Brief History of the Theory.

The nature of fluid resistance has been investigated for many years, and the general principles are to be found in Newton's "Principia." The ballistic researches of Hutton and Robins at the end of the eighteenth century first clearly showed the quantitative value of air resistance, and their work is still valuable. On the hypothesis deducible from Newton's work, Messrs. Navier and Gay-Lussac early in the nineteenth century formulated a theory of flight which showed that great power was necessary, and this notion held sway for many years after, so that little progress was made with the subject, flight being deemed impracticable. Experiments by Wenham and Browning in the 'eighties, together with Langley's researches in America and Maxim's in England, clearly showed the fallacy of this idea. Pénaud in 1876 first gave the mathematical theory of the aëroplane, which had been conceived by Henson in 1840. The late Mr. Froude, Lord Rayleigh, and Prof. Bryan developed this theory, and in 1903 the last-named produced equations of stability for the aëroplane. Two years later Captain Ferber, of the French artillery, amplified these equations to find the conditions of lateral stability and the form of the trajectory, and quite recently Mr. Lanchester has done similar work. Prof. Fitzgerald and Lord Rayleigh have given some attention to the ornithoptère, and Profs. Pettigrew and Marey at an earlier date arrived at several important conclusions respecting bird flight. The helicoptère has not received very much attention, but the cognate work of the late Mr. Froude and his son on propellers has a most important

[1] Abridged from a paper by Mr. Herbert Chatley read before the Society of Engineers on December 7, 1908.

bearing on the matter. Mr. Alexander, Sir Hiram Maxim, and several other engineers have made researches on the subject of air-propellers.

Theory.

Resistance of Surfaces and Solids.[1]—A certain resistance is experienced when any body is moved through the air, depending on the form of the body and the relative speed. If the air is abruptly parted the sudden alteration of its relative momentum causes a thrust on the body; its friction against the body produces further resistance, and the partial vacuum at the rear (due to the air not immediately returning) causes still more resistance. The air enters this rear space in a series of whirls or eddies, the kinetic energy of which must be supplied by the moving body. Hence we must consider the front form, the surface, and the rear form of the moving body. All the effects are, at the speeds commonly occurring, nearly proportional to the square of the speed.

If a thin but rigid plane be moved perpendicularly to itself with a speed of V feet per second, it will be subjected to a dynamic resistance and also to a negative pressure due to the whirling behind. The skin resistance will be negligible except when the dimensions are very great. The dynamic resistance depends on the quantity of air affected, which again varies with the area, so that we may write

$$P=k\left(1+\frac{1}{n}\right)SV^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where P is the total pressure in lb., S is the area in square feet, V the speed in feet per sec., and k and n are constants; k is the mass of a cubic foot of air divided by 2, and is equal to about 0·0012 at normal temperature and pressure; n is the ratio of the dynamic to the negative pressure, and is generally rather more than 2, so that $k\left(1+\frac{1}{n}\right)$ varies according to different experimenters from 0·0013 to 0·0017. Langley's value 0·0017 is frequently used, so that we have

$$P=kSV^2 \text{ (where } k=0{\cdot}0017) \quad . \quad . \quad . \quad . \quad . \quad (2)$$

If the plane be turned so that it make an angle γ with the direction of motion, the dynamic action is no longer symmetrical, skin friction becomes important, and negative pressure decreases. Many rules have been given for this case, but except for very small (say less than 2°) and very large angles (more than 40°) the following rule will serve:—

$$P=2kSV^2 \sin\gamma \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

As the surface becomes nearly coincident with the direction of motion P decreases, but there is a certain residual resistance due to edge dynamic action and skin friction. Lanchester makes this approximately

$$F=\frac{2kSV^2}{20} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

where F is the total resistance in lb.

(The author is responsible for this formula.)

This means that the coefficient of skin friction is upwards of 5 per cent. of the coefficient of resistance. There is some difference of opinion as to this, but the value will serve.[2]

Curved surfaces experience analogous resistances when inclined so as to present a *definite* convexity or concavity forwards, the coefficient being rather larger. If such surfaces have their chords in the direction of motion, they will be subject to skin friction, and will also experience an upward or downward thrust according as the convexity is beneath or above, provided that the curvature is easy so that the air may stream into the concavity. Surfaces laterally great experience more thrust than those the major dimensions of which are in the direction of motion, the ratio of thrust per unit area varying about 30 per cent. above and below that on a square surface.

The resistance of air to solids in motion is similar to that of water, but in the decreased ratio of the density of air to water (about 1 : 800).

[1] See Lamb's "Hydrodynamics," Lanchester's "Aërodynamics," also an article by the author on the "Stream Line Theory in Relation to Aërodynamics," in *Aëronautics*, August, 1908.

[2] See Baden-Powell's "Practical Aërodynamics," Langley's "Experiments in Aërodynamics," and the author's book, "The Problem of Flight."

Centre of Pressure.

The dynamic resistance is not symmetrical, the resultant pressure being ahead of the centre of area. More information is required as to this displacement. For planes inclined at an angle γ to the direction of motion, the following rule, given by Joëssel and Avanzini, is much used:—

$$\Delta=0{\cdot}3(1-\sin\gamma)L \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

where Δ is the distance in feet from the centre of area to the centre of pressure, and L the length in feet of the plane in the direction of motion.

Turnbull (*Phys. Review*, xxiv., March, 1907) contests this rule, and states that his experiments indicate that when γ is less than 18°, Δ simply varies with γ, so that when $\gamma=0$, $\Delta=0$. For surfaces having a convex underside or concavity in front and convexity at the rear (both on the underside), he gets a law similar to, but in excess of, Joëssel's. He maintains that these two types of surface only are stable.

As this quantity enters into all the stability formulæ, further experiment is urgently required.[1]

Energy Required for Flight (Aëroplane).

Since the normal pressure varies as the area of the plane and the square of the speed, the component of this in the direction of motion will similarly vary. Thus if the

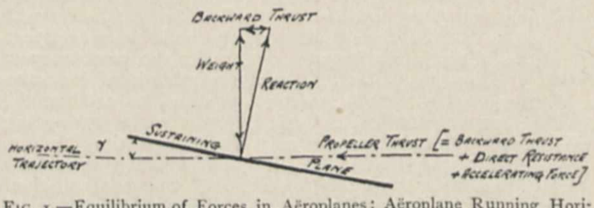


FIG. 1.—Equilibrium of Forces in Aëroplanes: Aëroplane Running Horizontally.

thrust is in the direction of motion we have R the resistance of the plane in lb.

$$R=P\sin\gamma=2kSV^2\sin^2\gamma \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

and if a further resistance CV^2 be allowed (where C is the projected area in square feet of the car at right angles to the direction of motion) for the car and framework, we have

$$\begin{aligned} H &= (R+CV^2)V \\ &= (2kS\sin^2\gamma+C)V^3 \quad . \quad . \quad . \quad . \quad . \quad (7) \end{aligned}$$

where H is in foot-pounds per second.

Hence the power required appears to vary as the cube of the velocity. γ, however, is not necessarily constant,

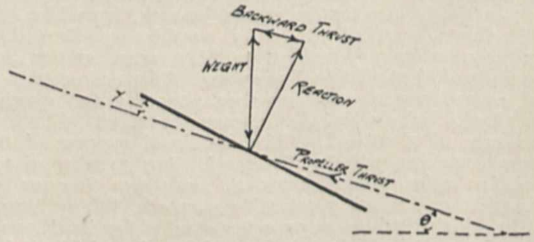


FIG. 2.—Equilibrium of Forces in Aëroplanes: Aëroplane Ascending.

so that we may diminish the power by decreasing γ, always remembering that C is invariable. The limiting value of γ is determined by the weight, for the vertical thrust must never be less than the weight. If the direction of motion is horizontal, then we have

$$W=P\cos\gamma=2kSV^2\sin\gamma\cos\gamma \quad . \quad . \quad . \quad . \quad (8)$$

where W is the weight in lb., so that V being known, γ can be computed, or *vice versâ*. It will follow from this that if a certain starting value for γ is assumed, the value V, found from equation (8), will be the lowest soaring speed, *i.e.* the starting speed required.

[1] See Turnbull's paper, also Kummer, "Berlin Akademie Abhandlungen," 1875-6; Joëssel, "Génie Maritime," 1870; Langley, "Experiments in Aërodynamics"; Moedebeck's "Pocket-Book."

By substitution between (7) and (8) the speed corresponding to a given power and angle may be obtained, or the power required to drive the machine at any particular angle and speed. If the machine be rising, so that the

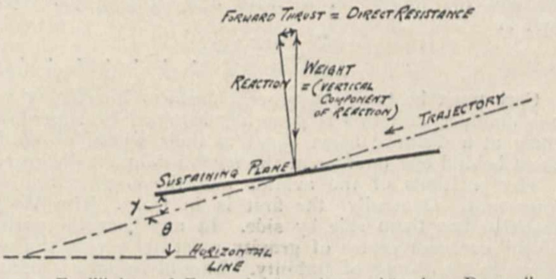


FIG. 3.—Equilibrium of Forces in Aëroplanes: Aëroplane Descending (gliding).

line of motion is inclined at an angle θ to the horizon, then (8) becomes

$$W = P\cos(\theta+\gamma) = 2kSV^2\sin\gamma\cos(\theta+\gamma \quad . \quad . \quad (9)$$

By substitution between (7) and (9) we can find the power,

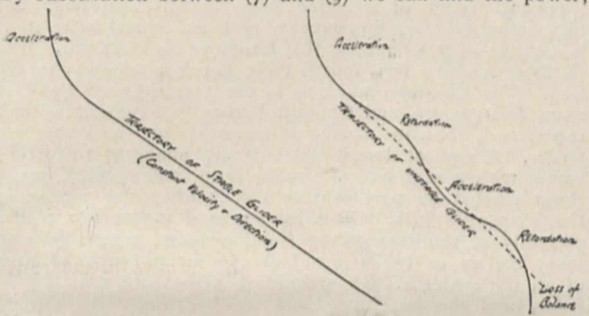


FIG. 4.—Trajectories of Stable and Unstable Aëroplanes.

speed, and angle in terms of one another in the new circumstances, which are the most adverse that have to be considered.

Power Required for a Helicoptère.

This will follow at once from a consideration of propeller thrust. For if T be the thrust in lb. of a propeller, under given conditions as to speed and slip, then in a helicoptère

$$W = nT \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (10)$$

where n is the number of propellers.

The ornithoptère will be discussed later.

Efficiency of Propellers.

Experiment has generally shown that, subject to correction for the difference of density, an air propeller is almost identical in its action with a marine propeller. The thrust is proportional to the area of the blades and the square of the speed, and the power varies as the cube of the speed. There is a diminution of thrust with a decrease of slip, and both power and thrust increase with the diameter of the propeller. There is no necessity to present here the general conclusions as to propellers, which will be found in Mr. Froude's papers in the Trans. Inst. Naval Architects, and in text-books on naval architecture and marine engineering. There is, however, one respect in which the action of a propeller in air differs from that in water, viz. the feed. Owing to the small inertia of air, a propeller, revolving on a fixed axis in air previously stationary, rapidly ejects air by axial propulsion and centrifugal force, and tends to surround itself by a vortex of air, with a consequent diminution of the thrust to almost zero. This is the reason for the lack of success in experiments which have been made on lifting screws for helicoptères. On the other hand, an axial or transverse flow caused by motion of the axis of rotation will supply the propellers with the necessary fresh air, and consequently we find that the smaller the slip (*i.e.* the greater the advance) of the screw the greater its efficiency. Similarly, in helicoptères moving laterally there is more lift.

For a sustaining screw not rising (*i.e.* with 100 per cent. slip) the author has deduced the following formula for the thrust (see "The Problem of Flight," p. 9):—

$$T = 0{\cdot}1r\sqrt[3]{HD^7} \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

where T is the thrust in lb., r the revolutions per second, H the horse-power, and D the diameter in feet of the propeller. This is based on the assumption that the area is that required by the conditions as to power, diameter, and speed. The following rule for the projected area must be applied:—

$$A = \frac{4}{\pi r}\sqrt[3]{\frac{H}{D^5}} \quad . \quad . \quad . \quad . \quad . \quad . \quad (12)$$

where A is the ratio of the projected area to the disc area.

These rules are based on Mr. W. G. Walker's experiments with fans, particulars of which will be found in Mr. Innes's book on "The Fan."

The thrust per horse-power obtained with the best forms of propellers varies from 20 lb. to 60 lb., 40 lb. being the common maximum. The mechanical efficiency, as in the case of marine propellers, rarely rises above 50 per cent., the best results being obtained with a minimum of slip. This alone gives the aëroplane a superiority over the helicoptère.[1]

Stability of Gliders.

We have seen that the centre of pressure is ahead of the centre of area, and that the distance between these two depends on the angle γ. If then the angle and the normal pressure are constant, the turning moment of the pressure about the centre of area is also constant, and may be balanced by shifting the centre of gravity until it lies over the centre of pressure. Seeing, however, that neither the angle nor the resistance is absolutely constant, it might be supposed that stability was impossible. That this is not so has been demonstrated by Prof. Bryan and Mr. Williams in a paper read before the Royal Society in 1903, and by Captain Ferber in an article in the *Revue d'Artillerie* (November, 1905). In the latter it is shown that an aëroplane is longitudinally stable if two conditions are satisfied.

(1) That the longitudinal radius of gyration about an axis through the centre of gravity does not exceed

$$\sqrt{\frac{P}{37b}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (13)$$

when P is the weight of the aëroplane in kilograms, and b the overall width of the machine in metres. The radius of gyration is here measured in metres.

(2) That the centre of gravity falls over the centre line between two points, one a little ahead of the centre of area of the sustaining surfaces, the other near the forward edge of the aëroplane. The exact values of these positions depend on the characteristic magnitudes of the machine through a series of somewhat complex equations, for which the papers referred to should be consulted. It must be recognised in this connection that the probable inaccuracy of Joëssel's formula invalidates the accuracy (*not* the method) of the values given by Captain Ferber in this paper.

If the centre of gravity coincide with one of these points, the machine is subject to two oscillations of long and short periods respectively, any increase of which will lead to collapse.

The behaviour of a machine running with a certain initial speed is then somewhat as follows. The continued resistance tends to retard the machine, and to cause the velocity to fall below the soaring limit, and the weight (in front of the centre of area) causes the front to dip. The gravitationally acquired velocity causes a forward acting pressure on the surface, so that if the machine is stable (in accordance with the above conditions), it settles down into a condition in which the resistance due to the resultant velocity just balances the component of the weight in the direction of motion. Pénaud has shown that the angle between the plane and the direction of motion (trajectory) (*l'angle d'attaque*) is half the angle between

[1] See the author's paper to the Aëronautical Society, October, 1908.

the trajectory and the horizontal when the trajectory is such as to give the greatest travel.

This condition is satisfied when

$$\tan\gamma=\sqrt{\frac{C}{2kS}}\quad . \quad . \quad . \quad [\text{see (7)}] \quad (14)$$

If from any cause the machine loses velocity, it will drop and gain kinetic energy by loss of potential, until its velocity is that required. On the other hand, if accidentally its velocity increases, it will rise, to lose kinetic energy by gaining potential energy. It is this exchange in the form of energy which causes the oscillations in an unstable glider. Prof. Bryan and Mr. Williams have photographed gliders bearing flash-lights, and demonstrated the reality of the long- and short-period oscillation, but the theory needs considerable amplification so as to apply to complex cases of combined planes, and simplification so as to be readily applicable to design.

Mr. Lanchester ("Aërial Flight," vol. ii., and British Association Trans., Dublin, 1908) gives new formulæ for the stability, and finds that the oscillations are trochoidal.[1]

Practice (Aëroplanes).

Time will not permit an exhaustive account of the theoretical principles involved to be given, but the more essential points have been touched upon, and it will be useful to indicate how these principles will be applied.

In designing an aëroplane the weight is perhaps the first consideration, and next the minimum velocity required. From formula (8) we can proceed to find S, the area.

$$W=2kSV^2\sin\gamma\cos\gamma \quad . \quad . \quad . \quad . \quad . \quad (8)$$

Let $\cos\gamma=1$, since γ is small, and $\sin\gamma=\frac{1}{3}$, and $2k=0{\cdot}004$,[2] then

$$W=0{\cdot}0012\,SV^2,$$

and

$$S=\frac{W}{0{\cdot}0012\,V^2} \quad . \quad . \quad . \quad . \quad . \quad (15)$$

Thus, if V is 30 feet per second (say thirty miles per hour), S=W, *i.e.* the area in square feet is the same as the weight in lb. Less area will necessitate more speed, and *vice versâ*.

A useful rule connecting the area and weight (based on bird flight in spite of dimensional theory) is that

$$S \propto W^{\frac{2}{3}} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (16)$$

Next, to find the thrust required, we take formulæ (7) and (8), and get

$$\frac{T}{W}=\frac{R+CV^2}{W}=\tan\gamma+\frac{C}{2kS\sin\gamma\cos\gamma} \quad . \quad . \quad (17)$$

as the ratio between the thrust and the load. Neglecting the second term, which is small (or rather, taking a higher value for the first, so as to include the second), we write

$$\tan\gamma=\sin\gamma=\tfrac{1}{3}\text{ or }\tfrac{1}{4},$$

so that

$$T=\frac{W}{3\text{ or }4} \quad . \quad . \quad . \quad . \quad . \quad . \quad (18)$$

Since the thrust per B.H.P. with a good propeller is about 30 lb. or 40 lb., we may write

$$40H=\frac{W}{4},$$

so that

$$W=160H \quad . \quad . \quad . \quad . \quad . \quad (19$$

where H is now in B.H.P.

This may be regarded as a high value, and probably only half this can be safely employed, so that 1 horse-power will carry, say, 80 lb. Great improvements should eventually be made in this direction.

The light motors (such as the Antoinette, Dufaux, and Esnault-Pelterie types) now made produce about 1 B.H.P. per 3 lb. of weight, or allowing for transmission gearing and friction losses, say 1 B.H.P. per 5 lb. of mechanism, so that the weight of this will be =5 H lb., and hence from (19) (modified as suggested) we get the available weight of the surfaces, framing, and aëronaut =75 H lb., or for framing and surfaces alone (reckoning aëronaut's weight at 150 lb.)

$$W=(75H-150)\text{ lb.} \quad . \quad . \quad . \quad . \quad . \quad . \quad (20)$$

Employing the rule obtainable from (15) that S=W, we find the weight of surfaces and framing per square foot is

$$\frac{W}{S}=\frac{75}{80}-\frac{150}{S} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (21)$$

Care must be taken to prevent surfaces interfering with one another, and this is generally attained by superposing them at a distance apart equal to their width, or placing them behind one another at the same minimum distance.

The positions of the aviator and the engines are very important. Generally the first is in front. The Wright machine has them side by side. In any case the position of the common centre of gravity must answer to the rules given in the theory of stability. Lateral balance is assured by the use of a dihedral angle between the wing planes or by a keel plane. Captain Ferber has discovered the laws controlling the size and position of the latter, which are to be found in the paper previously referred to. Steering is accomplished in several ways, as will presently be described.

Constructive Features.

Several types of machine may be distinguished, but three especially are noteworthy, and are named after their inventors:—(*a*) Chanute; (*b*) Langley; (*c*) Wright. The Phillips machine is a fourth type, but is analogous to the first. The *Chanute machine* is the type adopted by Farman, Delagrange, and Captain Ferber. It consists of two superposed, narrow surfaces mounted on a transverse girder. A central longitudinal girder connects this front frame with a rear one of similar form, but smaller, sometimes divided by partitions into cells after the pattern of the Hargrave kite. The aviator and motor are placed centrally at the rear of the front surfaces, where the c.g. must be, so as to be ahead of the mean centre of area of all the surfaces. The trimming planes are generally in front, and the steering planes at the rear. This differs, however, and will be discussed presently. One propeller is used between the sets.

The *Langley type*, generally termed monoplanar, consists of two pairs of wing surfaces, inclined 67½° from the vertical, so as to include a dihedral angle of 135°. A central shaft, or framed girder, supports the cantilever ribs which stay the wings. The engine is between the pairs of wings, and the two propellers are paired alongside.

Wright type.—Consists simply of two superposed surfaces as in the Chanute type, with no tail. Front trimming planes similar to the main wings, and rear vertical planes for steering. Catapult initial propulsion. Two propellers behind the wings.

Trimming and Steering.

Guide planes of various forms are used for trimming and steering. A cruciform set of planes for both purposes has been used on the Langley and Ludlow machines. Superposed pairs for trimming, placed in front, have been used by Farman, Delagrange, and the Wrights. Santos Dumont (xiv., *bis*) employed a cellular kite for both purposes, and M. Bleriot has used trimming planes, turning on axes, at the tips of the wing planes. A sliding weight is used in the Weiss gliders, and the author has suggested a weight on a coarse-pitched leading screw as useful. For steering laterally, vertical surfaces are generally employed at the rear. By slightly canting the machine a lateral thrust is produced which will turn the machine, although the consequent diminution in lift tends to make it lose elevation.[1] The Wrights also employ torsion of the main surfaces.

Starting and Alighting.

In starting an aëroplane there are numerous difficulties. The essential is that the soaring velocity shall be reached before the machine leaves the ground. If a machine be simply propelled along a track, so soon as the soaring velocity is approached the friction on the ground becomes negligible, and the propulsive effort is uncertain. Usually

[1] See the *Engineer*, September 18, 1908.

[2] Twice 0·0017 (see p. 414) plus an addition of 0·0006 for the lateral spread generally employed.

[1] See paper by M. Renard in *Comptes rendus*, 1908.

the machine rears or sinks forward, touches the ground, and loses its required velocity, so that no start is made. Langley experienced great difficulties in this way. Four methods are available.

(1) Starting on a track which the aëroplane cannot leave until the required velocity is reached. (Langley.)

(2) Starting on a track employing a small plane angle, and when a velocity has been reached in excess of the minimum for the machine, raise the planes quickly until the angle suits. The excess of speed will give the initial elevation required. (Farman, Delagrange, Ferber.)

(3) Start from a height, preferably down a slope. (Voisin, Roe.)

(4) Use a frame which can by the store of energy in springs, or a lifted weight, act as a catapult. (Wright Brothers.)

In each case the starting device (carriage, sledge, or catapult) may be integral with, or separate from, the machine. Separately, weight is, of course, saved. On the other hand, the machine is useless without the hoisting device. Starting-stages with necessary catapults or other devices have been suggested. The Aéro Club de France tests machines from a steel tower in the Galerie des Machines, on the principle given third in the foregoing list.

With regard to descent, this is intimately related to gliding stability. As we have seen, if the weight is in the right place, oscillations will be damped out, and the descending machine will follow a straight descending line with a uniform velocity. The alighting springs should be capable of storing the energy of impact corresponding to this speed and angle.

Helicoptères.

It will have become evident from what has been said that this type of machine is more or less at a discount. Machines have been made by Santos Dumont, Kress, Dufaux, and others, but as yet the results are not very important. The ability to soar is undoubtedly a great advantage, but the loss due to insufficient air supply, the absence of wedge action, and the necessity for further machinery to give lateral propulsion are great drawbacks. Mr. Rankine Kennedy is one of the strongest advocates of this type just now, and is evidently convinced as to its ultimate success. The author has interested himself in the type for a long time, but cannot say that at present he considers it to be superior to the aëroplane. In a paper just presented to the Aëronautical Society he has discussed the question.

Ornithoptères.

Profs. Marey and Pettigrew have shown that the wings of flying animals rotate while reciprocating, so as to provide a forward thrust as well as a downward one. (See "The Problem of Flight," p. 59.) The researches of Mouillard, Langley, Fitzgerald, and Deprez have also shown how the greater flying birds manage to utilise the pulsations of the wind and its vertical component to soar and glide. Lord Rayleigh has given simple rules in this connection.

A type not uncommon (on paper) is the rotating machine, in which a number of blades are controlled by a cam, so that on the downstroke they move perpendicular to their planes and on the upstroke parallel to their planes, and thus produce an upward resultant thrust. The mechanical efficiency of such an arrangement cannot be so high as that of an aëroplane. Moy's aërial steamer and centrifugal fan types correspond to this variety.

Future Work.

Reference has been made to the necessity for further research as to the centre of pressure. Information is also wanted as to the resistance and stability of combined planes, the thrust of screw propellers, and the effect of lateral currents on propellers and gliders. The mathematical analysis of the equations of motion of the aëroplane in space needs to be advanced. Simpler forms of the equations of stability and trajectory are required. The application of the latest investigations as to resistance (such as M. Eiffel's) and centre of pressure to these equations has yet to be made, and bird flight needs much study by ornithologists trained in applied mechanics.

Relation to War and Commerce.[1]

The sudden development of aërial navigation led to a popular panic which was quite baseless. At present the dirigible balloon is extremely vulnerable, cannot carry more than a few pounds' weight of projectiles, and has great difficulty in hitting a mark. In espionage it may be useful. Aëroplanes may perhaps be presently available for attacking vital points and despatch work, but it will be long before they will be steady in a wind.

Commercially, the outlook is worse. Although the energy required for aërial transport is not much greater than in terrestrial and marine locomotion, the danger and unpunctuality will take many years to eliminate. Wind occasionally (not frequently) will have serious effects on direction and time of passage. Eventually the airship and flying machine will affect society, but the author thinks it will not be for some years to come.

Finally, the author wishes to point out the deplorable backwardness of English invention in this direction.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following programme for the Darwin centenary celebrations, subject to alteration in detail, will be issued at an early date:—

Tuesday, June 22.—8.30 p.m. to 11 p.m., reception of delegates and other invited guests by the Chancellor in the Fitzwilliam Museum. By kind permission of the master and fellows, the gardens of Peterhouse will be accessible from the museum.

Wednesday, June 23.—10.30 a.m., presentation of addresses by delegates in the Senate house; 2.30 p.m. to 3.45 p.m., visits to colleges; 4 p.m., garden-party given by the master and fellows of Christ's College in the college grounds; 7 p.m., banquet in the new examination hall; 10 p.m. to 12 p.m., the Vice-Chancellor and fellows of Pembroke College "At Home" in the college hall and gardens.

Thursday, June 24.—11 a.m., honorary degrees conferred in the Senate house; 12 a.m., Rede lecture in the Senate house by Sir Archibald Geikie, president of the Royal Society.

A Darwin exhibition will be held in Christ's College on the lines of the Milton exhibition of last year. The syndics of the University Press have agreed to present to each invited guest a copy of the first draft of "The Origin of Species," which is being prepared for press and edited by Mr. Francis Darwin. This is the draft of which Mr. Darwin speaks in his autobiography:—"In June, 1843, I first allowed myself the satisfaction of writing a very brief abstract of my theory in pencil in thirty-five pages."

It is proposed to prepare an illustrated programme of the commemoration containing some account of Darwin's Cambridge days, under the editorship of the registrary, the senior secretary to the celebration committee.

Of the seventeen colleges, fifteen have now published the results of their entrance scholarship examinations. The number of scholarships has slightly increased, and in natural sciences seven and a half more scholarships have been awarded this year than last. The mathematical scholarships are fewer by the same number; the half represents a scholarship which has been awarded partly for natural sciences and partly for some other subject. There is also an increase of four in the history scholarships. Out of the 201 scholarships, 74 have been awarded for classics, 43½ for natural sciences, and 35½ for mathematics. Only eight candidates availed themselves of their privilege of resigning their emoluments whilst retaining the status of a scholar.

The special board for biology and geology has appointed Mr. J. Stanley Gardiner, of Gonville and Caius College, to be a manager of the Balfour fund until June 14, 1911, in succession to Dr. Harmer, who has resigned.

Mr. David Sharp has resigned the curatorship in zoology from March 25, 1909, and Mr. Hugh Scott, of Trinity College, has been appointed in his stead for one year from March 25, 1909.

[1] See article by Prof. Newcomb in the *Nineteenth Century*, September 1908.

The Gordon Wigan income for 1908 at the disposal of the special board for biology and geology has been applied as follows:—(a) 50*l.* to Mr. D. Sharp, the curator in zoology; (b) 50*l.* to Mr. A. G. Tansley, to enable the botanic garden syndicate to continue to offer special facilities for plant-breeding experiments; and (c) 50*l.* to Prof. Hughes, being 30*l.* for the purchase of a projection lantern for the geological department, and 20*l.* for the expenses of research on Pleistocene deposits in the neighbourhood. The prize of 50*l.* from the Gordon Wigan fund for an investigation in chemistry was awarded in the year 1908 to Mr. L. A. Levy, of Clare College, for his essay entitled "Investigations on the Fluorescence of Platinocyanides."

AT the last meeting of the committee of Bristol University, the treasurer, Mr. George A. Wills, mentioned that he had received from Lord Winterstoke a letter intimating that he was prepared to give an additional 15,000*l.* towards the University. This, with the 20,000*l.* he had already given, makes Lord Winterstoke's contribution to the fund 35,000*l.*

A VERY interesting article on foreign associates of national societies, by Prof. E. C. Pickering, of Harvard College Observatory, which was published in the *Popular Science Monthly* in October last, has been received in excerpt form. Prof. Pickering points out that mere membership of scientific societies is, in general, a poor test of the qualifications of a man of science; but the case is very different if only foreign associates of the principal national societies or academies of the world are considered. Dealing with the physical and natural sciences alone, and assuming that foreign associates are elected wholly for eminence in a particular science, Prof. Pickering arrives at some important conclusions so far as the United States are concerned. Speaking of American representation among foreign members of the seven great scientific societies of the world, he says that in the United States the representation per million inhabitants is less than a fifth that of the principal countries of Europe. There is no American representative in mathematics or medicine, while in astronomy there are three out of ten members. Prof. Pickering explains this result by saying that while immense sums are spent on higher education in the United States, the endowment for advanced research is comparatively small. He states that astronomy is almost the only science having institutions in America devoted to research, and in which a great deal of the time and energy of men of science is not expended in teaching. Of the six American foreign associates referred to, five have occupied positions in which no teaching was required, but their entire time was supposed to be devoted to original investigation.

IT has often been pointed out that the courses of instruction in schools in India have been hitherto far too literary in character, and that the whole training has not been sufficiently scientific and practical. Education in India has, in fact, suffered, as education in England suffered for a generation, because of the inability of the responsible authorities to understand that book-learning is not the knowledge that makes for progress. The supreme test of educational success is not the power to reproduce the words or works of others, but the ability to undertake an independent inquiry and to arrive at sound conclusions. The science teaching which is truly scientific makes the printed or spoken word subsidiary to the workshop or laboratory exercises, and uses adaptability rather than phonographic capacity as a measure of mental growth. As the only sound basis of scientific instruction is individual experience and activity, the extent of ground which can be studied by practical methods in a school course is necessarily limited. In our schools this is being recognised, and good science syllabuses only include subjects with which pupils may reasonably be expected to become acquainted by experiment. In several provinces of India such a desirable state of responsible opinion does not seem yet to have been reached. For instance, the *United Provinces Government Gazette*, published at Allahabad at the end of last year, contains a science syllabus for the award of high-school scholarships, and we have no hesitation in saying that it would be better not to teach science at all than to attempt to cover the extensive course prescribed for the candidates. In addition to the rudimentary principles of physics and chemistry—which by themselves are more than sufficient for a school course studied by scientific methods—the syllabus includes subjects from sound, light, heat, electricity and magnetism, and chemistry of metals and non-metals. The syllabus in elementary science (physics and chemistry) for the matriculation examination of the University of Madras is of similar character—extensive instead of intensive. To prescribe such syllabuses for Indian students is to put a premium upon learning by reading rather than by doing. It may be urged that practical work is impossible in many Indian schools; but that provides no justification for instituting science courses which require a large equipment of apparatus when taught properly, instead of courses which can be studied experimentally with few special appliances. Directors of public instruction in India who desire to know how the experimental method of science can be successfully introduced into village schools should inquire into the work of the Irish Board of National Education, which has excellent schemes of work capable of being carried out without special equipment and at a minimum cost.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, January 12.—Prof. J. Rose Bradford, F.R.S., vice-president, in the chair.—Observations on the flagellates parasitic in the blood of fresh-water fishes: Prof. E. A. **Minchin.** Five species of Trypanosoma and four species (two new) of Trypanoplasma, from fishes of the Norfolk Broads, were described in detail. Particular attention was paid to the minute structure of the parasites, and it was shown that it is possible to give a uniform description for the nuclear apparatus of both Trypanosoma and Trypanoplasma.—Zoological results of the third Tanganyika expedition, 1904–5. Report on the Copepoda: Prof. G. O. **Sars.**—The gonadial grooves of a medusa, *Aurelia aurita*: T. **Goodey.** The author dealt with investigations which confirmed his earlier suggestion that the gonadial grooves, which lie in the interradial axes between the central gastric cavity and the gastric pouches, have a sexual function. From sectionised material, drawings had been obtained of spermatozoa and eggs lying within the limits of the gonadial grooves, thus proving that the latter are functional gonoducts.—The tuberculin test in monkeys, with notes on the temperature of mammals: Dr. A. E. **Brown.** The paper described the methods and results of experiments which have recently been carried out at the zoological gardens of Philadelphia with the view of suppressing tuberculosis in monkeys.—*Balaena glacialis* and its capture in recent years in the North Atlantic by Norwegian whalers: Prof. R. **Collett.**

Geological Society, January 13.—Prof. W. J. Sollas, F.R.S., president, in the chair.—Labradorite-norite with porphyritic labradorite: Prof. J. H. L. **Vogt.** This rock occurs off the northern coast of Norway. It contains 23 per cent. of labradorite-phenocrysts, in a crystalline groundmass of a more acid plagioclase, hypersthene, diallage, and titanomagnetite. Olivine is conspicuously absent. The plagioclase-phenocrysts are more acid in their outer zones, and the groundmass plagioclase is still more acid. From analyses the relative proportions of the constituents are calculated, and the formula of the felspars determined. The order of crystallisation is found to be:—(1) phenocryst plagioclase; (2) plagioclase with magnetite; and (3) plagioclase, magnetite, pyroxenes. The order of crystallisation follows the physicochemical laws applying to the phase liquid-solid. Graphic representations illustrate the order of crystallisation of a ternary system of plagioclase, magnetite, and pyroxene. Equilibrium between the solid and the liquid albite-anorthite phase must have been maintained long enough for the phenocrysts to acquire a composition different from the first crystals, but eventually the equilibrium broke down. The temperature-interval of crystallisation is estimated to have been between about 1400° and 1000°. This investigation suggests that the processes of crystallisation in a magma may be explained in all details according to physicochemical laws.—The genus

Loxonema, with descriptions of new proterozoic species: Mrs. Jane **Longstaff** (*née* Donald). There is some confusion with regard to the type of the genus Loxonema. The author, following Lindström, Koken, and Perner, takes *L. sinuosum*, Sowerby, as the type. Then the other two types mentioned by Phillips cannot remain in the genus, one belonging to the genus Macrocheilina and the other to Zygopleura. The paper deals only with Ordovician and Silurian species. The diagnosis of Loxonema is amended, and a note given as to the range and the distribution of the genus.

Linnean Society, January 21.—Dr. D. H. Scott, F.R.S., president, in the chair.—The genus Nototriche, Turcz.: A. W. **Hill.** The genus Nototriche (Malvaceæ) includes some seventy species formerly placed in the genus Malvastrum, A. Gray. Two types of flower are found in the genus; in the one case the petals are almost free, and are fused with the staminal column only at the base; in the other, including the majority of the species, there is a definite tube formed by the fusion of the petals with the staminal tube. At the base of each calyx segment there is a glandular nectary. The carpels are beaked and dehiscent, and are often provided with long, silky stellate hairs. In the paper several new species are defined, and the descriptions of those already known have been amplified and re-written.—Longitudinal symmetry of Centrospermæ: Dr. Percy **Groom.** By means of measurements of many stems—primary, secondary, tertiary, and quaternary—of one species, *Atriplex rosea*, and of other chenopodiaceous genera, namely, Salsola and Chenopodium, additional evidence is given that the internode curve of alternate-leaved Chenopodiaceæ is always of a zigzag nature, and can be analysed into two subcurves. Of these, one represents the displacements of the leaves from the originally opposite arrangement at the successive nodes, and the other indicates the lengths of the modern representatives of the original internodes.

Institution of Mining and Metallurgy, January 21.—Mr. Alfred James, president, in the chair.—A theory of volcanic action and ore deposits, their nature and cause: Hiram W. **Hixon.** Starting with the known fact that there is an increase of temperature of about 1° C. for each 100 feet of depth, the author claims that at about 100 miles below the surface of the earth the temperature is above the critical temperature of all known elements, from which it is assumed that all matter from the commencement of the zone of critical temperature to the centre of the earth is in a gaseous condition. The conclusion arrived at is that within that zone a part of each of the gases present is diffused throughout the zone. Secular cooling results in reducing the outer surface of the zone below the critical temperature of a part of some of the gases. As a result of secular cooling matter of high critical temperature is added to the "zone of flowage" of the solid crust, while the gases of low critical temperature would saturate the zone of flowage and segregate upward to the bottom of the "zone of fracture." There the further upward progress of the gases would be stopped until, by accumulation, they had acquired sufficient elastic force to rupture the zone of fracture. From this—the author's theory of volcanic action—is deduced his theory of ore deposition.—The Silver Islet vein, Lake Superior: Walter **McDermott.** This paper was presented, though a reprint from a technical journal published thirty-two years previously, as it bore on the subject of the foregoing paper on volcanic action and ore deposits, chiefly in connection with the occurrence of graphite and silver. It dealt with facts, however, rather than with theories.—An instance of secondary impoverishment: H. H. **Knox.** This paper, dealing with deposits on the private estates of Kishtim, in the government of Perm, Russia, had to be held over for discussion at the February meeting.

PARIS.

Academy of Sciences, January 25.—M. Bouchard in the chair.—Presentation of vols. xi. and xiii. of the *Annales de l'Observatoire de Nice*: M. **Bassot.** The first volume contains four memoirs:—the velocity of light by the toothed-wheel method, meridian observations, equatorial and meridian observations concerning the planet Eros, and the third catalogue of nebulæ discovered with the large Nice equatorial by M. Javelle. The other volume is devoted to meteorology.—Reunion of the permanent international committee of the map of the sky: B. **Baillaud.** This committee will meet at the Paris Observatory from April 19–24.—A *résumé* of some observations of M. A. Ricco on the earthquake in Sicily and Calabria of December 28, 1908: A. **Lacroix.** A map is given showing the epicentral zone at Messina, and seven other zones, classified according to the severity of the effects produced.—A fossil alga from the Sinemurian: P. **Fliche.** This fossil was shown to arise from a purely cellular plant, and this conclusion was derived, not only from the characters of the parenchyma constituting the plant, but also from the elliptic bodies borne on its surface. This is the first plant of its kind found in the Lias.—The tenth campaign of the *Princesse Alice II.*: **Albert I., Prince of Monaco.**—Fridtjof Nansen addressed a letter to the perpetual secretary concerning the proposed Polar expedition of Captain R. Amundsen.—The deformation of surfaces of negative curvature: E. **Goursat.**—Electrocapillary phenomena in gases at low pressures: G. **Reboul.** A capillary electrometer in which the dilute acid is replaced by a rarefied gas exhibits analogous phenomena.—An arrangement for sensibly reinforcing the sound perceived in a receiver with an electrolytic detector: M. **Jégou.**—A plate with a network of lines giving stereoscopic relief by direct vision: E. **Estanave.**—A new method of preparation of the alkyl ethers: J. B. **Senderens.** The catalytic substance employed is alumina, obtained by precipitating sodium aluminate with sulphuric acid. If this is maintained at a temperature between 240° C. and 260° C., and the vapour of ethyl alcohol passed over it, ethyl ether is continuously formed. It is not necessary for the success of this experiment that the alcohol should be absolute. Methyl ether and propyl ether have been obtained in the same way.—The condensation of the mesoxalic esters with tertiary aromatic amines: A. **Guyot** and E. **Michel.**—The regeneration of coffee plantations by the introduction of a new species: Jean **Dybowski.** Owing to the destruction of *Coffea arabica* by disease, many districts have been obliged to grow coffee. The substitution of *Coffea liberica*, a more robust plant, has not been successful, owing to the inferior quality of the coffee produced by this plant. The author now proposes the use of a new species, *Coffea congoensis*, which grows wild in the neighbourhood of Oubanghi. Its resistance to the disease of Hemileia appears to be well established; the coffee berries are of good commercial quality, and it contains about 1·2 per cent. of caffeine.—The unification of the number of segments in the larvæ of the Muscidæ: J. **Pantel.**—Contribution to the study of the constitution of the proteid materials by the hydrolysing action of hydrofluoric acid. The preparation of definite natural peptides: L. **Hugonenq** and A. **Morel.** The advantages of the use of a 25 per cent. solution of hydrofluoric acid as a hydrolysing agent have been pointed out in a previous paper. It is now shown that by varying the strength of the acid employed the hydrolysis can be stopped at different stages, and several well-defined natural peptides have been isolated in this way (as the picrate).—The ammoniacal fermentation: J. **Effront.**—The value of the muscular striations in polarised light: Fred. **Vlès.**—The application of d'Arsonvalisation localised to certain regions, principally in the cephalic region: A. **Moutier.** In these experiments the solenoid only surrounded the head and shoulders. In all the cases treated the results were favourable; the objective phenomena disappeared, and the arterial pressure was lowered.—The extension of the rhætic sheet in the pre-Alps of Berne and Fribourg: F. **Rabowski.**—The rhætic sheet in the Vaudois pre-Alps: Alphonse **Jeannet.**—Transportation phenomena in Anjou and Brittany: E. **Jourdy.**—The value of the magnetic elements at the Observatory of Val-Joyeux on January 1, 1909: M. **Moureaux.**—The earthquake of January 23, 1909: Alfred **Angot.** A copy of the seismographic trace from the Parc Saint-Maur Observatory is given.

NEW SOUTH WALES.

Royal Society, December 2, 1908.—Mr. W. M. Hamlet, president, in the chair.—Diagram showing the rainfall of Australia: J. **Barling.** The chart is designed to show, at a glance, the annual rainfall of many years for all Australia, as taken from the official returns. Geraldton, Queensland, holds the record for great rains, while the least rainfall of Australia appears to be that of Lake Eyre and its vicinity. The lake, now, is mostly a dry bed, and is below sea-level. A second chart shows the daily rainfall of Sydney for the past fifty years, together with other details. —Revision of the Australian Orectolobidæ: J. D. **Ogilby** and A. R. **McCulloch.** An account of the Australian members of the family, which includes the wobbegongs or carpet sharks, cat sharks, &c. Diagnoses of the genera and species are given, and a new name, Cirrhorhinus, is proposed for *Brachaelurus colcloughi*, Ogilby. The extraordinary egg-case of *Chiloscyllium punctatum*, M. and H., is described for the first time. Whereas in most other sharks the egg-case is attached to surrounding weeds, &c., by long tendriliform processes at either end, that of *C. punctatum* hangs by a median loop, the parts of which are woven round the support by the lips of the parent after deposition. The paper is illustrated with plates of several of the species.—Some geological notes on the country behind Jervis Bay: Dr. H. I. **Jensen.** The writer shows that the country between the Upper Shoalhaven and the sea has the character of a raised marine plain subsequently dissected by faulting and erosion. The Sassafras Tableland and Currockbilly Range he considers to be a "horst" or "block mountain."—Vocabulary of the Ngarrugu tribe, New South Wales: R. H. **Mathews.**—The sedimentary rocks of the Lower Shoalhaven River: C. F. **Laseron.** In this paper it is intended primarily to show the geological sequence of the various formations in the district and the local geographical changes which took place at the close of the period, during which the Clyde Coal-measures were deposited.—The discontinuity of potential at the surface of glowing carbon: J. A. **Pollock,** A. B. B. **Ranclaud,** and E. P. **Norman.** In a circuit with one heated electrode in air at ordinary pressure, the projection of ions from the hot surface necessitates the establishment of a potential difference between the electrodes if the current in the circuit is to be zero. This potential difference in certain circumstances may be taken as a measure of the surface discontinuity, and values have been obtained in the case of glowing carbon at various temperatures.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 4.

ROYAL SOCIETY, at 4.30.—On the Electricity of Rain and its Origin in Thunderstorms: Dr. George C. Simpson.—The Effect of Pressure upon Arc Spectra, No. 3, Silver. λ 4000–λ 4600: W. Geoffrey Duffield—The Tension of Metallic Films deposited by Electrolysis: G. Gerald Stoney.—A Further Note on the Conversion of Diamond into Coke in High Vacuum by Cathode Rays: A. A. Campbell Swinton.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—The Stability of Arches: Prof. Henry Adams.

LINNEAN SOCIETY, at 8.—On *Fucus spiralis*, Linn.: Dr. F. Börgesen.—Economy of *Ichneumon manifestator*, Linn.: C. Morley.—On the Polyzoa of Madeira: Rev. Canon Norman, F.R.S.

RÖNTGEN SOCIETY, at 8.15.—The Transport of Ions: Dr. Howard Pirie.

FRIDAY, FEBRUARY 5.

ROYAL INSTITUTION, at 9.—The Influence of Superstition on the Growth of Institutions: Prof. J. G. Frazer.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Design and Construction of Docks: Sir Whately Eliot.

GEOLOGISTS' ASSOCIATION, at 7.30.—Annual General Meeting.—Presidential Address: The Jubilee of the Geologists' Association: Prof. W. W. Watts, F.R.S.

MONDAY, FEBRUARY 8.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—My Recent Expedition in Tibet: Dr. Sven Hedin.

TUESDAY, FEBRUARY 9.

ROYAL INSTITUTION, at 3.—The Architectural and Sculptural Antiquities of India: Prof. A. A. Macdonell.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Deneholes: Rev. J. W. Hayes.

FARADAY SOCIETY, at 8.—Applications of Electrolytic Chlorine to Sewage Purification and Deodorisation by the "Oxychlorides" Process: Dr. S. Rideal.—A New Electrical Hardening Furnace: E. Sabersky.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further Discussion*: On Heat-flow and Temperature-distribution in the Gas-engine: Prof. B. Hopkinson.

COLD STORAGE AND ICE ASSOCIATION (Royal Society of Arts), at 7.30.—Some Scientific Problems in the Preservation of Food by Artificial Refrigeration: C. T. Tabor.

WEDNESDAY, FEBRUARY 10.

GEOLOGICAL SOCIETY, at 8.—Geological Features observable at the Carpalla China-Clay Pit, Cornwall: J. H. Collins.—Recent Observations on the Brighton Cliff-formation: E. A. Martin.

ROYAL SOCIETY OF ARTS, at 8.—Bosnia and Herzegovina: A. R. Colquhoun.

THURSDAY, FEBRUARY 11.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Nerves of the Atrio-ventricular Bundle: J. Gordon Wilson.—An Experimental Estimation of the Theory of Ancestral Contributions in Heredity: A. D. Darbishire.—On the Determination of a Coefficient by which the Rate of Diffusion of Stain and other Substances into Living Cells can be measured, and by which Bacteria and other Cells may be Differentiated: H. C. Ross.—The Origin and Destiny of Cholesterol in the Animal Organism. Part III., The Absorption of Cholesterol from the Food and its Appearance in the Blood: C. Dorée and J. A. Gardner.—On the Origin and Destiny of Cholesterol in the Animal Organism. Part IV., The Cholesterol Contents of Eggs and Chicks: G. W. Ellis and J. A. Gardner.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Use of Large Gas Engines for Generating Power: L. Andrews and R. Porter.

MATHEMATICAL SOCIETY, at 5.30.—On the Relation between Pfaff's Problem and the Calculus of Variations: Prof. A. C. Dixon.—On Implicit Functions and their Differentials: Dr. W. H. Young.—On a Certain Family of Cubic Surfaces: W. H. Salmon.—Some Fundamental Properties of Lebesgue Integrals in a Two-dimensional Domain: Dr. E. W. Hobson.—Modular Invariants of a General System of Linear Forms: Prof. L. E. Dickson.

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