THURSDAY, JULY 13, 1916.

BRITISH MARINE ANNELIDS.

A Monograph of the British Marine Annelids. Vol. iii., part i. Text. Polychæta: Opheliidæ to Ammocharidæ. By Prof. W. C. McIntosh. Pp. viii+368. Also vol. iii., part ii. Plates lxxxviii–cxi. (London: Dulau and Co., Ltd., 1915.) Price 25*s*. net each volume.

THE first part of the first volume of this monograph of British Annelids dealt with the Nemertine worms. The second part of the first volume, the two parts of the second volume, and now the third volume are devoted to the Chætopoda, and still the great work is incomplete. At least one more volume will be required before the order Polychæta is finished.

The third volume includes those families that were grouped together by Benham in the suborders Spioniformia, Capitelliformia, and Scoleciformia, together with the family Cirratulidæ of the sub-order Terebelliformia.

The author has not adopted in his monograph any system of grouping the families into suborders such as that suggested by Benham, and it is rather awkward for the zoologist who is not a specialist in the Chætopoda and does not know the sequence of families which Prof. McIntosh employs that he has no guide to the position in the three volumes of any family he wishes to study, nor a list of those that have still to be described.

No doubt the author will prepare a tabular statement of the classification of the order for the last volume, but it would have been a great convenience if he had included in each part a list of all the families arranged in the order of their treatment.

We make this comment in the first place because the monograph is on a much higher plane than many of the systematic treatises on zoology with which we are acquainted, and it is important in the interests of science that everything should be done to facilitate its use.

The present volume includes many of the most important of the marine worms, such as the Arenicola (or lug-worm of the fisherman), the phosphorescent Chætopterus, the Spionidæ, the rock-boring Polydora, and the morphologically interesting forms Magelona and Capitella. In studying the chapters on these important worms the reader must be impressed not only by the vast amount of labour and learning bestowed upon their systematic treatment, but also by the author's generous appreciation of the anatomical, physiological, and embryological knowledge concerning them that has accumulated during recent years. It is clearly shown on every page that infinite pains have been taken with the tedious but necessary and valuable work of completing the lists of synonyms and references to species; but intimate knowledge and life-long research have also been employed in summarising what is known of the morphology of the species described. The monograph stands, therefore, as an important contribution to our general knowledge of the order as a whole, as well as a descriptive catalogue of the species that inhabit the British sea area. It is a standard work of the highest importance, and we may be proud of it as a product of British science.

It is unfortunate that our final judgment of the illustrations must be suspended. Six of the twenty-four plates that illustrate part ii. of this volume were to have been issued in colours, but in consequence of the war they have not yet been delivered, and to prevent further delay in publication uncoloured copies have been substituted for them. This is undoubtedly a serious misfortune, and we may cordially extend to Prof. McIntosh our good wishes that in the coming times of peace the coloured plates may be recovered. In the meantime, however, we may say that, apart from this drawback, the illustrations are at least equal to the very high standard attained by those of the earlier volumes, and add immensely to the value of the monograph.

S. J. H.

COLLOIDAL SOLUTIONS.

The Physical Properties of Colloidal Solutions. By Prof. E. F. Burton. Pp. vii+200. (London: Longmans, Green, and Co., 1916.) Price 6*s*. net.

THIS work forms one of the series of monographs on physics edited by Sir J. J. Thomson, and it is perhaps natural that the author should have practically confined himself to discussing that class of colloidal solutions which has so far proved amenable to quantitative and mathematical investigation—the class known as suspensoids. The treatment of the emulsoids is very brief and inadequate, an omission all the more striking as the author several times insists on the importance of colloidal physics to the arts and to biology and physiology, the former of which are largely, and the latter exclusively, concerned with emulsoids.

Within these limits, however, the treatment is full and very clear. The chapter on preparation and classification gives all that is necessary in a small compass. In that on the ultramicroscope the author has gone a good deal further than is usual, and perhaps necessary, by including a brief account of the principal theories of image formation and resolving power. The chapters dealing with the theory of the Brownian movement—to the physicist the crowning achievement of colloidal science—are admirable and give the best historical account, as well as the clearest presentation, of the mathematical work of Einstein, v. Smoluchowski, Langevin, and Perrin at present available in any text-book. The optical properties are also treated with unusual fulness, while the electrical ones receive ample, but not excessive, attention. The frank confession—which probably only one of the best-known workers in this much-tilled field can afford to make—that the stability of sols is still a puzzle is to be welcomed. Adsorption is only touched upon as bearing upon electrolyte coagulation, and the statement that the adsorption isotherm approaches a line parallel to the C-axis "asymptotically" is certainly surprising, if Freundlich's equation is accepted as correct.

An agreeable feature of the book is the amount of space devoted to presenting the historical development of different branches of the subject, many quotations from the original papers of pioneer workers being given. In this connection the author fixes 1750 as the earliest date at which gold sols had been obtained by reduction. "Aurum potabile," however—a red liquid prepared by reducing gold chloride with oil of rosemary and undoubtedly a gold sol—had considerable vogue as a medicine much before that time, being mentioned, *e.g.*, by John Evelyn in his diary under the date June 27, 1653.

The references to literature—given at the end of each chapter—are copious, and names and subject matter are well indexed. The book may be thoroughly recommended to the large class of students to whom a knowledge of colloidal science is becoming increasingly necessary; to cover the whole field it should be supplemented by a volume dealing with emulsoid sols and gels, which latter in particular are systems quite as fascinating, and certainly as important, as sols.

MATHEMATICAL PAPERS AND ADDRESSES.

(1) *Proceedings of the London Mathematical Society*. Second Series. Vol. xiv. Pp. xxxviii + 480. (London: F. Hodgson, 1915.) Price 25*s*.

(2) *Four Lectures on Mathematics*. Delivered at Columbia University in 1911 by Prof. J. Hadamard. Pp. v + 52. (New York: Columbia University Press, 1915.)

(1) A VOLUME of the L.M.S. Proceedings is not only a permanent record of achievement. At its first appearance it is a useful index of the state of English mathematics at the time; and it also, from year to year, suggests the appearance of new stars in the mathematical firmament. It may be not without significance that, in the present volume, there is a first contribution (we believe) by a Japanese gentleman, and another by an Indian fellow-subject. Unless we are greatly mistaken, or unkindly fate should intervene, Mr. S. Ramanujan is likely to become an arithmetician of the first rank. At any rate, his paper on highly composite numbers is original, profound, and ingenious, and shows complete mastery of the new methods and notation inaugurated by Landau. Mr. Tadahiko Kubota provides one of the two papers in the volume which have any claim to be called geometrical, and of these it is the more truly such. Under certain assumptions, most of which are explicit, or nearly so, he proves the following theorem: "If a closed convex surface be cut by every pencil of parallel planes in homothetic curves, it is an ellipsoid." The method of proof consists mainly in showing that such a surface defines a polar field precisely similar to that which is determined by an ellipsoid. The comparative simplicity of the demonstration is very remarkable.

The other geometrical paper, by Mr. E. H. Neville, was suggested by the racecourse puzzle of covering a circle by a set of five circular discs. Unfortunately, the solution depends upon four simultaneous trigonometrical equations, and as these are treated analytically, the paper has only a tinge of geometrical theory. Once more we must express our regret that English mathematics is so predominatingly analytical. Cannot someone, for instance, give us a truly geometrical theory of Poncelet's poristic polygons, or of Staude's thread-constructions for conicoids?

The other papers cover a wide range, from group-theory at one end (Prof. Burnside) to tide-theory at the other (Prof. Larmor). One of the most important, in our opinion, is that of Mr. and Mrs. W. H. Young on the reduction of sets of intervals—one of the many notable extensions of the famous Heine-Borel theorem. It would be foolish to try to give a detailed estimate of all the twenty-six papers.

Prof. Love's address on mathematical research is bright as well as stimulating, and many of his crisp sayings deserve the most careful attention; for example, his remarks on exact solutions of physical problems, on the difficulty of applying the general theory of ordinary linear differential equations, on "curiosity," on the danger of being overwhelmed by the mass of literature, and so on. We wish we could agree with his unqualified assertion that "text-books and treatises include always later additions to knowledge"; perhaps he regards productions that do not conform to this statement as mere samples of those "books that are no books" to which Lamb refers. Lastly, we may note that Prof. Love attaches due importance to mathematical style in composition. This is too often neglected; simplicity, clearness, and appropriate notation ought, at any rate, to be aimed at with all possible diligence. We rejoice, too, that in this connection he boldly and truly says that a mathematical book or paper is (or should be) a work of art.

(2) The United States have been pioneers in the practice, now common, of inviting eminent foreigners to give occasional lectures, or courses of lectures, on their chosen subject; we do not refer to lectures or addresses on ceremonial occasions. Prof. J. Hadamard is renowned for his original researches in function-theory; in the present short course of four lectures he deals with the bearings on physics of various types of equations (differential, integral, integro-differential), and, in a minor degree, of topology (*analysis situs*). It is needless to say that they are highly suggestive and valuable; their defect, such as it is, is that in trying to cover a wide field the author is obliged to be very concise, and in some cases this leads to obscurity. As an example of what we mean, take p. 34. Substantially (unless we mistake the author's intention), Prof. Hadamard wishes to point out that physical problems which have the same analytical solution lead to different interpretations of the solution,

and that in drawing our conclusions we must attend to the circumstances of the case. The example he chooses is the dynamical one, where we have a Lagrangian system in generalised co-ordinates, reducible to $2T = m(\dot{x}^2 + \dot{y}^2)$, $U = c$, where m, c are constants. One such system is that of a particle under no forces; another is a gyrostat with two degrees of freedom, for which x, y are angular co-ordinates (and therefore periodic, so far as the actual motion is concerned). All this is plain enough; but when the lecturer says, "The assemblage of all possible positions of system (2) can be represented not on a plane, but on the surface of an anchor-ring," the reader may feel confused, especially since to trace the path of any particular point of the gyrostat we must introduce *additional* co-ordinates.

Prof. Hadamard emphasises (p. 17) the work of Poincaré on ordinary differential equations, especially in the *Journ. de Math.*, 1887 (on the shape of curves defined by differential equations). He also (p. 33) protests, we are glad to see, against the over-analytical drift of current mathematics. In his dealing with Green's theorem we regret to see no reference to Mr. J. Dougall. Doubtless this is due to ignorance; but Mr. Dougall's work is masterly and in the true spirit of Green, and it is most unfortunate that it is practically buried in a periodical which (for no fault of its own) has no very wide circulation.

The text, on the whole, seems to be a satisfactory rendering of the French original; "admit" for "allow" or "assume," "effectively" for "as a matter of fact," etc., are such common errors that they are unlikely to lead to mistakes on the part of the reader. The typography is unusually good, and a credit to the Columbia University Press.

G. B. M.

W. B. TEGETMEIER.

A Veteran Naturalist: being the Life and Work of W. B. Tegetmeier. By E. W. Richardson. With an introduction by the late Sir Walter Gilbey, Bart. Pp. xxiv+232. (London: Witherby and Co., 1916.) Price 10*s.* net.

THIS is a pleasantly written sketch of the life of a versatile naturalist, of strongly marked individuality, whose name will be for long associated with poultry and pheasants, homing pigeons and bees, to the study of which he made notable contributions. W. B. Tegetmeier (1816–1912) was the son of a doctor and also the grandson; and he was himself more or less of a medical student and apprentice for ten years (1831–41). But an inborn attraction to birds and beasts, a recoil from humdrum routine, and a conspicuous absence of a bedside manner (as he said himself) led him to teaching for a short time, and to journalism for a very long time, and to a life of fruitful zoological inquiry, especially along economic lines.

The story of Mr. Tegetmeier's life, which Mr. E. W. Richardson, a son-in-law, has told with directness and enthusiasm, shows how a man of talent and industry, honesty and courage, wrung a livelihood out of unpromising circumstances, and won the respect and affection of all worthy men who knew him. For half a century Mr. Tegetmeier was in charge of the poultry and pigeon department of the *Field*, and for a score of years he wrote regularly for the *Queen*. As a consultant and expert judge he was incessantly busy in connection with pheasants, poultry, pigeons, and the like, and did important work in setting a high standard of accuracy, both of statement and action.

Introduced by Yarrell to Darwin in 1855, he enjoyed the master-naturalist's friendship for twenty-five years, and the value that Darwin put upon his observations is well known. It may be recalled that Tegetmeier, who was a convinced evolutionist, had strong suspicions as to the theory of sexual selection, pointing out, for example, that disfigured game-cocks were accepted just as thoroughly as the dandiest of their rivals. In connection with the Savage Club, of which he was one of the founders, and in the pursuit of various hobbies, Mr. Tegetmeier allowed himself relaxation, but it appears that he never went for a walk or took a holiday. He was absorbed in his work, almost always thoroughly enjoying it, and he lived for nearly a century.

Mr. Richardson tells us of Tegetmeier's early "observation-hives," and how he once took a swarm of bees from over the door of the Gaiety Theatre, to the fearful delight of the spectators; how he was interested in school "nature-study" when the very idea was novel; of his numerous breeding experiments when neither Darwin nor he knew of Mendel; of his realisation of the importance of homing pigeons in ante-"wireless" days; of his endless post-mortems, which sometimes rather embarrassed his household; of his interesting chronicling of the metamorphosis of the axolotl; and of much more besides, not forgetting his anti-feminist prejudices. The delightful biography is in its mood harmonious with the sincerity of one who never suffered humbugs gladly, and the numerous interesting illustrations increase the impression of picturesqueness which marked the man himself. Of a sceptical and agnostic mood, he never disparaged religion; and when Mr. Richardson once asked him if he denied the existence of God, he replied: "My boy, how could I, when every leaf on every tree proclaims its Maker, and is a living witness to the power, wisdom, and providence of the Creator of the leaf and of life and of all things?"

OUR BOOKSHELF.

Modes of Research in Genetics. By Raymond Pearl. Pp. vii+182. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 5*s.* 6*d.* net.

DR. RAYMOND PEARL'S book inquires into the methodology of modern genetic science, and does so with clearness, concreteness, and vigour. The first chapter discusses the current modes of research on heredity, by which is meant the complex of causes which determine the resemblance between individuals genetically related. "The critical problem of inheritance is the problem of the cause, the material basis, and the maintenance of the somatogenic specificity of germinal substance." Towards a solution of this problem contributions have been made along four lines—biometric, Mendelian, cytological, and embryological, and each of these methods is valuable and necessary. But they have at least one fundamental limitation in common. "This is that they offer no means of *directly* getting at any definite information regarding the origin, cause, or real nature of that specificity of living material which is the very foundation of the phenomenon of heredity." The most hopeful line of attack on this outstanding problem is biochemical.

A second chapter deals with the value and likewise the limitations of biometric methods, and it is full of good sense and good counsel. "To attempt to draw conclusions in regard to inheritance from studies involving the correlation method alone is futile." Third comes a useful essay on the nature of statistical knowledge, which is not, as some would have us believe, a higher kind of knowledge than that obtained in other ways. The statistical method furnishes shorthand descriptions of groups and a test of the probable trustworthiness of conclusions.

"It is, however, a descriptive method only, and has the limitations as a weapon of research which that fact implies." After a more technical chapter on certain logical and mathematical aspects of the problem of inbreeding, the author completes his interesting volume with the warning that the value of research in genetics is to be judged by its contributions to knowledge rather than by its aid to the practical breeder—useful as that aid may be.

The Universal Mind and the Great War. Outlines of a New Religion, Universalism, based on science and the facts of creative evolution. By E. Drake. Pp. vii+100. (London: C. W. Daniel, Ltd., n.d.) Price 2*s.* 6*d.* net.

THERE is much honest and suggestive thinking in this book, though the writer is sometimes both pedantic and ill-informed. Having proclaimed the bankruptcy of all dogmatic religion, all philosophy, and all ethics, he proceeds to give us the right thing. Matter and mind are the two certainties; they are entities, of which we can know only the manifestations. The universal mind is individualised in each living organism, the creative intellect directing matter from within. God is in us; we are His direct personification. From the first beginnings of life on the planet He has been moulding matter for His ends of manifestation, dropping the saurian forms, *e.g.*, when not found to work, and trying another tack. He is continually *fighting matter,* aiming at fuller control, fuller manifestation; and matter is so big and strong that only a bit at a time can be grappled with—*i.e.*, the part which thereby we see as "alive." At death the mind that was in the organism survives, but in what form—individualised or not—we cannot know. The whole argument is in the right direction, though it is crudely put; if the author had read Fechner and Samuel Butler he might have improved it. Both of these see God as Logos manifesting through matter; but Fechner from the beginning, and Butler after trying a theory almost exactly identical with Mr. Drake's and finding it unsatisfactory, accept Him as energising not only through that small portion of matter which we call "living," but through all the matter of the universe.

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.]*

Gravitation and Temperature.

I SHOULD like to make a statement on the very suggestive contribution by "J. L." in NATURE, June 15, regarding my result of a temperature effect for gravitation of $+1\cdot2\times10^{-5}$ per 1° C. The confirmation, or otherwise, of this result will come, of course, from the laboratory, not the study. Still, a discussion at this difficult juncture might define the issue and perhaps indicate the best line for further experiment.

To take the scanty known data chronologically:

I. From Kepler's third law we deduce that gravitational mass (*g.m.*) and inertia mass (*i.m.*) vary together at the same rate, if at all, with temperature change. The mean temperature of the larger planets is probably much higher than that of the smaller ones. Thus if it were established that at these high temperatures *g.m.* rises with temperature, *i.m.* must rise proportionally. Any small departure from this principle would appear as a change in the mean motion for the observed distance, not as a periodic inequality; so it would be cumulative, and, with the great accuracy of modern astronomical methods, should be observed, unless very small. No such effect is known.

II. The pendulum experiments of Bessel establish the same principle, but since the temperature range is very small, this test is probably much less severe.

III. Poynting and Phillips found that for change in temperature of 100° in a mass of 200 grams, counterpoised on a balance, the change in *g.m.* is less than $1/10^9$ per 1° C. This very exact and direct result, taken in conjunction with I. and II., would seem to show that in the case of a gravitational couplet of a very large mass M and a small mass m the temperature of the latter can vary considerably at ordinary temperature without sensible change in *g.m.* or *i.m.*

IV. My result, quoted above, shows that when M, but not m, is raised in temperature, there is an increase in *g.m.* It will be seen that this case differs from I., II., and III., in that here the large, not the small, mass has temperature varied. My result appears to be in direct conflict with III. Can we make any justifiable physical assumptions whereby this seeming conflict may disappear?

A simple view of the effect of temperature on attraction is that the gravitational masses M, m increase with temperature, and the two increased masses, $M(1+\alpha T)$ and $m(1+\alpha t)$, would be multiplied together to obtain the resulting attraction. Thus, before rise of temperature, we have GMm/d^2. After rise we have

$$\frac{GMm}{d^2}\left[1+\alpha(T+t)\right].$$

If we, however, assume that increments in *g.m.* are multiplied separately, we should have

$$\frac{GMm}{d^2}\left[1+\alpha^2(Tt)\right]$$

Neither of these formulæ helps us to reconcile the above facts.

But now suppose that gravitational attraction between two masses consists of two parts:—

(*a*) The essential-mass term. Attraction between the masses occurs in virtue of the ether displaced by the Faraday tubes attached to their electrons. This would be like Maxwell's stress theory of gravitation: compression of ether radially from each body and tensions in directions perpendicular to the radii. This term is represented by the usual form $f_1=GMm/d^2$. It is independent of molecular vibration and exists at absolute zero.

(*b*) The temperature term. Attraction is due to vibration of the Faraday tubes, which are carried to-and-fro by the molecules in their vibratory motion. This is like Challis's wave theory of gravitation, whereby bodies in a vibrating medium attract one another if their phases are in close agreement. Dr. C. V. Burton suggested that for very high velocity of wave transmission the vibrating bodies might resonate one another and have approximately like phases. Presumably the waves in this case are longitudinal and their velocity nearly infinite. If the power that one mass has of setting another to resonate depends on the ratio, mass of vibrator/total mass, this attraction would be

$$f_2=\frac{G}{d^2}\left[M\alpha T\left(\frac{M}{M+m}\right)m+m\alpha_t\left(\frac{m}{M+m}\right)M\right].$$

Adding (*a*) and (*b*) terms,

$$f=f_1+f_2=\frac{GMm}{d^2}\left[1+\alpha\left(\frac{MT+mt}{M+m}\right)\right]. \quad . \quad . \quad . \quad \text{i.}$$

This expression was suggested, though not derived, by Poynting and Phillips. Evidently, when M preponderates greatly over m (the only case we need consider),

$$f=\frac{GMm}{d^2}\left(1+\alpha T\right),$$

so that a change in temperature of M might affect f appreciably, but no such change in m could do so.

This expression, then, would make all the facts compatible. We have supposed that the temperature effect depends on the first power, but it would be more natural to consider that the intensity of vibration varies as the square or higher power of temperature. In that case we should have for variation in the Newtonian constant, $G=G_0(1+\alpha T^n)$.

It may be significant that the coefficient of cubical expansion of lead (the material used), viz. $8{\cdot}4\times10^{-5}$, is *of the same order* as my result, $1{\cdot}2\times10^{-5}$, the increment of f being 1/7 of the increment in volume in the lead.

Above we have taken *g.m.* and *i.m.*, so far as these depend on ether displacement, to be invariable, but as the body rises in temperature from absolute zero, the vibrations may, especially at high temperature, cause such violent agitation of Faraday tubes that the effective displacement of ether is increased. If this were so, of course both *g.m.* and *i.m.* would increase, since in that case the essential mass would increase. Mathematicians might assist in deciding this point. But, at present, for temperatures up to, say, 500° C., we might suppose neither *g.m.* nor *i.m.* to change from this cause to any perceptible amount.

To make clear the action of the above formula, imagine the case of sun, earth, and moon. If the mean temperature of the earth were to rise greatly, say through sudden radio-activity in its interior of some element previously inactive, then the temperature term for the earth would increase by an amount small compared with the essential mass term of (sun + earth), but large compared with that of (earth + moon). Thus the earth's orbital motion would not change appreciably, but attraction between earth and moon would increase and the moon's orbital motion might be greatly affected.

Applying our formula i. to the comments of "J. L.," we should not anticipate change due to temperature in *g.m.* or *i.m.* in the cases of pendulum experiments or planetary orbital movements, nor should we expect "kicks" in moving masses the temperatures of which are suddenly changed. In like manner, a comet, even though considerably heated or cooled, would be expected to have regular motion. The great difficulties suggested by "J. L." would all vanish if formula i. or something akin were true.

It might be thought that my research, standing alone, is slender evidence on which to raise such important results; but I would mention that, as shown in my paper, my result is buttressed by indirect evidence.

If the formula i. be true, my contention is strengthened (see NATURE, October 7, 1915) that a laboratory value of G should not be considered valid for application to the attraction between masses (*e.g.* the heavenly bodies) the temperatures of which are far from ordinary. The whole problem is complicated by the high temperatures involved in the members of the solar system. We know that the rigidity of the earth, taken as a whole, is very great, so that the immense pressure in the core counteracts the fluidising influence of the very high temperature. Elasticity is, at a surface view, a molecular property; gravity is primarily an electron/ether property; nevertheless we are on unsure ground in reasoning that any property will be the same, say, at 5000° C. and at 0° C.

Following the guidance of the formula i., we may expect fruitful research if we vary the temperature of the large mass; but we should anticipate that no good results could be derived from experiments on temperature change of the small mass.

Poincaré pointed out (Report to the International Congress in Physics, 1900) that the mass of Jupiter, as derived from the orbits of its satellites, as derived from its perturbations of the large planets, and as derived from its perturbations of the small planets, has three different values. This would lead one to give to G a different value in each of the three cases. It will be seen to accord with equation i. above, for in the three cases the ratio $\left(\frac{m}{M+m}\right)$ is very different. It may be a useful fact in the present argument.

P. E. SHAW.

University College, Nottingham, June 24.

Payment for Scientific Research.

IN future discussions on this difficult but important question, it will be well that a distinction should be drawn between the case of a specialist who engages in research on a subject of his own choice, devoting as much or as little of his time as he cares to give to it, and that of a scientific expert who agrees to undertake work for the Government or some other body on definitely stated subjects, and who is, as a general rule, expected to complete the duties within a more or less definite time-limit.

For investigations falling under the first category the problem of remuneration presents serious difficulties, and we may at least console ourselves with the knowledge that a step in the right direction has been taken by the Board of Education in requiring returns to be made of researches conducted by the staffs and graduates of our university colleges. In this connection it is, further, becoming recognised that teachers in these institutions should have sufficient opportunity in term time, as well as in vacation, for research.

It is with regard to the second class of investigation that the claim for remuneration is most urgent. From personal knowledge, I consider that it is impossible for an average skilled labourer in the scientific industry to earn a living wage consistent with his necessary expenses unless his whole time is available for remunerative duties. It is true that intervals occur, sometimes quite unexpectedly, during which he may be temporarily unemployed, and these can be utilised for purposes of research; on the other hand, there are certain periods of the year when the work is extremely heavy, and latitude of time is necessary even for the performance of paid work.

There are probably very few scientific labourers who would be justified in refusing an invitation to mark 500 examination papers at a fee of 1s. per paper in order to complete an investigation for the Government for which they received no fee. As soon, however, as the labourer accepts remuneration for a definite undertaking, his employer has some guarantee that he will not let future engagements interfere with the fulfilment of his contract. This at least applies to scientific specialists who are not members of trade unions.

I am very much afraid, however, that a great many people are undertaking unpaid work under conditions quite incompatible with the present depressed conditions of the scientific labour market. In some cases this is being done from a sense of patriotism. Undoubtedly their labours may have the effect of reducing the duration and the severity of the lesson which the enemy countries are teaching us in regard to our national neglect of science—a lesson which is the one good turn the Huns are doing us. But they are certainly tending to diminish the efficacy of that lesson.

G. H. BRYAN.

Negative Liquid Pressure at High Temperatures.

IN my paper with Lieut. Entwistle on the effect of temperature on the hissing of water when flowing through a constricted tube (Proc. Royal Soc., A. 91, 1915) I have determined the temperature coefficient of an effect which indicates that the tensile strength of water would be zero at a temperature between 279° C. and 363° C., with a mean from all the experiments published of 328° C. Sir Joseph Larmor's calculated result, 265° C., quoted by him in his letter in NATURE of June 29, agrees satisfactorily with the experimental value if we take into account the difficulty of getting the precise point at which hissing ceases, and that the result was obtained by extrapolation from observations taken at temperatures between 12° C. and 99° C. Lieut. Entwistle and I have experimented with other liquids—alcohol, benzene, acetone, and ether—and obtained results of a similar character. Experiments are now in abeyance, for my colleague is otherwise engaged.

My own view, formed from physical conceptions, was that the tensile strength of a liquid would become zero at its critical temperature. It is of very great interest that Sir Joseph has been able to show mathematically that the negative pressure can only subsist at absolute temperatures below 27/32 of the critical point of a substance.

The conclusions appended to our paper are:—

1. That the phenomenon of hissing of water passing a constriction is due to a true rupture of the stream at the point where the pressure is lowest.

2. That the temperatures at which the hissing just occurs, between 0° and 100° C., follow a law which may be expressed $V=C(\theta-t)$, where V is the velocity of the stream at a temperature t, θ the critical temperature of water, and C a constant.

If we adopt Sir Joseph Larmor's view the latter law will require to be expressed

$$V=C\{27/32(\theta+273)-(t+273)\},$$

or by a slightly more complex formula.

SIDNEY SKINNER.

South-Western Polytechnic Institute, Chelsea,
July 3.

THE PROPAGATION OF SOUND BY THE ATMOSPHERE.

SINCE the beginning of the war the sound of gun-firing in Flanders and France has often been heard in the south-eastern counties of England. There can be little doubt as to the origin of the sounds, for the reports of distant heavy guns have a character which is readily recognised. A correspondent of the *Daily Mail* (July 6) states that at Framfield (near Uckfield), in Sussex, it is easy to identify the particular kind of gun which is being used. The great distance to which the sound-waves are carried under favourable conditions is evident from the letters recently published in the *Daily Mail*. As firing has occurred lately over a great part of the Western front, the exact position of the source of the sound is uncertain. But if it were in the neighbourhood of Albert the waves must have travelled about 118 miles to Framfield, 150 miles to Sidcup, and 158 miles to Dorking.

Of far greater interest are the form and discontinuity of the sound-area. A remarkable example of the inaudibility of neighbouring reports in the face of a gentle wind was given in the last number of NATURE (p. 385). This is a subject on which many observations have been made since the beginning of the present century, especially in connection with the sounds of volcanic and other explosions. The source of sound is always surrounded by an area of regular or irregular shape within which the sound is everywhere heard, though the source is not always situated symmetrically with reference to the boundary of the area. On several occasions a second sound-area has been mapped, separated from the former by a "silent region" in which no sound is heard. Sometimes this second area partly surrounds the other, sometimes it consists only of isolated patches. As a rule, according to Dr. E. van Everdingen, who has made a detailed study of the subject,[1] the least distance of the second area from the source is much more

[1] "The Propagation of Sound in the Atmosphere." *Koninklijke Akad. van Wetenschappen te Amsterdam*, Proc., vol. xviii., 1915, pp. 933-960.

than 100 km., and the intensity of the sound at this least distance is not less than near the boundary of the inner sound-area.

Dr. van Everdingen refers to several dynamite and volcanic explosions which have been carefully studied from 1903 to 1911. He also adds some interesting observations made chiefly in Holland during the present war. The most important case is that of the bombardment of Antwerp on October 8, 1914. The reports were heard at many places in Holland within 100 km. from the source and again outside a circle of 158 km. radius, but at very few intermediate places. The silent region is bounded by two curves, which are roughly circular, the inner arc being traced for more than 180° and the outer for more than 90°. In some cases of heavy firing at later dates there are also indications of silent regions; in others an increased audibility has been established near the line of 160 km. In no case is there any certain indication of any asymmetrical propagation of the sound.[2]

Dr. van Everdingen examines the two explanations which have been offered of the existence of the silent region, one of which relies on variations of wind-velocity and temperature with the altitude; the other (von dem Borne's) on changes in the composition of the atmosphere at great heights. On the former explanation we might expect asymmetry, on the latter symmetry, with regard to the source of sound. He considers that both explanations are true and should be applied in combination. In favour of the second explanation, he urges the facts that in recent cases the outer margin of the silent region has always been about 160 km. from the probable source of sound and that no appreciable deviations from the circular form have been observed. The above distance is greater than the limiting distance (114 km.) assigned by von dem Borne, but Dr. van Everdingen shows that it agrees well with estimates made on the supposition that the percentage of hydrogen in the upper atmosphere is much smaller than that assumed by von dem Borne.

There can be no doubt as to the value and interest of Dr. van Everdingen's investigations. It would seem desirable, however, to continue and extend them. Though the existence of silent regions may be regarded as established, many more negative records are required to prove the symmetry of the region with reference to the source of sound. It must be remembered that the deep sounds of these explosions may at great distances be below the lower limit of audibility of some observers. Moreover, the mean radius of the outer margin of the silent region is very far from being constant. In one of the earliest cases in which the silent region was noticed—that of the minute-guns fired during the funeral procession of Queen Victoria on February 1, 1901 (*Knowledge*, vol. xxiv., 1901, pp. 124–5)—the radius was about 80 km. C. DAVISON.

[2] It may be mentioned that, on October 28, 1914, the sound of the British naval guns that bombarded the Flemish coast was heard at a distance of 280 km., or 174 miles.

AERONAUTICS AND THE WAR.[1]

(1) MR. LANCHESTER'S latest book, unlike his previous works on aerial flight, can be read with considerable interest and without any great effort. The preface, by Lieut.-General Sir David Henderson, at once arrests attention and has caused more comment than any other equally long section of the book. The summary of the present aeronautical position is so interesting that a quotation of considerable length is here given. General Henderson writes:—

> There are no experts in military aeronautics; there are experts in the various branches: in flying, in scientific research, in the design and construction of aeroplanes and engines, in military organisation and tactics. But as yet there is little opportunity for the expert in one branch to gain definite knowledge of the others except by hard personal experience; in every direction there is progress, in every section of work opinion is fluid. . . . Of all the fields in which work for the advancement of military aeronautics has been undertaken in this country, that of scientific research has, up to the present, produced the results that will probably be most enduring. . . . In the work of stating and solving the problems of aeronautics, Mr. Lanchester was one of the pioneers; he was bold enough to publish the results of his investigations at a time when flying had only just been proved possible; and he has reason now to be well satisfied with the quality of his early work.

The author himself, in his introductory note, rubs in the last point very vigorously.

Mr. Lanchester commences by describing the functions of an aeronautical arm, stating that reconnaissance is the main duty, in which aircraft are related to the older arms of the Service. The opposing and destruction of enemy aircraft are classed as secondary functions. The problem of the relative merits of aeroplane and dirigible is treated at some length. Attention is directed to the superior speed of the aeroplane (practically double that of the dirigible). The limit of size is practically reached for the dirigible, whereas the present-day aeroplane nowise defines the limit, in Mr. Lanchester's opinion. This seems scarcely consistent with his present views, for his recent article in *Engineering* expresses the opinion that large aeroplanes will be less efficient than smaller ones. Mr. Lanchester is doubtful whether fighting is a primary function of the dirigible, and thinks that bomb-dropping is altogether a misuse. He points to the vulnerability of the airship, stating that "even to-day the finest of Germany's fleet of Zeppelins would be absolutely at the mercy of a modern aeroplane in the hands of a man prepared to make his one and last sacrifice." Before proceeding to more general considerations he disposes of the dirigible as a part of the aeronautical service, pointing out that if this proves untrue his main conclusions will not be affected.

The question of the vulnerability of the aero-

[1] (1) "Aircraft in Warfare: the Dawn of the Fourth Arm." By F. W. Lanchester. Pp. xviii + 222. (London: Constable and Co., Ltd., 1916.) Price 12s. 6d. net.
(2) "Aircraft in War and Peace." By W. A. Robson. Pp. xi + 176. (London: Macmillan and Co., Ltd., 1916.) Price 2s. 6d. net.

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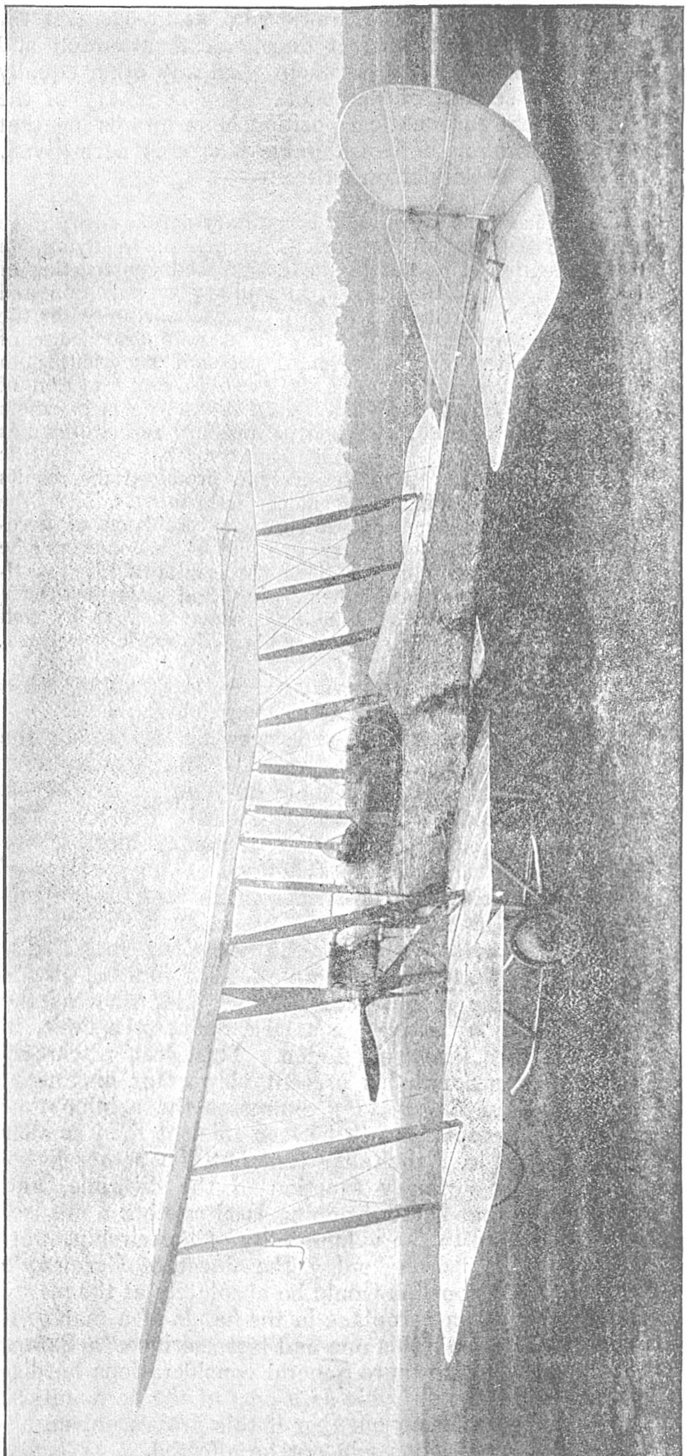
plane is next dealt with, the advantage of the small target area offered is pointed out, and the possibility of armouring for low-altitude flying discussed. The fact that an insufficiency of armour is worse than none is strongly insisted upon.

Next follows a discussion of the principle of concentration, with numerous examples of the author's *n-square* law. This section does not call for much comment here.



Early (experimental) model of B.E.2c. Calculated and demonstrated as inherently stable by the late Mr. E. T. Busk. From "Aircraft in Warfare."

Mr. Lanchester expresses the opinion that treaty restrictions framed for the other arms of the Service should not apply to the new arm, particularly pointing out that expanding bullets could be used with great effect in the destruction of the spars and struts of aeroplanes by gunfire. The question of the difficulty of aiming bombs is dealt with, and Mr. Lanchester thinks that the gun will eventually displace the bomb in the armament of aircraft.

The subject of naval aeronautics receives some attention, the great difference of the conditions from those of military aeronautics being specially remarked upon. The great value of aircraft for combating submarines is mentioned, and the question of the relative merits of seaplanes and aeroplanes carried by pontoon ships is discussed. It is stated that the pontoon ship offers better alighting facilities and enables faster machines to be used.

A great deal of space is devoted to the probable tactics of large fleets of aeroplanes. This subject gives Mr. Lanchester ample scope for his lively imagination, and his treatment of the subject is speculative in the extreme. It seems scarcely possible to define aeronautical tactics in such an extensive fashion at such an early stage in the development of the new arm.

Mr. Lanchester completes his book with a consideration of the present position, pointing out with no uncertain voice that the British aeroplane of to-day is better aerodynamically, more stable, more robust, and more weatherproof than the enemy's best machines, and in all ways better fitted for service conditions. It is stated that there was no good gun-carrying aeroplane in existence at the commencement of the war, and that the progress made has been astonishing. Reference is made to the work of the Royal Aircraft Factory, special praise being given to the full-scale experimental work of the late Mr. E. T. Busk. The scientific research work of the National Physical Laboratory receives consideration, and Mr. Lanchester reiterates that in scientific knowledge we are well ahead of all other nations. A board of aeronautical construction is advocated, as apart from the present advisory committee.

There is a brief appendix giving some details of the Lewis gun, the chief armament of our present military machines.

As General Henderson remarks at the close of his preface, Mr. Lanchester's book is well worth reading, and there is much in it worthy of study and reflection.

(2) The book by Mr. Robson can in no sense of the word be called a scientific work. It is a book for the "man in the street" who wishes to know a little about aircraft and about the organisation of our present-day air services. A great part of the discussion of the importance of the new aeronautical arm follows Mr. Lanchester's argument very closely, often in almost identical terms. There are many extravagant phrases in the book, as an example of which may be given the author's statement, in treating of the courage and resource of British airmen: "Germany could not wrest from us our ascendancy in the air even if she had ten times as many aeroplanes as we have." This is obvious exaggeration. Mr. Robson foresees the time, after peace is established, when aerial travel and transport will be the order of the day, and everyone of moderate means will possess his own private aeroplane. This seems to be going too far at the present stage of development, and only future experience can justify the prediction of such a brilliant future for aeronautics. The book can in no way be compared with Mr. Lanchester's work on the same subject, but it may prove useful to those who want a non-technical and popularly written outline of the present, and possible future, position of aeronautics in warfare.

E. F. R.

SIR GASTON MASPERO, K.C.M.G. (Hon.).

THE receipt of the news of the sudden death of Sir Gaston Maspero, whilst attending a meeting of the Académie des Inscriptions et Belles-Lettres in Paris on Friday, June 30, has been received with keen regret not only by Egyptologists, of whose science he was the ablest and most competent living exponent, but also by archæologists generally throughout the world. To his personal friends his death was not wholly unexpected, for during the last two years he suffered severely from acute illnesses at intervals, and his usually bright and cheery outlook on life was clouded by the bitter grief he felt at the loss of his nearest and dearest during the war. His brave spirit, however, clung to his work, and the last parts of the *Annales du Service* and *Recueil de Travaux* prove by his contributions to them that his great mental faculties and powers of work remained in effective condition to the end.

Maspero was born in Paris on June 23, 1846, and his family appears to have been of Italian origin. Little is known of his early years, but whilst still a boy he devoted himself to the study of Egyptology as expounded in the works of Chabas and de Rougé. His first important publication was a copy of the hieratic text of an Egyptian hymn to the Nile, edited from papyri in the British Museum, and accompanied by a French translation; it appeared in Paris in 1868, when he was about twenty-two years old. He was greatly encouraged in his work by Mariette, who in 1854 had been commissioned by Saîd Pâshâ to found a museum of Egyptian antiquities at Bûlâk. In 1873 Maspero took the degree of Docteur-ès-Lettres, and soon after succeeded de Rougé as professor of the Collège de France. In 1878 Mariette proposed to the French Government to found an archæological mission, and, on the proposal being accepted, Mariette succeeded in obtaining the appointment of director for Maspero, who took up his duties in Cairo in 1880.

In the following year (January 17, 1881) Mariette died, and Maspero became director of the Bûlâk Museum. In a very short time he arranged the objects in the museum on a definite system, and the catalogue of them which he published formed a most valuable compendium of Egyptian archæology. That the book may still be read with pleasure and advantage is a great testimony to the literary skill and knowledge of its writer. Having arranged the museum, Maspero devoted himself to developing, throughout the country, the system of excavations which Mariette had begun, and to the completion of Mariette's unfinished editions of papyri, etc. The discovery of the royal mummies and of the necropolis of Panopolis, and the clearing of the royal pyramids at Sakkârah and of the Temple of Luxor are evidences of the activity of Maspero during the first period of his rule at Bûlâk. In 1886, for private reasons, Maspero resigned his directorship at Bûlâk and returned to Paris, where he devoted several of the best years of his life to the compilation of his monumental "Histoire Ancienne des Peuples de l'Orient Classique," which appeared in three portly quarto volumes in 1895–99. A smaller work, bearing almost the same title, was published by him in 1875, and the number of editions through which it has passed attests its utility and popularity.

After Maspero's departure from Cairo in 1886 the management of the Egyptian museum fell into weak hands, and the scandal that attended the removal of the collections from Bûlâk to the Gizah Palace will not soon be forgotten by all who are interested in Egyptology. Matters went from bad to worse until British public opinion in Egypt demanded a change of director, and another Frenchman was brought to Egypt to preside over the Service des Antiquités. After two years it became evident that the scandals connected with the administration of the museum were increasing in frequency and magnitude, and at length Maspero was induced to return to Egypt and to resume the directorship of antiquities. This he did in 1899.

From 1899 to 1914 Maspero worked with a constancy and vigour which were marvellous. He directed and visited the excavations carried out by the Egyptian Government; he inspected the temples, and tombs, and other ancient buildings each year, spending some months in the process;

he directed the publication of the volumes of the official "Catalogue," which were compiled by English, French, and German experts; he edited the *Recueil de Travaux*, the *Annales du Service*, the "Mémoires" of the French archæological mission in Cairo, and the *Bibliothèque Egyptologique*, and still found time to write his new books and to revise and re-edit long Egyptian texts. His management of the museum was broad-minded and liberal, and he did a great deal to popularise the collections in it by means of his "Guide," of which, alas! edition after edition has been published without an index!

Maspero's knowledge of Egyptology was colossal, and he was always ready to place it at the disposal of the expert as well as of the layman. He broke through the old rule of only allowing favoured investigators to excavate in Egypt, and often supported personally applications to dig made to the committee by comparatively unknown individuals. He was courteous and helpful to every honest inquirer, and, oddly enough, seemed to go out of his way to help most those who exploited his works and who most reviled his methods and belittled his learning. During the last two or three years of his career in Egypt his action in respect of the native dealers in antiquities was much criticised, and it provoked much angry comment both among natives and Europeans. But his friends knew that the mistakes he made were not due to incapacity or ignorance, but to failing health and overwork. He did his own work well, but in doing that of half a dozen other men he did some of it badly. No French official in Egypt was ever more liked and respected by the natives than Maspero, for they trusted him and regarded him as a friend, and they greatly appreciated his justness. In private life he was a delightful companion, and his stories of Oriental life and character were drawn from a fund of knowledge of the East which seemed to be literally inexhaustible. The charm of his conversation was great. His words were carefully chosen, though his expressions were often archaic and quaint, whilst the little mannerisms and gestures by which they were accompanied well suited the genial nature, the warm sympathy, and the kind-heartedness of the man. In both hemispheres his death will be greatly regretted. Maspero received the D.C.L. from Oxford in 1886, an honorary K.C.M.G. in 1909, and he was elected perpetual secretary of the Académie des Inscriptions et Belles-Lettres in 1914.

E. A. W. B.

NOTES.

THE KING has been pleased to approve of the appointment of the Earl of Crawford to be President of the Board of Agriculture and Fisheries.

THE Harben lectures for 1916, on "Rivers as Sources of Water Supply," will be delivered by Dr. A. C. Houston at the Royal Institute of Public Health, 37 Russell Square, W.C., on July 13, 20, and 27, at 5 p.m.

PROF. ARTHUR SMITHELLS, F.R.S., professor of chemistry in the University of Leeds, has received a special appointment for scientific service on the Staff at General Headquarters (Home Forces) with the rank of Lieutenant-Colonel and graded for pay as a Deputy-Assistant Adjutant-General.

THE medical committee of the British Science Guild, under the chairmanship of Sir Ronald Ross, passed the following resolutions at a recent meeting: (1) The medical committee of the British Science Guild views with disfavour the suggestion that has been made by certain district councils to cease watering the streets as a war economy, and is convinced that such a step would be prejudicial to the public health. (2) The medical committee also views with great disfavour the pollution of the streets of London, and of most cities and big towns, by dogs, and considers that the attention of the Government and of municipalities should be called to the possibility of reducing the evil by increasing the tax on dogs and by enforcing by-laws. The committee considers that in towns the tax on one dog should be doubled and a large progressive increase imposed on each additional dog.

THE *Times* announces the death from wounds received in action of Lieut. C. G. Chapman, R.E., at the age of twenty-four. Lieut. Chapman, who had served in more than one of the theatres of war, was the son of Prof. R. W. Chapman, of Adelaide University. He was formerly in the Irrigation Branch of the Survey Department of the Australian Government, and had been in charge of surveying parties which did good work in the Northern Territory and the Daly River country. Since the outbreak of war, when he enlisted as a private, he took part in the survey of Lemnos for the Headquarters Staff, and afterwards passed through the Royal Engineers' School at Chatham.

ATTENTION is directed to the confusion that may be caused by the Summer Time Act in the Meteorological Office Circular, No. 1. In accordance with the Act, the use of Greenwich mean time is not interfered with for meteorological purposes, yet it is inevitable that, unless the standard of time used is always indicated in the record of observations, mistakes will occur, especially as the expression "local time" is often erroneously used as a synonym for the new "Summer Time." The scheme of hours of observation at meteorological stations is international in usage, and alternative schemes for winter and summer were never contemplated. The eight sets of observing hours are given in the Circular, and observers who cannot continue at the old hours are strongly recommended to select from the eight alternatives one which will be convenient both for summer and winter, and to change to that scheme once for all. A list is given of the observatories in the British Isles which have changed their hours of observation since the Act came into force.

A CONFERENCE organised by the Bread and Food Reform League on the national importance of utilising whole cereals in time of war was held in London on July 4. The Government was urged to make the use of whole cereals, especially whole wheat meal and 80 per cent. wheat flour, *i.e.* meal from which the less digestible woody fibre has been removed, much more general than it is at present. In this way it is claimed that not only would the national bread supply be considerably increased, but the public would be provided with a more substantial and nutritious food. The Government was further asked to take action to prevent the abstraction from cereal foods of the germ of wheat and of the strong gluten without notification to the consumer. The questions involved in these resolutions have been before the public on several occasions during the last hundred years, most recently in the form of the "Standard" bread crusade, but the present conditions give them a new significance, and in any case the matter is of real scientific importance. In 1881 the late Sir J. H. Gilbert, in a letter to the Royal Society of Arts, expressed the view that while whole meal bread was undoubtedly beneficial to the sedentary worker, the bulk of the labouring population was better suited by a white bread containing a more concentrated nourishment. The apparent waste involved in the production of white flour is largely illusory, as the offals when fed to stock are merely converted into another form of concentrated food. Modern methods of milling have since introduced another factor, but until rigidly controlled feeding experiments on the human subject have been made, the question must remain controversial.

IT is of high importance to the well-being of our industries that we should gather the views of men who stand at the head of great manufacturing concerns as to the type of man, his education and training, who in their opinion is best fitted to direct them. We welcome, therefore, the experience of so eminent an industrial leader as Sir Robert Hadfield, who, in a recent issue of the *Coal and Iron Trades Review*, has expressed himself on this subject. We have not always had this advantage: nothing in the past has been more discouraging to the directors of our scientific and technical institutions than the apathy, not to say the callous indifference, of all but a few far-seeing employers. This newly-awakened interest doubtless finds its origin in the successful industrial rivalry of the United States and Germany, and if we fail to grip the true reason for its success in the wise and ample provision of general scientific and specialised education we shall miss its vital significance. Yet the burden of Sir Robert Hadfield's message is that of the old adage, *Poeta nascitur, non fit*, that the successful "captain of industry" must have original force of character and gifts of natural temperament; in short, must possess inborn qualities that neither education nor training can bestow, but only develop. It thus becomes the business of the nation to set up what Huxley called "effective capacity-catching machinery," so that no potentially capable child shall wither in neglect. One of the greatest qualities of an organiser is the gift of selection, the ability to pick out the fit man for a given place, and if he has had a sound general education and an effective scientific training he will be in full sympathy with all grades of workers, and alive to the possibilities of each. The qualities of mind leading to scientific discovery are one thing, the gift of invention and application another, and they do not often reside in the same person; they even indicate a different order of mind. A Dalton or a Faraday would not necessarily have made a first-rate organiser of a modern business, but by their patient investigations and their penetrating vision they have made possible the great modern technical developments. The true place for the adjustment of theoretical knowledge to industrial aims and conditions is in the workshop, and if manufacturers were wise and far-seeing they would give ample opportunity to the well-educated young man to acquire this essential experience, and would find abundant reward therein.

THE paper published in No. 3317 of the Journal of the Royal Society of Arts for June 16, by the Right Hon. Sir W. MacGregor, entitled "Some Native Potentates and Colleagues," supplies an admirable example of the methods by which one of our most distinguished colonial officials succeeded in gaining the confidence and affection of the native races under his control. He begins with an account of Thakambau, "the greatest and best-known man of the Fijian race," of whom it may be said that no ruler "ever saw his country transformed by such enormous changes as this Fijian chief saw and assisted in." Sedu, the Papuan, "one of the finest characters I have ever known," met an untimely fate in an ambuscade, and the Garter King-of-Arms has allowed Sir W. MacGregor to quarter a figure of this hero as the dexter supporter of his coat-of-arms. The writer's wide experience enables him to record worthies of other races, such as John Allan, an Australian Aboriginal, and the Alake of Abeokuta in West Africa. In the discussion which followed the reading of the paper the Hon. J. G. Jenkins acknowledged in graceful terms the great services of the writer in the administration of British New Guinea in the early days of the colony.

MOST of the June number of the *Zoologist*, (4), vol. xx., No. 900, is occupied by Capt. Malcolm Burr's highly interesting account of his travels in the Caucasus and the Asiatic territory beyond. His military duties have taken him through a remarkable country, and he is able to record many observations on plants and animals, notably birds and orthoptera. The centre of attraction, from the naturalist's point of view, is Geok Tapa, where Capt. Burr was the guest of that famous collector, Alexander Shelkovinov.

SOME facts bearing on the "struggle for existence," as understood by Darwin, are contributed in a short note, "Sur l'équilibre naturel entre les diverses espèces animales," by A. Pictet in the *C. R. des Séances de la Soc. de Physique et d'Hist. nat. de Genève* (xxxii., 1915, pp. 10–13). The author reckoned that if a pair of white butterflies (*Pieris brassicae*) produce 500 eggs, 99·6 of the larvæ must be destroyed if the numbers of the species remain constant. He then collected all the caterpillars—148 in number—from a certain bush, and found that of these 137 had been parasitised by the small ichneumonoid Microgaster, that 9 died of disease, and that only 2 completed their transformations. From the age of these collected larvæ he believed that twice as many had already perished, and thus arrives at a survival ratio (0·04 per cent.) agreeing with his estimate. The agreement thus reached after several assumptions is perhaps too close to be altogether convincing.

THE January number of the *South African Journal of Science* (vol. xii., No. 6) contains an article on the Sarcosporidia by G. van de Wall de Kock, in which the effect of these obscure protozoan parasites on their mammalian hosts and their probable action in causing various diseases are discussed. Recent work on the life-history of Sarcosporidia is usefully summarised.

IN the Proc. Roy. Soc. Victoria (xxviii., 1916, part 2) Miss G. Buchanan gives the results of a comparative examination of the blood of certain Australian animals, with coloured figures of the various forms of corpuscles. She finds a general decrease in size and increase in number of red cells in ascending through the vertebrate classes, while the lymphocytes decrease in number and increase in size. The reptilian relationship of the Monotremes is suggested by a similarity in the mononuclear corpuscles. Platelets were recognised in mammalia only.

VALUABLE reports on sponges (calcareous and non-calcareous) from the Indian Ocean have lately been published by Prof. A. Dendy in the "Report to the Government of Baroda on the Marine Zoology of Okhamandal, in Kattiawar" (part ii., pp. 79–146, 10 plates). The specimens described were collected by Mr. J. Hornell in 1905–6. Many of the calcareous species are identical with those from the African coast, while a large proportion of the Tetraxonida and Ceratosa were already known from the seas around Ceylon. The plates show the general aspect and the spicules of the new species; unfortunately, the material was largely unsuitable for histological study, and it is to be hoped that collectors will take to heart Prof. Dendy's exhortation to avoid formalin as a preservative for sponges.

IN the recently issued part, No. 4, of vol. v. of the Transactions of the Royal Society of South Africa Mr. F. Eyles contributes a long list of plants collected in southern Rhodesia. His record, which occupies 251 pages and is furnished with a full index, includes representatives of 160 families, 869 genera, and 2397 species. The plants collected are mainly flowering plants and ferns, and details of localities, collectors' names, and numbers are given for each species. The record will prove of value to students of African botany, and especially to those of the Rhodesian flora; it should also serve to encourage others to collect and study the plants of the country.

A STUDY of the geography of the Fox Valley is the first of a series of regional surveys on the State of Wisconsin, U.S.A. Three years ago the Wisconsin Geological and Natural History Survey published an introductory survey devoted to the State as a whole. The present volume (Bulletin xlii., Educational Series, No. 5) is by Prof. R. H. Whitbeck, and, like the preliminary one, is published by the State. The object of the work is educational in the main, and the study of geography in the schools of the district will certainly be helped by the use of this intensive survey of a small region. Physical considerations occupy but a small part of the volume, which is mainly concerned with cities and industries. The requirements of school children appear to have been kept well in view throughout, and yet the book avoids being either trivial or didactic.

THE question of the nature and origin of the minute plates that impart the "aventurine" effect to felspars appears to have been finally solved by Olaf Andersen ("An Aventurine Feldspar," *Amer. Journ. Sci.*, vol. xl., 1915, p. 351). The author, after goniometric and optical investigation, adopts Scheerer's view, put forward in 1845, that the substance present is hæmatite. His research covers American albites, oligoclase from Kragerö and Tvedestrand (sunstone), labradorite from Labrador, and several microclines. The plates are found always to be oriented after simple crystal forms, although these forms may not be present in the felspar crystal; but the edges of the plates do not yield simple crystallographic relations. These edges, however, are referred to a mineral with hexagonal or trigonal symmetry. The author believes that Fe_2O_3 was originally present in solid solution in the felspar, either as hæmatite or as a constituent of a ferric compound; a disturbance of equilibrium, perhaps a temperature-change, has caused it to separate out as individual crystals of hæmatite along structural planes of the felspar. The bluish tints of the schillerised moonstones, murchisonites, and labradorites are said to be due, like the blue of the sky, to the "scattering of light by particles smaller than the wave-length of light, and cannot be explained as ordinary interference colours of thin films."

IN the Journal of the Washington Academy of Sciences for June 4 Mr. Paul D. Foote, of the U.S. Bureau of Standards, shows how the melting points of metals, *e.g.* tungsten, can be determined from the luminosity of the molten metal. The radiation at absolute temperature θ of a black body between wave-lengths λ and $\lambda + a\lambda$ being taken as $c_1\lambda^{-5}e^{-c_2/\lambda\theta} . d\lambda$, where c_1 and c_2 are constants, that of a metal over the visible part of the spectrum the author represents by $c_1\lambda^{-5}e^{-c_2/\lambda\theta} . Ae^{q/\theta} . e^{c_2 p/\lambda} . d\lambda$, where p and q are constants. If $V(\lambda)$ is the visibility of radiation λ, the luminosity of the surface of the metal is

$$Ae^{q/\theta} . c_1\int_0^\infty \lambda^{-5}e^{-c_2/\lambda(1/\theta - p)} . V(\lambda)d\lambda.$$

On writing $1/\theta' = 1/\theta - p$, this becomes

$$Ae^{q/\theta} . c_1\int_0^\infty \lambda^{-5}e^{c_2/\lambda\theta'}V(\lambda)d\lambda,$$

which, with the proper value of $V(\lambda)$, has been shown graphically to reduce to $Ae^{q/\theta} . P\{(\theta' + B)/(\theta' + C)\}^D$, where P, B, C, D are constants. In the case of tungsten the author shows that the values of the constants are $A = 0{\cdot}303$, $p = 1{\cdot}04 \times 10^{-5}$, $q = 322$, $c_2 = 14450$, $B = -106$, $C = 265$, $D = 72$, $P = 1{\cdot}91 \times 10^{-7}$. From Langmuir's observation that at the melting point tungsten has a luminosity of 6994 candles per square centimetre, it is shown that the preceding constants give 3712° as the absolute temperature of the molten surface. This method of determining high temperatures seems likely to prove of great value.

THE *Mathematical Gazette* for May contains a paper by Prof. H. S. Carslaw entitled "A Progressive Income Tax," dealing with the complicated system of taxation adopted in Australia. Although the British Chancellor of the Exchequer took his B.A. degree in the Cambridge Mathematical Tripos in 1886, he seems to have so far forgotten all his mathematics that he has imposed taxes at the rates of more than 2500, 5000, or 8000 per cent. on persons whose incomes exceed 1000*l.*, 1500*l.*, or 2000*l.* by a single pound. It would be more correct to say that the rate becomes infinity in the pound at these points of the scale, and the case may easily arise in which a professional man may have to throw up his duties at short notice in order to avoid losing money by earning more. But in Australia they appear to have gone to the opposite extreme, and determined the rate of tax by complicated mathematical formulæ defined by curves of the second and third degrees. Indeed, Prof. Carslaw has to use the integral calculus in the examples that he works. Why cannot Chancellors of the Exchequer bring a little more common sense, as well as *elementary* mathematical knowledge, to bear on income-tax problems? The discontinuities in the *gradient* of the income-tax curve, which the Australians have taken so much trouble to eliminate, are of no very great moment, while the present English discontinuities in the *total amount* of the tax are open to serious objection. With 100*l.* exempt, and rates of 2*s.* 6*d.* on the next 400*l.*, 4*s.* on the next 500*l.*, and 5*s.*, 6*s.*, and 7*s.* on subsequent additions to income of 500*l.*, the average rate on 2500*l.* would be very nearly 5*s.* in the pound, but the man with 2000*l.* who earned an extra 1*l.* would still gain 13*s.* instead of losing more than 50*l.* or 80*l.*

THE statement that, since the war began, Germany has succeeded in obtaining her full supply of nitrates by fixation from atmospheric nitrogen lends additional interest to the account of a Swedish company for the same purpose contained in *Dagens Nyheter* (June 8). Eyde's method of obtaining nitrogen from the air by means of an electric arc is relatively dear, and its profits depend on the local price of electrical energy. It has, moreover, been calculated that if all the waterfalls of Europe were to supply energy for this industry alone, this would not result in a greater production than would balance the present yearly increase in the world's need of fertilisers. The Swedish company employs a method invented by Th. Thorssell (formerly technical head of the fertiliser and sulphuric acid factories in Malmö), which method depends on purely chemical processes, and demands only the special treatment of easily accessible raw material; but no details of the process are given in the article. The chief products of the new factory are ammonia, ammonium nitrate and cyanide compounds, saltpetre, and sulphuric acid. The process is said to be of such a character that factories can be installed in most places without requiring any large supply of energy. Experimental work was begun in the autumn of 1911, and during the summer of 1912 the results were approved by the outside experts—Prof. H. G. Söderbaum and Dr. Gustaf Ekman. The company was then set going definitely, and, in spite of difficulties inseparable from an entirely new manufacture, as well as losses by fire, it is now preparing to deliver its products in large quantities, and has for this purpose decided to increase its capital from 3·7 million to 8 million kronor.

PROF. OTTO PETTERSSON, of Holma, Lysekil, Sweden, has devised an apparatus for saving life at sea which presents some features of novelty and interest. It consists of three parts: (1) An ordinary horsehair mattress of the thickness, width, and length which are usual for a ship's berth. This mattress is to form the bottom of what will be a kind of collapsible boat when used for life-saving. (2) Attached to the sides of the mattress, and capable of being folded underneath it when used for sleeping purposes, are two cushions which, when the whole is employed for life-saving, form the sides of the craft and on which its buoyancy depends. In the original model these cushions were filled with the hair of the reindeer—a material much used for such purposes in Scandinavia—but, of course, kopok would be equally serviceable. (3) The stem and stern of the little craft are formed of double layers of impermeable, closely woven waterproofed cloth strengthened by cords sewn in and uniting at the ends of the mattress in a metal ring, to which the rope of a sea-anchor may be fixed. Each seam is strengthened by a layer of india-rubber to keep the water from entering the inner stuffing of the mattress. Between the mattress and the side cushions are two pieces of cloth with holes for putting the arms through. The whole forms a sort of cloak in which one wraps oneself, as in an ulster coat, securing it round the waist. The sea-anchor is taken in one hand and one flings oneself backward into the sea. The anchor is let go and the craft emptied of water by a syringe which is placed at the side and is easily worked by the passenger. Once emptied it will not easily fill again, the sea-anchor keeping the prow against the wind and the waves. The little boat is unsinkable, even when filled with water, and is sufficiently buoyant to carry more than one person. If two or three boats are tied together by the anchor line one sea-anchor will keep them steady. The sea-anchor is an essential part of the apparatus. It consists of a canvas bag sewn on to a metal ring, and is provided with a stout manila rope about 20 m. long. The apparatus is made by K. M. Lundberg, of Stockholm, and has been proved to be very serviceable.

AN article on "Fruits for Health, Strength, and Longevity," which appears in the *Fortnightly Review* for July, though an advocacy of fruitarianism, fails to offer any convincing physiological argument in support of the end in view. Like most productions of its kind it consists of manifest inaccuracies mixed with a modicum of truth. For example, "when a man reaches the age of fifty, especially should he be careful about his diet," is only too true; but that "the juices of oranges and lemons act like magic upon the waste chalky accumulations which bring about the stiffening of the arteries"—in other words, cure arteriosclerosis—is a statement unsupported by experimental evidence in the field of modern therapeutics. Nor is there sufficient evidence to show that eating fish and the flesh of the pig is in any way associated with cancer, scrofula, and tumours. Fruit jellies are said to "possess no nitrogen"! and "*condensed starch* seriously taxes the digestive organs." What is condensed starch? "The action of glucose, like that of cornflour, induces sluggish action of the system and tends to disorganisation, driving consumers to purgatives." Yet many fruits are rich in glucose or sugars readily converted into glucose. Moreover glucose has a mild aperient action on most people. "Utilised over a course of years ripe fresh fruits and their juices will effectually prevent aneurismal dilatations and arterial rupture, which of late years have increased to an alarming extent." It would be interesting to know what medical evidence there is for either of these conclusions.

THE June issue of the Chemical Society's Journal contains a report of a lecture by Dr. F. Gowland Hopkins delivered before the society on May 18 on "Newer Standpoints in the Study of Nutrition." This is the third of a series of lectures delivered by invitation of the council during the past session, the two earlier lectures having been given by Dr. E. J. Russell and by Prof. W. H. Bragg. To the chemist, Dr. Hopkins's lecture is particularly attractive by reason of the large measure of success which the author has achieved in his endeavour to interpret biochemical phenomena in terms of the known reactions and products of organic chemistry. Amino-acids, such as tryptophane, arginine and histidine, glutamic and aspartic acids, derived from the hydrolysis of natural proteins, are shown to be the essential units in the nutrition of animals. If these are provided, together with filtered butter-fat or lard, potato-starch, cane sugar, the requisite inorganic salts, and the mysterious vitamine or food-hormone factor (supplied in the form of a nitrogen-free alcoholic extract of fresh milk), life can be preserved and growth maintained without protein or any nitrogenous compounds of unknown constitution. Interesting experiments have been made which show that the withholding of the aromatic compound tryptophane, or of both arginine and histidine, prevents growth and causes a rapid loss of weight; but glutamic and aspartic acids, which constitute 28 per cent. of the protein molecule (as contrasted with 1½ per cent. of tryptophane), can both be removed without causing loss of body-weight or even any marked retardation of growth; and the removal of histidine and arginine separately does not arrest growth, indicating that these two amino-acids can replace one another in nutrition, and may even prove to be chemically interconvertible.

OUR ASTRONOMICAL COLUMN.

A PARTIAL ECLIPSE OF THE MOON.—The moon will be in partial eclipse during the early morning hours of Saturday, July 15. The first contact with the shadow occurs at 3h. 19·3m. a.m., the angle from the north point being 40° to E. At Greenwich the moon sets at 3h. 59m. a.m. (one hour later in legal time), nearly 47 minutes before the middle phase.

A BRIGHT METEOR.—A notable meteor was observed at the Hill Observatory, Sidmouth, early on July 8. First seen at 1h. 5m. a.m. G.M.T. a little E. of N. about 15° above the sky-line, rising in the sky, it then passed not quite overhead and reached 30°–40° beyond the zenith. Unfortunately, although the sky was clear and the meteor considerably exceeded Jupiter in brightness, it left no visible trail. The meteor gave the illusory impression of coming quite near to the observer and not of describing a meridian, an effect no doubt largely due to its increasing brilliancy.

COMET 1916*b* (WOLF).—An investigation of the orbit of this comet has been carried out by Messrs. R. T. Crawford and Dinsmore Alter, of the Berkeley Astronomical Department (Lick Obs. Bull., No. 282). From this it appears that Prof. Barnard succeeded in identifying the comet on a photograph taken on April 24. The time of the observation indicates that it must be the same photograph on which a confusion of the minor planet 446 Æternitas with the new comet had been pointed out by the editors of the *Astronomisch Nachrichten* (No. 4845). The earliest position available to the American calculators was that derived from Prof. Barnard's plate. With this and other observations made at Yerkes, May 10 and May 23, the following differentially corrected parabolic orbit has been calculated:—

$$T = 1917 \text{ June } 16{\cdot}4806 \text{ G.M.T.}$$

$$\omega = 120^\circ\ 37'\ 07{\cdot}9'' \qquad \Omega = 183^\circ\ 16'\ 58{\cdot}8''$$

$$i = 25^\circ\ 40'\ 06{\cdot}4'' \qquad \log q = 0{\cdot}226855$$

These elements and the resulting ephemeris only differ slightly from the calculations by Prof. A. Berberich (NATURE, June 1). Numerous American observations, mostly made at Yerkes, are represented closely. The orbit resembles that of Wolf's periodic comet 1884, III., and consequently an elliptic orbit with a period of seven years was calculated; the differences, however, disproved identity. The faint luminosity and low altitude of the comet now probably put it out of reach until it becomes a morning star.

AREQUIPA PYRHELIOMETRY.—In consequence of the recommendations of the Committee of the International Union of Solar Research, measures of solar radiation have been made at Arequipa since 1912. Some of the results so far obtained have been published by C. G. Abbot (Smithsonian Miscellaneous Collection, vol. lxv., No. 9). Special attention has been given to the question of solar variability and atmospheric transmission. At Arequipa the chief factor in the latter connection is the amount of water vapour, and consequently the silver-disc pyrheliometer measures of radiation have been supplemented by a nearly simultaneous series of measures of atmospheric humidity. The monthly mean values show a close connection between the solar radiation and vapour pressure. This was represented by empirical formulæ which gave values of the solar constant in good agreement with the more rigorous values obtained at Mount Wilson and generally confirming the variability of the solar radiation.

The dust of the Katmai eruption (June, 1912) did not affect the Arequipa measures.

CANADIAN ECONOMIC GEOLOGY.[1]

THE White River District of Yukon extends east from the Alaskan-Canadian boundary, and its geology continues that of country well known by the work of the American geologists. Some Carboniferous rocks, resting on an Archean foundation, are followed by thick Mesozoic sediments which contain a few Cretaceous fossils. The Cainozoic is represented by land and fresh-water beds containing lignites. As in Alaska, there are two volcanic series, one of which was erupted during the world-wide disturbances between the Jurassic and Cretaceous, and the other is Upper Cainozoic and continued until very recent though pre-Glacial times. In the early Pliocene the country was uplifted and greatly fractured, the evidence of which is most distinct on the coast. The chief ores of the White River District are of gold and copper. The discovery of the placer deposits at Chisana in 1913 occasioned the greatest "stampede" or mining rush since that to Klondyke in 1897–98. The copper ores have long been worked by the Indians, and in 1891 the exaggerated reports of their quantity led to the first prospecting of the country. Mr. Cairnes's memoir is illustrated by some excellent maps and photographs.

At the opposite corner of Canada, on the southern shore of the Northumberland Strait, is an area strikingly unlike the White River District. It was one of the first Canadian districts geologically investigated; it was settled during the latter part of the eighteenth century, and the names Arisaig, Knoydart, Moydart, Lismore, etc., show that the pioneers were the expatriated exiles from the western Highlands. The district is composed of Palæozoic rocks ranging from the Ordovician to the Upper Carboniferous, with some Ordovician rhyolite lavas and Upper Palæozoic diabase dykes. The surveys of recent years have supplemented and in some respects corrected the earlier results of Dawson and Honeyman. Thus there is a full Silurian sequence, as the Moydart beds represent the Wenlock series, which had been considered absent. The Devonian is represented by the Knoydart series, which is correlated with the British Lower Old Red Sandstone. The absence of the Middle and Upper Old Red Sandstone is attributed to great faulting, that corresponds to that which caused the absence of the Middle series from south-western Scotland. The Carboniferous is represented, as in Britain, by a lower marine series and an upper continental series.

The most interesting economic deposits in this district are the Silurian oolitic ironstones, which the author infers from their special fauna were laid down under unusual conditions, during which the sea contained much ferruginous material. This view is not adequately explained, and there is no proof that the ores were not due to a partial replacement of an oolitic limestone. The report is accompanied by two clear geological maps.

The oil discoveries in the United States in the early 'sixties stimulated research for oil in eastern Canada. Oil was found, though in comparatively small quantities, and some of the districts continued to yield ever since. This oil belt extends from Lake Huron to the Gaspe peninsula, south of the mouth of the St. Lawrence. The most important fields are in the south-western peninsula of Ontario, south of a line from the southern end of Lake Huron to the western end of Lake Ontario. The oils come from various hori-

[1] D. D. Cairnes: Upper White River District, Yukon. Canada, Department of Mines, Geol. Surv. Mem. 50, Geol. Ser., 51, 1915, iv. Pp. 191+xvii plates+3 maps.

M. Y. Williams: Arisaig-Antigonish District, Nova Scotia. *Ibid.*, Mem. 60, Geol. Ser., 47, 1914, vi. Pp. 173+2 maps.

W. Malcolm: The Oil and Gas Fields of Ontario and Quebec. *Ibid.*, Mem. 81, Geol. Ser., 67, 1915, ii. Pp. 248.

zons. There are traces in the Trenton (Ordovician); small quantities are obtained from four distinct Silurian series. The largest quantity of oil comes from the Onondaga beds, which are Devonian. The author mentions both the organic and inorganic theories of the origin of petroleum; he expresses no definite preference, but appears to be inclined to the latter, and some of the facts stated in the memoir indicate why some Canadian geologists are firmly attached to that view. The most interesting evidence is based on the uniform composition of the associated natural gas, which is advanced as incompatible with its local origin; but the balance of the evidence stated seems difficult to reconcile with the inorganic hypothesis.

Each of the three memoirs is a useful contribution to Canadian geology. J. W. G.

RADIO-ACTIVITY AND PLANT GROWTH.

FOR some time past Mr. Martin Sutton has been making experiments on the effects of radio-active ores and residues on plant growth. A preliminary account of the experiments was given in NATURE for October 7, 1915, and the detailed report now to hand, issued as Bulletin No. 7, from Messrs. Sutton, of Reading, confirms the conclusions then drawn. The experiments were soundly conceived and well carried out; the results showed that radium compounds have no sufficient effect on plant growth to justify any hopes of practical application in horticulture or agriculture.

The experiments were made with tomatoes, potatoes, radishes, lettuces, vegetable marrows, carrots, onions, and spinach beets; some of the plants were grown in pots, and others in the open ground. Pure radium bromide was used in some experiments, and radium ores in others. In order to eliminate the effect of substances other than radium present in the ores, a mixture of these was made and applied to some of the plants. In certain cases small increases in growth over the unmanured plants were obtained, but nothing approaching the increases given by artificial fertilisers or farmyard manure.

A number of rather extravagant claims are thus disposed of, including one to the effect that radium treatment caused plants to take on certain flavours that they do not naturally possess. Thus a previous investigator had claimed that vegetable marrows grown in presence of radium compounds assume the flavour of pineapples; Mr. Sutton's marrows were cooked and tasted by a distinguished exponent of horticultural science, whose tastes in these matters are recognised as being beyond reproach, and were found to be indistinguishable from the others. Mr. Sutton has rendered good service by disposing of this and other of the hares started in the field of horticulture that were distracting attention from the larger problems with which the horticulturist has to deal.

THE ORGANISATION OF INDUSTRIAL SCIENTIFIC RESEARCH.[1]

I.

IF one attempted to formulate the common belief concerning the origin and development of modern technical industries, it would probably be found that stress would be laid upon financial ability or manufacturing skill on the part of the founders; but if, instead, we were to make a historical survey of the subject, I think that we should find that the starting and development of most manufacturing businesses depended upon discoveries and inventions being made by some individual or group of individuals who developed their original discoveries into an industrial process. Indeed, if the localities in which various industries have developed be marked on the map, they will often be found to have far more relation to the accidental location, by birth or otherwise, of individuals than to any natural advantages possessed by the situation for the particular industry concerned. The metallurgical industries, of course, are situated chiefly near the sources of the ores or of coal, but why should the chief seat of the spinning industry be in Lancashire or of modern optical industry in Jena, except that in those places lived the men who developed the processes which are used in the industry? And, moreover, industries are frequently transferred from one locality to another, and even from one country to another, by the development of new processes, generally by new individuals or groups of workers.

The history of many industries is that they were originated and developed in the first place by some man of genius who was fully acquainted with the practice of the industry and with such theory as was then known; that his successors failed to keep up with the progress and with the theory of the cognate sciences; and that sooner or later some other genius working on the subject has rapidly advanced the available knowledge, and has again given a new spurt to the development of that industry in another locality.

Thus, in the early days of the technical industries the development of new processes and methods was often dependent upon some one man, who frequently became the owner of the firm which exploited his discoveries. But with the increasing complexity of industry and the parallel increase in the amount of technical and scientific information, necessitating increasing specialisation, the work of investigation and development which used to be performed by an individual has been delegated to special departments of the organisation, one example of which is the modern industrial research laboratory.

The triumphs which have already been won by these research laboratories are common knowledge. The incandescent lamp industry, for instance, originated in the United States with the carbon lamp, but was nearly lost to the United States when the tungsten filament was developed, only to be rescued from that danger by the research laboratory of the General Electric Company, who fought for the prize in sight and developed, first, the drawn-wire filament, and then the nitrogen lamp; and we may be sure that if the theoretical and practical work of the research laboratory of the General Electric Company were not kept up the American manufacturers could by no means rest secure in their industry, as, undoubtedly, later developments in electric lighting will come, and the industry might be transferred, in part, if not completely, to the originators of any improvement. Manufacturing concerns, and especially the powerful, well-organised companies who are the leaders of industry in this country, can, of course, retain their leadership for a number of years against more progressive but smaller and less completely organised competitors, but eventually they can ensure their position only by having in their employ men who are competent to keep in touch with, and themselves to advance, the subject, and the maintenance of a laboratory staffed by such men is a final insurance against eventual loss of the control of its industry by any concern.

There was a time when the chief makers of photographic lenses were the British firms, the owners of which had been largely instrumental in developing the early theory of lens optics, but that position was lost entirely as a result of the scientific work of the German opticians, led by Ernst Abbe; in a smaller divi-

[1] An address delivered at Columbia University by Dr. C. E. Kenneth Mees, director of the Research Laboratory, Eastman Kodak Co., Rochester, N.Y.

to be cont.

sion of optical work, however, the staff of Adam Hilger, Ltd., has been able by its superior knowledge and intensive study of the manufacture of modern spectroscopes to transfer a large portion of the manufacture of such instruments from Germany to England again.

In a recent book review in NATURE (December 2, 1915, p. 366) it is pointed out that the rare earth industry has been chiefly concentrated in Germany. The manufacture of gas mantles, discovered by an Austrian, developed an entirely new chemical industry, which has been carried on almost completely under German auspices. It seems to be suggested at the present time by some of the leaders of British industry that such specialised chemical operations as the manufacture of compounds of the rare earths can be transferred to Great Britain by the application of superior financial methods, or better business foresight, or even merely more intense application. I do not believe that anyone who is acquainted with the business men of several countries will believe that the British manufacturer is lacking either in financial capacity, or in business foresight, or in application, but none of these things by itself will develop a chemical industry. The only thing that will attract and retain the business is the manufacture and development of new and improved products, and this can be done only by the use of more and better research chemists and physicists than the competitor is willing to employ. In fact, at the present time it seems to be clear that the future of any industry depends upon its being able to command a sufficient supply of knowledge directed towards the improvement of the product and the development of the methods of that industry, and that any failure in this respect may involve eventual failure. While this view of the importance of research work to the industries is now obtaining universal acceptance, I feel that many who assent without hesitation to the value of a research laboratory still take far too low a view of the work which it should perform.

Industrial laboratories may be classified in three general divisions:—

(1) Works laboratories exerting analytical control over materials or processes.

(2) Industrial laboratories working on improvements in product and in processes, tending to lessen cost of production and to introduce new products on the market.

(3) Laboratories working on pure theory and on the fundamental sciences associated with the industry.

The first class of laboratories are so obviously necessary that practically all works are so equipped, and frequently each department of a factory maintains its own control laboratory. The second class of laboratories are frequently termed "research" laboratories, and this type has been very largely instrumental in forwarding the introduction of scientific control into industry.

Unfortunately, however, the immediate success of the application of scientific methods to industrial processes has often led the executives of commercial enterprises into the belief that such work along directly practical lines is capable of indefinite extension, and in this belief a number of laboratories have been started, some of which, at any rate, have been sources of disappointment in consequence of a failure to grasp the fact that if the whole future of an industry is dependent on the work of the research laboratory, then what is required is not merely an improvement in processes or a cheapening in the cost of manufacture, but fundamental development in the whole subject in which the manufacturing firm is interested, and for this purpose it is clear that something very different from the usual works laboratory will be required, and that in order to attain progress the work of the research laboratory must be directed primarily towards the fundamental theory of the subject. This is a point which seems to be continually overlooked in discussions of industrial scientific research, where such stress is generally laid upon the immediate returns which can be obtained from works laboratories, and upon the advantage of scientific control of the operations; but in every case where the effect of research work has been very marked, that work has been directed, not towards the superficial processes of industry, but towards the fundamental and underlying theory of the subject. From Abbe's work on lenses, and Abbe and Schott's work on glasses, to the work of the research laboratory of the General Electric Company on the residual gases in lamp vacua, which resulted in the production of the nitrogen-tungsten lamp and the Coolidge X-ray tube, this will be seen to be true, and we must consequently agree that for industries to retain their position and make progress they must earnestly devote time and money to the investigation of the fundamental theory underlying the subject in which they are interested.

Research work of this fundamental kind involves a laboratory very different from the usual works laboratory, and also investigators of a different type from those employed in a purely industrial laboratory. It means a large, elaborately equipped, and heavily staffed laboratory, engaged largely on work which for many years will be unremunerative, and which, for a considerable time after its foundation, will obtain no results at all which can be applied by the manufacturer.

The value of a research laboratory is essentially cumulative; in the beginning it may be of service as bringing a new point of view to bear on many problems; later, accumulated information will be more and more available; but most men acquainted with industrial research work consider that five years is the earliest date at which any considerable results can be expected from a newly-established research laboratory, and that the development of really new material in considerable quantities so that it will have an effect upon the industry as a whole cannot be looked for in less than ten years' consecutive work. This does not mean that a laboratory is useless during the initial period, since it will be of considerable service in many other directions than in that of its main work on the fundamental problems, but when this main line of research begins to bear fruit it will absorb the energies both of the laboratory and of the factory.

It is often suggested that the problem of the organisation of scientific industrial research is really the problem of obtaining satisfactory co-operation between the manufacturers and the universities, possibly with small research laboratories in the factories themselves acting as intermediaries. Various schemes have been suggested for enabling the universities to carry out research work of value to the manufacturers, but if it is believed that the work chiefly required for the development and maintenance of industry deals with the fundamental theory of the subject, it will be seen that this cannot possibly be carried on to any large extent in collaboration with a university; it requires a continuity of application by the same investigators over long periods, with special apparatus, and with the development of special methods which cannot be expected from any university. This necessity for continuous work along the same line is, indeed, the greatest difficulty in making use of the universities for industrial research. The conditions of a university laboratory necessarily make it almost impossible to obtain the continuous application to one problem required for success in industrial research, and, indeed, in the interests of teaching, which is the primary business of a university, such devotion to one problem is undesirable, as tending to one-sidedness.

There are also difficulties in obtaining the co-operation of manufacturers with universities and in the application of university work to industry, which I see no hope whatever of overcoming; the universities do not understand the requirements of the manufacturer, and the manufacturer distrusts, because he does not understand, the language of the professor. Moreover, it is quite essential that any investigator who has worked out a new process or material should be able to apply his work on a semi-manufacturing scale, so that it can be transferred to the factory by skilled men who have already met the general difficulties which would be encountered in factory application. This development on a semi-manufacturing scale is, indeed, one of the most difficult parts of a research resulting in a new product, and the importance of it is shown by the fact that all the large industrial research laboratories, however concerned they may be with the theory of the subject, have, as parts of the laboratory, and under the direction of the research staff, experimental manufacturing plants which duplicate many of the processes employed in the factory itself.

All these arguments tend to show that an industrial research laboratory must necessarily be of considerable size, but this requirement is much accentuated by another consideration altogether.

Except in a few branches of pure science small research laboratories are relatively inefficient, in the technical sense of the term—that is, they require more time and cost more money for the solution of a given problem.

When considering this subject it is necessary first to dismiss completely from the mind the idea that any appreciable number of research laboratories can be staffed by geniuses. If a genius can be obtained for a given industrial research, that is, of course, an overwhelming advantage which may outweigh any disadvantages, but we have no right to assume that we can obtain geniuses; all we have a right to assume is that we can obtain, at a fair rate of recompense, well-trained, average men having a taste for research and a certain ability for investigation. The problem, then, is, how can we obtain the greatest yield from a given number of men in a given time? Investigation of the subject shows that the yield per man increases very greatly as the number of men who can co-operate together is increased. The problems of industrial research are not often of the type which can be best tackled by one or two individual thinkers, and they rarely involve directly abstract points of theory, but they continually involve difficult technical and mechanical operations, and most of the delays in research work arise because the workers engaged on the subject do not know how to do some specific operation. In my own experience, I have seen a good man stick for six months at an investigation because he did not know and could not find out how to measure a conductivity with a precision higher than one part in a thousand, a point which was finally found to be perfectly well known to several scientific workers in the country. Again, it took another good man three months to learn how to cut a special form of section, but, having learned the trick, he can now cut sections for all the workers in the laboratory with no delay whatever.

In this connection the advantage of permanent setups of apparatus may be pointed out. Among a large number of chemists some one will continually be wanting to photograph an ultra-violet absorption spectrum or to take a photomicrograph, and if the apparatus for these purposes is erected and in charge of a competent man who understands its use, the work can be done without any delay at all, the photography of the absorption spectrum of an organic liquid by a man who is used to the work taking only an hour; but if this point is vital to the research, and the chemist is quite unacquainted with the technique of the subject and has no apparatus available, it may easily take him six months to find out what has been done on absorption spectra, to buy and erect the apparatus and become skilled in its working.

From these causes, then, the efficiency of a laboratory increases very greatly with its size, provided that there are good arrangements for co-operation between the different workers of the laboratory, so that they are kept informed of each other's problems.

When considering the efficiency of research work it must be remembered that the efficiency is necessarily extremely low, since it is very rarely possible to arrange any research so that it will directly proceed to the end required.

(To be concluded.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—Dr. O. F. Hudson has resigned his post as lecturer and instructor in assaying and special lecturer in metallography in order to take up duties as assistant investigator to the Corrosion Committee of the Institute of Metals.

The degree of Doctor of Science has been awarded to the following: Elizabeth Acton (botany), Henry Briggs (mining), George William Clough and Albert Parker (chemistry).

LEEDS.—On the occasion of Degree Day on July 1 the vice-chancellor (Dr. M. E. Sadler) in the course of an address reviewed the position of the university, with special reference to the war. Of nearly fourteen hundred associated with the university who are on active service, fifty-one had received military distinction. The war has found the university able and ready to give the nation unforeseen and many-sided service, and the long vacation is little more than a name for those in the university who are doing scientific or administrative work in connection with the war. The war, Dr. Sadler remarked, has already enriched the university with a deepened tradition of fellowship in public service. In the years to come it will be called upon to prove the power of patient but imaginative investigation, of trained judgment, and of unjealous and patriotic energy in helping forward whatever will impart a finer quality to the social and economic conditions of the national life. Grateful mention was made of the recent benefaction of Sir James Roberts for the endowment of a chair of Russian language and literature—an act of international significance. As important and opportune would be the foundation of a professorship of Spanish language and literature.

Alluding to the future of the universities, Dr. Sadler said, whilst they must continue to work in intimate co-operation with the great local authorities and the Government, it must never be forgotten that the living power of their work will depend on their continuing free from mistaken, however well-meant, kinds of external interference. Germany has failed, in spite of her brilliant endowment of knowledge, to keep unsullied in her universities freedom of moral judgment in respect of some vital questions of duty to mankind and to the State. She has gradually and half-consciously undermined, by subtle pressure of State control and by inducements of official distinctions, independence of moral and political judgment in some of the teachers through whom that higher education is given. This should be a warning to us.

St. Andrews.—At the summer graduation ceremony on July 6 the honorary degree of LL.D. was conferred upon Mr. W. E. Clarke, keeper of the zoology department, Royal Scottish Museum, Edinburgh; Mr. C. T. Clough, district geologist, Geological Survey of Scotland; Dr. R. B. Don; Mr. L. R. Farnell, rector of Exeter College, Oxford; Dr. C. G. Knott, lecturer in applied mathematics, University of Edinburgh; Dr. J. Musgrove, Bute professor of anatomy, St. Andrews, 1901, 1914; and Prof. W. R. Scott, professor of economics, University of Glasgow.

Mr. Asquith stated in the House of Commons on July 10 that he does not propose to advise the appointment of a Royal Commission on Education. The Government is itself engaged in a comprehensive review of the system of education as a whole.

At the invitation of the Paris Academy the Imperial Academy of Sciences of Petrograd has appointed three of its members as delegates to the International Commission established on the initiative of the Paris Academy for the purpose of taking steps, after the war, of restoring so far as possible the library of the University of Louvain burnt by the Germans.

The recently established School of Slavonic Studies at King's College, London, wishes to form a special Slavonic library, and hopes for the sympathetic co-operation of Russian learned societies by donations of suitable books. This having been brought to the notice of the Imperial Academy of Sciences of Petrograd by the Minister of Public Instruction, the Academy at once expressed its willingness to contribute to the desired end, and directed that a catalogue of the Academy's publications be sent to the school with the request that a list be prepared of the works which it wishes to receive.

Numerous bequests to aid medical science in the United States are reported in a recent issue of *Science*. By the will of the late Dr. J. W. White, trustee of the University of Pennsylvania, and Prof. J. R. Barton, emeritus professor of surgery, 30,000*l*. is bequeathed in trust as a permanent endowment fund, the income to be used for establishing a professorship of surgical research in the medical department of the university. Two hundred thousand pounds will be available for use by the Washington University Medical School, with the opening of the new term in September, through the gift to the school of 33,200*l*. each by Mr. E. Mallinckrodt and Mr. J. T. Milliken, of St. Louis. One fund of 100,000*l*., to be known as the Edward Mallinckrodt Fund, will be devoted to teaching and research work in pediatrics. The other fund of 100,000*l*., to be known as the John T. Milliken Fund, will be devoted to teaching and research work in medicine. The funds will enable the medical school to employ physicians in these departments for their full time. The amount, in addition to the Mallinckrodt and Milliken donations, to bring the fund to 200,000*l*. has been given by the General Education Board. A movement has been inaugurated to secure at least 400,000*l*. additional endowment for Jefferson Medical College, Philadelphia. Mr. D. Baugh, founder of the Baugh Institute of Anatomy and Biology, subscribed 20,000*l*., provided that an equal amount was raised on or before June 16. The executors of the estate of the late Mr. Emil C. Bundy, of New York, have paid over to Columbia University the sum of 20,000*l*. for research work in cancer.

Attention may be directed to the help rendered to manufacturers and business men for some time past by the librarian and staff of the City of Coventry Public Libraries. From time to time lists of recent books in technical chemistry, metallurgy, etc., are issued in printed form and circulated widely among those likely to be interested. In addition, lists are prepared and issued dealing, *e.g.*, with a specific metal and its alloys. We have before us one such relating to aluminium, which gives an admirable series of references to original papers and books published in the last ten years. These lists are not only circulated among manufacturers and business men, but are also given a wider publicity by being pasted inside books on the same subject. The Central Library and its branches are well supplied with technical journals, to which the public have access without any restriction. The technical section is reinforced by cutting out the best articles from duplicate and unbound periodicals, mounting them on sheets, and exposing them in boxes where they are classified under appropriate headings. In addition, the staff of the library invites inquiries for information, whether made verbally, or by letter, or by telephone. All inquiries are treated as confidential, and no effort is spared to supply the fullest and most trustworthy information. No doubt the instance we have quoted is not unique, but it appears worth while directing attention to a practice which must be most helpful to the technical staff of manufactories, particularly where, as is so often the case, few, if any, technical books or periodicals are taken. The example of the staff of the Coventry Public Libraries is warmly to be commended.

SOCIETIES AND ACADEMIES.

London.

Challenger Society, June 28.—Dr. E. J. Allen in the chair.—Capt. Campbell **Hepworth**: The meteorology of Davis Strait and Baffin Bay, including ice distribution and frequency. The paper was based on a set of charts that had been prepared in the Meteorological Office.

Dublin.

Royal Dublin Society, June 20.—Dr. J. M. Purser in the chair.—Prof. W. H. **Thompson** and J. **Pimlott**: The possibilities of food production in the United Kingdom.—Prof. G. H. **Carpenter**: Injurious insects and other animals observed in Ireland during the years 1914 and 1915. The summer of 1914 was noteworthy for the great abundance of the "diamond-back" moth (*Plutella cruciferarum*) on turnip crops, both in the east and west of Ireland. Nymphs of the large shield-bug, *Tropicoris rufipes*, were very destructive to young apples in Co. Kilkenny in the summer of 1915. Another unusual observation was the abundance of two weevils, *Phyllobius argentatus* and *Strophosomus coryli*, on larch.

Royal Irish Academy, June 26.—The Most Rev. Dr. Bernard, Archbishop of Dublin, president, in the chair.—M. W. J. **Fry**: Impact in three dimensions. The paper showed that the course of impact in three dimensions can be minutely followed in the most general case. There are two or four directions (according to the value of the coefficient of friction) in which if sliding initially takes place it persists without change of direction, and of these alternate ones correspond to stable motions. Any other direction of sliding tends to get parallel to the adjacent stable direction, and does so if the impact is sufficiently prolonged, and at the same time the velocity of sliding vanishes, but does not if the direction is that special one along which sliding may take place, when the velocity of sliding vanishes and rolling is impossible. In three dimensions the velocity of compression may vanish three times, so that before the first period of compression is over a second one may intervene. No matter how rough the bodies are, sliding may not cease, and the solution often given of impact between perfectly rough bodies may be inaccurate.—H. **Kennedy**: The large ions and condensation nuclei from flames. An examination is made of the nature of the large ions and nuclei from flames, which seem to be identical with those studied by Aitken and occurring in the atmosphere. The rate of decay of ionisation in the case of the large ions from flames is found to be according to the law $dq/dt = -\beta q^2$, where q is the charge of one sign per c.c. and β a constant. The number of nuclei per c.c. was measured by Aitken's apparatus. It is found that the nuclei disappear according to the law $dn/dt = -\gamma n^2$, and the rate of disappearance seems to be the same whether the nuclei are charged or uncharged. The large ions carry multiple charges, and the value of the charge depends on the circumstances of production. The mobility of the large ion, so far as experiment has gone, seems to be the same in all circumstances of production. The mobility must, therefore, be independent of the charge. The formation of the nucleus does not depend on the presence of the charge.

EDINBURGH.

Royal Society, June 4.—Dr. J. Horne, president, in the chair.—Prof. A. A. **Lawson**: The prothallus of *Tmesipteris tannensis*. Tmesipteris and the closely-related Psilotum form a group the main interest of which lies in their phylogenetic isolation. Both genera are limited to the tropics and sub-tropics, Tmesipteris being found in the South Sea Islands, Australia, New Zealand, and parts of Polynesia. With the exception of certain important descriptions by Lang, our knowledge of the gametophytes and embryo of the Psilotaceæ may be regarded as a complete blank. Shortly after his arrival in Australia in 1913 Prof. Lawson learned that both genera were to be found in great abundance in the vicinity of Sydney. After careful search several specimens of the prothallus of Tmesipteris and one specimen of what is believed to be the prothallus of Psilotum were discovered. The present paper contained an account of the general features of these prothalli, including descriptions of the antheridia and the archegonia. Observations on the embryo were also made, but a full account is reserved for a later paper, when more material will have been obtained. As regards the structure of the archegonium, which bears no very striking resemblance to either Equisetum or Lycopodium, one is inclined to regard it as reduced. This is not surprising in a plant the sporophyte and gametophyte of which are both reduced and highly specialised in their adaptation to definite habitats.—Prof. E. T. **Whittaker**: On the theory of continued fractions. The paper gave a general process for expressing a continued fraction as a continuant, and showed how to express the differential coefficient of a continued fraction as the ratio of two determinants the constituents of which are definite functions of the terms of the continued fraction.

June 19.—Sir T. R. Fraser, vice-president, in the chair.—Prof. C. R. **Marshall**: The pharmacological action of nitric esters. The paper dealt mainly with the relation between the chemical constitution and pharmacological action of these esters. All that were investigated, except those of organic acids and their alkyl esters, caused dilatation of the blood-vessels. The quantitative effect of the fully nitrated esters of the polyhydric alcohols and the sugars was chiefly dependent on their solubility in aqueous media; that of nitric esters of monohydric alcohols was much less dependent on this property. The influence of different groupings was described, and the theory that the pharmacological action of nitric esters is wholly due to their reduction to nitrites was combated. Evidence of the formation of nitric oxide hæmoglobin was not obtained.—C. W. **Tyrrell**: On the petrography of the trachytic and allied rocks of the Carboniferous age in the Clyde lava plateaux. These rocks were shown to fall into four groups, viz.: (*a*) Albite Bostonites, A. Trachytes, and A. Keratophyres; (*b*) Bostonites, Trachytes, and Keratophyres; (*c*) Quartz Keratophyres and Felsites; (*d*) Phonolites.

NEW SOUTH WALES.

Linnean Society, April 26.—Mr. C. Hedley, vice president, in the chair.—G. I. **Playfair**: Oocystis and Eremosphæra (Algæ). The object of this paper is threefold:—(1) To give an account of all forms of Oocystis and Eremosphæra met with in New South Wales; (2) to direct attention to the polymorphism of Eremosphæra, and to its connection with Oocystis; (3) to supply the original descriptions and figures, so far as possible, of all published species and forms of the two genera.—Dr. J. M. **Petrie**: The chemical investigation of some poisonous plants in the N.O. Solanaceæ. Part ii.—*Nicotiana suaveolens*, and the identification of its alkaloid. *N. suaveolens* is the "native tobacco" of Australia, and the only endemic species. It is a troublesome weed in the stock country, sometimes referred to as poisonous, at other times as a good fodder-plant, readily eaten by stock. As only a very few among the eighty described species of Nicotiana are known to contain nicotine, the author examined plants from three different localities in the interior of New South Wales, and in all identified and proved the presence of nicotine. The amounts found were 0·035, 0·003, 0·004 per cent. of the fresh plants, or 0·124, 0·011, 0·015 per cent. of dried (at 100°) plants. It was calculated from the lowest figure stated that enough alkaloid is contained in half a pound of green plant to poison an ordinary-sized sheep.—A. A. **Hamilton**: The instability of leaf-morphology in relation to taxonomic botany. The principal factors affecting leaf-morphology are tabulated, and a summary of the more important alterations resultant from their agency are given. A series of examples (chiefly Australian) is submitted, illustrating the effect of environment on leaf-structure; and evidence is offered, in certain cases, demonstrating the development of heterogeny in the foliage of closely allied plants, using dissimilar contrivances as protective agencies against adverse conditions; and homoplasy in plants distantly related, but employing a common protective device.—J. H. **Maiden**: *Brachychiton populneo-acerifolius*, F. v. M., the crimson-flowered Kurrajong. The name was applied by the late Baron von Mueller to a tree, recognised as a hybrid between *B. acerifolius* and *B. populneus*, growing in a garden at Mulgoa. Plants of the parent species were then growing in the garden, but it was not certain that the hybrid had not been introduced as a seedling from elsewhere. Inquiries for similar plants have been widely circulated, and records are now given of examples growing in different localities; but, except in one instance, they are all cultivated plants, the history of which is unknown.—J. H. **Maiden**: A Eucalypt hybrid (*Eucalyptus calophylla* × *E. ficifolia*). *E. calophylla* has white or creamy filaments, and *E. ficifolia* bright scarlet. Plants of a more or less intermediate character, with rose to crimson filaments, are now in cultivation; and these are regarded as hybrids.

QUEENSLAND.

Royal Society of Queensland, May 1.—H. A. **Longman**: The supposed Queensland artiodactyle fossils. In 1886 a series of teeth from post-Pliocene deposits on the Darling Downs, Queensland, was described by the late C. W. De Vis as artiodactyle, under the name of *Prochoerus celer* (Proc. Roy. Soc. Queensland, vol. iii., p. 42). Although the author suggested that the teeth denoted an alliance with the peccaries rather than with the true pigs, his statements were interpreted as evidence of the occurrence in southern Queensland of the Papuan *Sus*. The Darling Downs deposits have yielded such a harvest of marsupial remains (including Diprotodon, Nototherium, Thylacoleo, and extinct kangaroos and wombats) that this supposed exception aroused considerable interest. The results of an examination of the type specimens by Mr. Longman show that the tooth recorded as a lower incisor is identical with the left lower laniary incisor of *Thylacoleo carnifex*; that the upper incisors and paratypes closely correspond with the posterior incisors of Nototheroid marsupials; that the imperfect molar tooth has no affinity with the Papuan pig, and does not present sufficient evidence to warrant its designation as non-marsupial. This molar is of a somewhat similar type to the remarkable large premolar of Macleay's "*Zygomaturus trilobus*," the status of which is in doubt, and which was included by Owen in *Nototherium mitchelli*. The evidence for the presence of fossil artiodactyles in Queensland thus disappears, and a much-discussed question has been settled.

CALCUTTA.

Asiatic Society of Bengal, June 7.—Dr. N. **Annandale**: Zoological results of a tour in the Far East. The tour was undertaken chiefly in order to investigate the lake-fauna of certain districts in Japan, China, and the Malay Peninsula. Three large lakes were visited, namely, Biwa-Ko in the main island of Japan, the Tai Hu or Great Lake in the Kiangsu province of China, and the Talé Sap or Inland Sea of Singgora in the north-east of the Malay Peninsula. The first two of these are inland lakes, whereas the Talé Sap is a lagoon connected with the Gulf of Siam. Full geographical details are reserved for a series of faunistic papers. Twenty-eight species of fresh-water Lamellibranch shells are discussed, belonging to the families Mytilidæ, Arcidæ, Unionidæ, and Cyrenidæ. The species of polyzoa of fresh and brackish water discussed are mostly from China and the Malay Peninsula. Four new Spongillidæ (three species representing Spongilla and one Trochospongilla) were found in the Tai Hu, and three, two of which were already known, in the Talé Sap.

BOOKS RECEIVED.

Indian Forest Records. Vol. v., part 7. (Calcutta: Superintendent, Government Printing.) 2*s*. 3*d*.

Indian Forest Memoirs. Sylviculture Series. Vol. i., part i. Pp. iv+126. (Calcutta: Superintendent, Government Printing.)

English Landscape: An Anthology, compiled by M. Baring. Pp. 122. (London: Oxford University Press.) 1*s*. net

Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Vol. xxxviii. Fasc. 4 and 5. (Genève: Georg et Cie.) 5 and 7 francs respectively.

A Scientific German Reader. By H. Z. Kip. Pp. xii+445. (London: Oxford University Press.) 5*s*. net.

Compendio de Algebra de Abenbéder. By J. A. S. Perez. Pp. xlvii+117. (Madrid: E. Maestre.)

Hitting the Dark Trail: Starshine through Thirty Years of Night. By C. Hawkes. Pp. 191. (London: G. G. Harrap and Co.) 3*s*. 6*d*. net.

The Mentally Defective Child. By Dr. M. Young. Pp. xi+140. (London: H. K. Lewis and Co., Ltd.) 3*s*. 6*d*. net.

Studies in Blood Pressure, Physiological and Clinical. By Dr. G. Oliver. Third edition. Edited by Dr. W. D. Halliburton. Pp. xxiii+240. (London: H. K. Lewis and Co., Ltd.) 7*s*. 6*d*. net.

Department of Mines. Memoirs of the Geological Survey of New South Wales. Geology, No. 7: Geology and Mineral Resources of the Southern Coalfield, with Maps and Sections. Part 1—The South Coastal Portion. By L. F. Harper. Pp. xiii +410+plates xlvi. (Sydney: W. A. Gullick.) 15*s*.

A Critical Revision of the Genus Eucalyptus. By J. H. Maiden. Vol. iii. Parts v. and vi. (Parts xxv. and xxvi. of the complete work.) (Sydney: W. A. Gullick.) 2*s*. 6*d*. each.

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