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Inventions and Unemployment.

FROM the days of the Luddite riots onwards men have felt vaguely that there is some kind of relation between inventions and unemployment. It is a little astonishing, therefore, that at a time when unemployment has become the most pressing of all social problems that that relation should be receiving so little attention from statesmen.

The only systematic attempt to study the economic effect of patents appears to have been that made twenty years ago by Mr. Ravenshear in his little book "The English Patent System". Mr. Ravenshear regarded inventions as ranging between two extreme types, the originative, which creates new demands and so absorbs labour, and the intensive, which cheapens the production of known commodities and tends, subject to certain reservations, to create unemployment. Mr. Ravenshear concluded that the patent system acts selectively by fostering originative inventions to a greater extent than intensive inventions, the output of which is far less dependent on special encouragement of this kind. If his view be correct, the patent system, in so far as it is efficient, tends directly to promote the absorption of unemployed labour. But however that may be, it is certain that if British manufacturers are to compete successfully with foreign rivals, they must have the advantage of a constant succession of inventive improvements, and the present is not a time to tolerate delays or other defects due to parsimony in the administration of the system.

Early last year a number of questions were asked in the House of Commons with regard to the arrears of work which had accumulated at the Patent Office, and some disturbing facts were elicited. It was learned that inventors had to wait seven months before the Patent Office could begin to turn its attention to their applications for patents, that 8400 complete specifications were awaiting the first action of the examiners, that the amount of work to be done annually had increased by 27 per cent while the strength of the examining staff had decreased by 11 per cent, and that this economy, effected at the expense of efficiency, had enabled the Patent Office to hand over to the Treasury no less than £112,939 in one year. This state of things was generally felt to be a very serious one. It often happens that opportunities for exploiting an invention commercially occur but will not wait, and beyond question these opportunities for creating employment are sometimes lost and

often postponed because of the false economies which have been effected in the administration of the patent system of Great Britain.

It might have been supposed that when attention had been directed to this matter the Board of Trade would have dealt with the problem resolutely and effectively. Actually, however, it was content with some such makeshift provisions as would avert the crisis for the moment without in any sense curing the evil. To-day inventors are not conscious of any material improvement, and meanwhile, according to the report for 1929 of the Comptroller-General of Patents, the annual surplus of fees over expenditure has risen to £157,005.

Another instance of the casual attitude of officialdom towards patent matters is to be found in the treatment meted out to the technical staff at the Patent Office. Applicants for important patents are surprised to find, on visiting the examiner whose demands they are required to satisfy, that he works in an overcrowded and badly lighted room, that he and his contemporaries have served for perhaps twenty-five years without hope of promotion, and that the Comptroller and Assistant-Comptroller, who are responsible for a service on which enormous amounts of capital depend, receive (according to the Civil Estimates) emoluments which amount in all to £1686 and £1306 respectively. Scientific knowledge and ability is cheaply valued by the secretariat of the State. Scientific men are being definitely exploited in the interest of a parsimony which wears very awkwardly the disguise of economy.

Some time ago a departmental committee under Sir Charles Sargant was appointed by the Board of Trade to inquire into the demand which has arisen for a general revision of the patent laws. Departmental committees are sometimes appointed with a practical object, and sometimes for use as pigeon-holes. Is there on the Sargant Committee a majority of positive-minded men whose temperaments will lead them to seek for positive solutions of the problems presented to them? Or has the majority been selected from among men of negative temperament, who can be relied upon to make out "an overwhelming case for doing nothing"? Time alone can answer these questions, and until they have been answered no inference in either direction can be drawn from the appointment of the Sargant Committee.

The general attitude of *Messieurs les Ronds-de-Cuir* is indicated by a reply given on Mar. 5, 1929, to a question in the House of Commons with regard to the Patent Office financial surplus. The Board of Trade has retreated from the position taken up in 1891 by Sir Michael Hicks-Beach, who stated (July 14) that "he did not think that the country ought to look to the Patent Office as a permanent source of income". To-day the Board relies on the fact that patent fees are paid by instalments, and that the first instalment, without subsequent renewal fees, does not pay in full for the administrative cost of grant. "Obviously," said its president, "the applicant for a patent who is charged a fee which does not actually cover the amount of work done is not being charged too much."

Thus, the Board of Trade has entirely misconceived the purpose and the constitutional basis of the patent system. The consideration given by an inventor in exchange for his monopoly is, constitutionally, either the disclosure of his invention or the establishment of a new manufacture. The Board, through the mouth of its president, has now recognised officially a third kind of consideration, namely, a money payment to the Crown, and thus has violated flagrantly the spirit, if not the letter, of the Statute of Monopolies, which is one of the bulwarks of English liberty.

No doubt, like Courteline's *Directeur des Dons et Legs*, the Board only asks that its tranquillity be not troubled, and feels "la rage justement exaltée du monsieur qui a fait l'impossible et au delà pour être agréable à tout le monde, qui a semé sans compter l'or des bonnes paroles et des sourires pleins de promesses, et dont une brute malfaisante vient troubler la bonne petite existence reglée au mieux de l'intérêt général"! So that, whatever the nature of the Sargant Committee's report, and pending its issue, one may well ask whether the Board of Trade will not always be content merely to wipe the floor a little, from time to time, when the pot of public indignation boils over, or whether it will some day begin to deal generously with the cause of these ebullitions.

For our guidance in answering this question, we have only a few facts. The most interesting of these is the fact that as a contribution to the £60,000,000 which is to be borrowed from the Exchequer for expenditure in unemployment benefit, the Patent Office surplus is being extracted from struggling patentees by a sacrifice of administrative efficiency which holds up for a year or more the exploitation of those inventions upon which employment in an industrial country directly depends. This appears to be the only relationship between inventions and unemployment which is recognised by the responsible authority.

Race Crossing in Jamaica.

Race Crossing in Jamaica. By C. B. Davenport and Morris Steggerda, in collaboration with F. G. Benedict, Lawrence H. Snyder, Arnold Gesell, Inez Dunkelberger Steggerda and many Residents of the Colony of Jamaica. (Publication No. 395.) Pp. ix+516+29 plates. (Washington, D.C.: Carnegie Institution, 1929.) 7.00 dollars.

IF length of title, weight of names, and number of printed pages can make a great book, this work should certainly be such. An 'abstract' printed at the back of the title tells us that the work is a *quantitative* study of three groups of agricultural Jamaican adults: blacks, whites, and the hybrids between them. Further, that the *variability* of each race and sex in respect to each bodily dimension and many bodily organs is discussed. We are also informed that it appears that mental traits which seem to have a genetic basis vary just as morphological traits do. In some sensory tests the blacks are superior to whites; in some intellectual tests the reverse is found. A portion of the hybrids are mentally inferior to the blacks. The studies embraced in the book are "morphological, physiological, psychological, developmental, and eugenical".

Now it will be seen from what we have cited from this abstract that the book claims to deal quantitatively with the type and *variation* of blacks, whites, and their hybrids. In other words, it is an anthropometric study and must be subjected to the accepted canons of biometric criticism. Let us first endeavour to ascertain the purpose that the numerous investigators concerned in the production of this work set before themselves. It appears to be the comparison of the White with the Negro and of both with the hybrid between them, in as many characteristics as can be conveniently measured. Now in order to do this we must first obtain (i) adequate-sized homogeneous samples of the three classes, and (ii) we must be acquainted with the genetic history of the hybrid. We must know whether he or she belongs to the F_1 or F_2 generation, etc., or whether there have, or have not, been back-crosses. Neither of these conditions appears to us to have been even approximately fulfilled.

The numerous authors, so far as we can judge, have paid no attention to the size of their samples. For the 'adults' the following table of numbers measured will emphasise what we mean:

Race.	Males.	Females.
Blacks . . .	54	51
Browns . . .	93	72
Whites . . .	50	50

Even within these anthropometrically extremely small groups, there is no homogeneity. To begin with, the classification appears to be by skin colour, and is subject to personal equation. Several of the authors are Mendelians and believe in segregation in the F_2 generation. What is to be done, or has been done, with the 'pass-for-whites'? And, if we accept Mendelian segregation, a black-skinned person or a 'pass-for-white' may be respectively as close to the white or as close to the black race as any 'brown'. The fact is that Jamaica with its centuries of racial intermixture is the last place where a study of the relative physical and mental traits of White and Negro can be made. At least 500, better 1000, Europeans of reasonably homogeneous race should have been compared with the same number of West African Negroes. Take, for example, the 50 male 'whites'. Of these, 23 were agricultural workers, the bulk of them coming from Seaford and probably of *German* descent; 19 were able-bodied seamen, said to be 'huge men' of English descent, and 8 were office workers from Kingston. Their ages varied from eighteen to forty. Although whites do not reach their prime for most characters before 25-26 years, no correction is made for age. The 54 male 'blacks' are equally heterogeneous in age, social class, and environment, consisting of small groups of students, cultivators, firemen, candidates for the police force, and prisoners. Such characters as weight and stature are compared for mixed groups like these.

The authors do not hesitate to calculate percentages for one, two, or three individuals. For example, they conclude on material such as this, and after deducting a round 4 lb. for the minimum clothing in which the whites were measured and *not* taking off 0·5 lb. for the residue of the blacks' clothing, that browns and whites have about the same mean weight while "the blacks are much the heaviest, on the average" (p. 49). They may be or may not be, but the present data prove nothing. Deducting the 0·5 lb., the blacks are 145·70 lb. ± 1·69 lb. and the whites 140·30 lb. ± 2·24 lb. The difference is accordingly 5·40 lb. ± 2·98 lb., or it is only 1·8 times its probable error, which cannot be considered of any significance.* On such heterogeneous small

* Weight does not reach its maximum in the white until about forty years. Hence if there were any significant difference between the above numbers of blacks and whites, it would have no racial meaning until correction had been made for the individual ages in the two groups.

populations with resulting high standard deviations and consequently large probable errors, no inference as to differences in type can be safely drawn. Again, with cephalic index, what scientific conclusions can possibly be deduced from a small group of 50 whites admittedly of mixed German and English descents, and from a group of 54 blacks, who if they have no white blood in them—which may well be doubted—may originally have come from many districts of Africa ?

Strong adverse criticism can easily be made of nearly all the anthropometric measurements in the volume, and this not only on account of the race, age, and class heterogeneities of the small samples used, but also on the basis of the descriptions as to how some of the measurements themselves were taken. Consider such a statement as the following:

"With a soft lead pencil, a line was drawn from the base of the orbit to the tragion, which is known as the 'Frankfort Horizontal'. The individual was informed of the importance of this line, and that his head was always to be held in a particular position. The individual was placed in the proper position and asked to remain quiet. Another line was drawn slightly below the glabella, and this represented for this study the nasion" (p. 20).

Anything more obscure it is hard to conceive, and the plates show that the photographs, so far from being standardised, were taken with the head and even the body with every variety of inclination and tilt—they are useless for anthropometric purposes. Even the light has not been studied by the photographer. For example, on Plate 13 two apparently complete blacks (if we are to judge by the colour of face and hands) are seemingly the parents of three thoroughly white daughters—a strong argument, if we could trust the photographs, in favour of Mendelian segregation ! On Plate 27 we are introduced to a boy with a white face and black knees, the son of a brown mother. We have not succeeded in finding any comment on this remarkable photograph. Was the boy piebald ?

When we come to basal metabolism, the author of this section has no hesitation in computing pulse rate, respiration rate, and basal metabolism on *eight* male blacks, and publishes standard deviations and probable errors for this sample of eight !

In discussion of the blood-groups we are suddenly confronted with a sample of 144 Jamaicans (147 in the text, 144 in Table 193, p. 277). We are not told how they were selected nor what proportions of whites, browns, and blacks occur in this number, but the 144 "Jamaicans" are classed with other presumably pure black and brown races. When we come to muscular strength as hand-grip, the numbers dealt with are 12 blacks, 25 browns, and 21 whites. On such numbers standard deviations and probable errors are computed. The results are 43·80 kgm.±1·40 for blacks and 41·96 kgm.±0·84 for whites (p. 274). The difference is 1·84 with a probable error of 1·63. The authors remark that "the blacks and browns exerted more pressure than the whites ; although it is not certan that the difference is significant". It certainly is not, and no such small heterogeneous samples could be expected to give anything significant. The twelve blacks are divided into twelve grades : four of these contain a single black, four two blacks, and four no blacks, and the percentages of these grade frequencies on the total of twelve are then tabled to two places of decimals! The authors seem unaware that the percentage 8·33 of 1 in 12 has a standard error of 8·00 and the percentage of 2 in 12 a standard error of 10·07. In other words, both are wholly unreliable.

In the case of the mental tests, we have exactly the same inadequacy of numbers ; there are, indeed, cases in which only 6 or 7 whites were tested, and the authors do not hesitate to calculate means and standard deviations with their probable errors on such series. A more valuable result, based, however, on *only* 33 cases, is a correlation between skin colour and nasal index* of 0·477±0·091 for blacks. The authors term this "an astounding result" (p. 296) ; presumably because they are thinking in terms of independent Mendelian factors. They remark : "It is possible that one of the factors for brown skin colour may reside in the same chromosome with a factor for broad nose, so that the two tend to be inherited together—are linked. Correlation is, however, not the criterion for linkage." Some persons may prefer to believe that some of the 33 blacks were not pure Negroes, and just as their skin colour had been lightened by European admixture, so their chamærrhinia had been diluted by European leptorrhinia. One of the most remarkable anthropometric processes is that adopted on pp. 257-259 ; no justification appears to be provided for it. Hair colour is divided into five classes—(i) black ; (ii) dark brown ; (iii) medium brown ; (iv) light brown ; (v) flaxen—and immediately below we find the means, standard deviations and probable errors presumably of hair colour. After some puzzling we find out that these

* Unfortunately, the correlation table is not published. It would appear that there were only four categories of skin colour.

had been obtained by using the index numbers of the above classes as the quantitative measure of 'blondness'.* In Table 176 'red hair' (vi) was added in with an intensity of blondness 6, that is, as blonder than 'flaxen'. The average red hair of whites has intensity of pigment granules, which places it among the brown hair group. No scale of melanotic pigment granules would distribute their intensity in black and flaxen hairs in the inverse ratio of 1 to 6.

As the points we have been endeavouring to emphasise in this notice turn on the heterogeneity as to age and race and its effect on 'small samples', we think it well to point out the fallacies which may arise, when arguments are based on such small samples by a final illustration.

We take the author's table for change of stature variability with age.

STANDARD DEVIATIONS OF FEMALE WHITES FOR STATURE AT VARIOUS AGES IN CENTIMETRES.

Age.	Book under Review.		British School Girls.	
	No.	Standard Deviation and its Probable Error.	No.	Standard Deviation and its Probable Error.
5	..	..	894	6·13±0·10
6	..	..	3,104	6·47±0·06
7	5	4·60±0·86	3,828	6·60±0·05
8	9	6·67±1·06	3,928	6·78±0·05
9	8	7·07±1·19	3,819	7·11±0·05
10	6	4·72±0·92	3,762	7·27±0·06
11	10	12·00±1·81	3,518	7·57±0·06
12	16	5·27±0·63	3,658	7·91±0·06
13	15	6·53±0·80	3,225	8·39±0·07
14	9	6·67±1·06	1,229	[7·90±0·11]
15	5	4·00±0·86	..	..
Total	83	..	30,965	..

On the left we have the data for white girls from the present research, and on the right data for adequate numbers of British girls.

We have enclosed the last figures for girls of fourteen years on the right in square brackets because, during the age-year 14 to 15, 2000 of the girls had left school, and the remainder were a relatively stringent selection with lesser variability. Now compare the two variability columns. On the right we see a steadily increasing variability in stature as the girls increase in age. On the left we have an irregularity of variability, absolutely screening by the inadequate numbers in the age classes any discovery of the law so obvious on the right! Yet it is on the basis of such series screening the continuous increase of variability with age that our authors draw the conclusion that: "It is apparent, also that among females, the blacks and browns are more variable than the whites between twelve and fifteen years of age" (p. 379).

The only thing that is apparent in the whole of this lengthy treatise is that the samples are too small and drawn from too heterogeneous a population to provide any trustworthy conclusions at all. There are sound biometricians and anthropologists in the United States, and it would have seemed worth the while of the Carnegie Institution of Washington to have placed the manuscript of this work before them before authorising its publication. We can scarcely believe that even some of those whose names appear on the title-page as an "Advisory Committee" have seen before issue this book with the biometric errors which abound in its pages.

KARL PEARSON.

* Any such order of classification neglects the existence of *two* fundamental hair pigments.

Strong and Weak Electrolytes.

The Conductivity of Solutions and the Modern Dissociation Theory. By Cecil W. Davies. Pp. viii + 204. (London: Chapman and Hall, Ltd., 1930.) 15*s*. net.

THE theory of reversible ionisation, advanced by Arrhenius in 1887, owed its widespread acceptance to the fallacy that the degree of dissociation of a salt can be calculated independently from the conductivity and the osmotic properties of its solutions. In more recent years the concordance between the values deduced in these two ways has been denounced on the grounds that it has no sound theoretical basis and that the numbers cited by Ostwald and others do not in fact provide the experimental justification that was claimed for them in the days when the study of dilute solutions was heralded as the birth of a new science of physical chemistry.

Although tentative attacks on Arrhenius's theory had been made in pre-War days by Sutherland and by Milner, the detonation of the charge was delayed by the distracting influences of the War-period, and the apparently final shattering of the theory did not take place until 1923, when Debye and Hückel showed how the waning conductivity of strong electrolytes with decreasing dilution could be explained by changes in the mobility of the ions instead of in their number. Their formula had the merit of providing a theoretical foundation for the experimental law, discovered by Kohlrausch in 1900, that the fall in equivalent conductivity is proportional to the square root of the concentration, $\Lambda_0 - \Lambda_c = b\sqrt{c}$, so that a straight line is obtained by plotting Λ against $\sqrt{c}$. This relation, which

was illustrated by Hartley in NATURE of Feb. 26, 1927, p. 322, had not hitherto received the theoretical justification which Kohlrausch had anticipated, and its interpretation by Debye and Hückel in terms of well-established phenomena was at least as important as the discovery of Ostwald's dilution law for weak electrolytes such as acetic acid. Consequently, in spite of the fact that the predicted slopes of the lines were quite different from those found experimentally, the theory of complete ionisation was received with the same enthusiasm which had been accorded thirty-six years before to the theory of reversible ionisation.

The general acceptance of the new theory (which was obviously in harmony with the ionic structure assigned by X-ray analysis to the majority of crystalline salts) was a noteworthy feature of the general discussion on strong electrolytes held at Oxford in April 1927 under the auspices of the Faraday Society (see NATURE, May 7, 1927, p. 676). On that occasion, indeed, the main obstacle to its general acceptance was removed by Onsager's development of a formula, in which, by allowing for the effects of molecular bombardment as manifested in the Brownian movement, the slope of the lines referred to above was increased to a point at which it appeared to correspond closely with that which is actually observed in solutions, provided that these are sufficiently dilute.

So recently as three years ago, then, it was possible to suppose that salts which crystallise in ionic aggregates are not merely ionised completely in solution, but also are dissociated almost completely into free ions, since calculation indicated that the proportion of ionic doublets was almost negligible. This position, however, is no longer tenable in view of the experimental work done by A. R. Martin and others, since it must now be admitted that, when the Debye-Hückel-Onsager correction for electrostriction has been applied to the mobilities of the ions, the resulting ionic concentrations are not 100 per cent except at extreme dilution, and that (especially in non-aqueous solutions) there is still a diminishing of equivalent conductivity with decreasing dilution which must be explained by decreasing dissociation of the molecules (or ionic aggregates) of the solute, and which appears to apply to Kirch Ostwald's dilution law just as well as it does to weak acids and bases. The time is thoroughly ripe for a further review of the situation, perhaps under form of a general discussion on weak electrolytes, at which the impression created at the previous Oxford discussion could be corrected, and brought to date.

From this point of view the appearance of Mr. Davies's book is very opportune. During recent years, the authors of a number of books on physical chemistry were in the unfortunate position of being afraid to scrap the deductions made by applying the law of mass action to electrolytes, but were forced to admit (usually in a separate chapter!) that the theory of electrostriction had made these calculations both obsolete and irrelevant. It was, therefore, possible to claim as a novelty a treatment of the subject in which the existence of reversible ionisation was admitted as freely as that of non-reversible ionisation. This contention, which is rapidly becoming quite orthodox, is the fundamental creed of Mr. Davies's book, since he admits that "two types of electrolytes will be looked for", and after citing the evidence in support of Onsager's equation, goes on to say that "there is every indication that in solvents of low dielectric constant no salts are completely dissociated at attainable dilutions".

This dual aspect of the phenomena makes the conductivity of solutions a more complex problem than it was when Kohlrausch wrote his "Leitvermögen", since the activities as well as the concentrations of the ions must be taken into account when calculating such apparently simple quantities as the solvent-correction in dilute solutions or the limiting values of the ionic mobilities, as well as when trying to deduce the coefficient of ionisation or the equivalent conductivity of solutions of finite dilution. These problems are treated, perhaps for the first time in a systematic manner, in Mr. Davies's work, and it can be asserted that no worker who undertakes research in this field will feel quite safe in his deductions unless he has weighed up the considerations which are here advanced. For this reason, the book can be commended heartily to the specialist as well as to the general student of chemistry, since both will find in it facts and deductions which are too important to be overlooked.

T. M. LOWRY.

Science in Soviet Russia.

Science in Soviet Russia. By J. G. Crowther. Pp. 128+13 plates. (London: Williams and Norgate, Ltd., 1930.) 7*s*. 6*d*. net.

MR. CROWTHER is one of the few English men of science who have ventured into Russia in recent years. He was impressed by the extent of the researches projected and prosecuted in the various institutes which he visited. It appears that the study of the different branches

of science have been placed in contact with the social institutions to which they are naturally related. Thus, all bodies concerned with applied botany are controlled by the State Department of Agriculture. The thousand workers at botany work to one planned scheme. Unnecessary overlapping has been reduced by centralisation. Institutions conducting researches of industrial value receive their endowments from the Supreme Economic Council and they work in contact with the industry upon which the research directly bears.

With regard to emoluments it would appear that men of science are among the better paid workers and their conditions are still improving. Engineers are the best paid and the highest salary quoted is £3500 per annum. Nevertheless, even the lesser paid research workers concentrate upon their tasks and attain a high degree of skill and efficiency. There is still a shortage of trained investigators, especially in physics and engineering, and the author suggests that there is scope for young English graduates to gain valuable experience in posts available in the Soviet's numerous electrical works which are in course of construction and extension.

Among the work in progress Mr. Crowther mentions the speeding-up of tobacco fermentation, the isolation of sulphur from the dioxide obtained in roasting copper ores, the synthesis and preparation of drugs hitherto imported from abroad, petroleum refining, and improved technique in the preservation of wood. Apparently investigations of a purely academic nature are not countenanced, although the term 'applied science' is being interpreted very broadly. At the moment large electro-technical developments are being made as a part of the five years' industrialisation plan. Power plants and technical factories are being erected all over the Union, and it would seem that Russia is making notable contributions to the progress and development of science. Russia is a vast country with well above a hundred million inhabitants, and although Mr. Crowther has seen many scientific institutes in the two chief centres, Leningrad and Moscow, his tour was restricted to less than four weeks. Furthermore, without a knowledge of Russian he was dependent on his interpreters, so that the value of his impressions is limited. Nevertheless, the information concerning the condition of Russian men of science and the progress of their researches is at least of interest to their colleagues in the rest of the world.

J. G. F. D.

Our Bookshelf.

Trattato di chimica generale ed applicata all' industria. Per Prof. Ettore Molinari. Vol. 2: *Chimica organica.* Parte seconda. Quarta edizione riveduta ed ampliata. Pp. xvi+661-1567. (Milano: Ulrico Hoepli, 1930.) 80 lire.

THE death of Molinari nearly four years ago doubtless accounts for the delay in the completion of the new edition of his "Organic Chemistry", the first part of which appeared in 1927. The alterations necessary to bring the contents of this second part up-to-date are due to the author's three sons, working in conjunction with Profs. Bargellini and Contardi. The subjects dealt with in the present volume comprise oils, fats, and waxes, carbohydrates, ring compounds, textile fibres, and proteins. The general scheme of the book, with its inclusion of numerous data regarding production, importation and exportation of raw materials and manufactured products, must by this time be generally known to chemists. The only new feature requiring comment is the insertion of large-scale flow sheets of an olive-oil refinery and of a sugar factory. Similar sheets for other processes might with advantage be given in any future edition.

The volume now published contains 860 pages of text, much of it of small type, but in view of the multiplicity of subjects treated—some quite foreign to the ordinary text-book of pure, or even of applied, organic chemistry—certain of these are necessarily dealt with all too briefly. Thus, vitamins are dismissed in less than two pages, and although the general characteristics of these substances are indicated, important recent results in this field are entirely omitted.

The full index supplied covers the two parts of the "Organic Chemistry", and the price of the whole work amounts to 125 lire, which is modest enough. The book is one which may be recommended to all engaged in chemical industry.

The Use of Iodine and its Compounds in Veterinary Practice. By Lieut.-Col. H. A. Reid. Pp. 88. (London: De Gruchy and Co., Ltd., 1929.) 3*s.* 6*d.*

ALTHOUGH the essential rôle played by minerals in animal metabolism has been recognised for many years, it is only recently that the importance of iodine in the diet has been stressed. The requirement of animals for iodine compounds is only small; nevertheless, a deficiency of such compounds in the diet may lead to acute pathological conditions in animals and human beings. Iodine deficiency, for example, has been shown to be the fundamental cause of goitre, an ailment which is especially prevalent in districts where the soil and water are notably deficient in iodides. Such iodine-deficient conditions are found in parts of the northern half of the United States, in which localities it is now customary to iodise the public water supplies or to insist on the use of iodised table salt.

In the book under review, Col. Reid has gathered

together, in very readable form, the conclusions which have been drawn from numerous investigations into the functions of iodine in maintaining health in animals. The use of iodine, and various compounds of this element, for antiseptic purposes is first dealt with. The author then proceeds to discuss the diseases of iodine deficiency, showing how these diseases are amenable to treatment by iodine and its compounds. Further sections deal with the influence of iodides in nutrition and on growth and reproduction. Mention should also be made of the useful bibliography at the end of the volume. Col. Reid's book should be read by all, whether scientific workers or laymen, who are interested in health problems and the future virility of the race.

An Introduction to Physical Anthropology. By E. P. Stibbe. Pp. vii + 199. (London: Edward Arnold and Co., 1930.) 12*s.* 6*d.* net.

ANYONE conversant with the needs of those entering upon a course of anthropological study will be aware of the difficulty in finding a satisfactory text-book in physical anthropology. Not that there are no text-books in existence; but they are for the most part too detailed for the beginner and recent advances have made them out-of-date. Dr. Stibbe's "Introduction to Physical Anthropology" meets the need admirably. It deals with its subject matter under the heads zoological, palæontological, and ethnological. In the first we are introduced to the methods and findings of comparative morphology; in the second, the palæontologist, geologist, and archæologist are called to the assistance of the anatomist in elucidating the origin, evolution, and antiquity of man; and in the third, racial characters and distribution are considered. Useful instructions for practical work and a glossary of technical terms complete a volume which should fulfil all the requirements of a beginner in anthropological studies, so far as this is possible in a text-book; for one of the most useful features in Dr. Stibbe's book is his insistence on the necessity for handling specimens in a laboratory and for constant practice in measuring the living. The arrangement of the text in the zoological section in which man and the apes are compared in detail will be found most helpful. The author himself would be the first to agree how much his text-book owes to the teaching of Prof. Elliot Smith, and perhaps its greatest merit is the way in which it leads the student inevitably to an intelligent appreciation of Elliot Smith's eminent services to anthropology.

Cours de chimie-physique. Par Prof. L. Gay. Tome 1. Pp. xii + 705. (Paris: Hermann et Cie, 1930.) 85 francs.

THIS volume is the first of a series of three, of which the first two are to be devoted to thermodynamics and the third to classical physical chemistry (electricity and magnetism, colloids, chemical kinetics, catalysis, radiant energy, and photochemistry). The modern and controversial questions of radioactivity, atomic and molecular structure, and the classification of the elements, are reserved for treatment in a later work. The first part of the present volume, covering nine chapters and 220 pages, is devoted to pure thermodynamics and thermochemistry. The second part, covering six chapters and 160 pages, unites rather ingeniously the study of the dilute gaseous state and of the crystalline state. The third part (three chapters and about 100 pages), dealing with osmosis and the phase rule, may be regarded as an introduction to the study of solutions, whilst the fourth part (five chapters and about 160 pages) is devoted to the study of pure substances, including the questions of continuity of state, the Brownian movement, and allotropy. An appendix of about 40 pages is devoted to problems, mainly of an industrial type, for which solutions as well as answers are given, and these may very well prove to be one of the most valuable features of the book.

Antarctic Adventure and Research. By Prof. Griffith Taylor. (Appleton New World of Science Series.) Pp. xi + 245. (New York and London: D. Appleton and Co., 1930.) 6*s.* net.

THERE are few general volumes on polar regions that deal with the scientific problems rather than with the adventure of exploration. This makes Prof. Taylor's volume welcome. As the title indicates, the adventure is not neglected, for about a third of the book treats of the history of Antarctic exploration. The remainder treats of scientific aspects. Prof. Taylor devotes most attention to the Ross Sea area with which he has personal acquaintance, and his predilection for physiography leads him to devote most space to several excellent chapters on topography, scenery, and ice. The biology receives less attention and the chapter on whaling is very brief. There are many graphic diagrams by the author and a useful bibliography, which might, however, be enlarged by more references to the Graham Land area and the Weddell Sea. The book makes no attempt to treat the islands of the Southern Ocean, but for a brief general account of the Antarctic it can be recommended.

Practical Chemistry: for Advanced Students. By Arthur Sutcliffe. Pp. vii + 216. (London: John Murray, 1930.) 4*s.* 6*d.*

MR. SUTCLIFFE'S book is suitable for pupils preparing for higher school certificate and similar examinations. Elementary experiments are not described and much detail concerning manipulation has been omitted, since students of this standard will not require it. The course covers qualitative and quantitative analysis, inorganic and organic preparations, and some simple exercises in physical chemistry. The directions for the preparations are clear and adequate, and the section on qualitative analysis contains all the equations for the reactions and explanatory notes. The course is well planned and the book should prove successful in schools where work of this standard is done.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Ionisation Potential of Radon.

WE have determined the ionisation potential of radon, using the well-known method,[1] due to Hertz, of compensation of the negative space-charge by positive ions formed by accelerated electrons from a subsidiary cathode. This cathode was an equipotential one and differed only in slight details from that

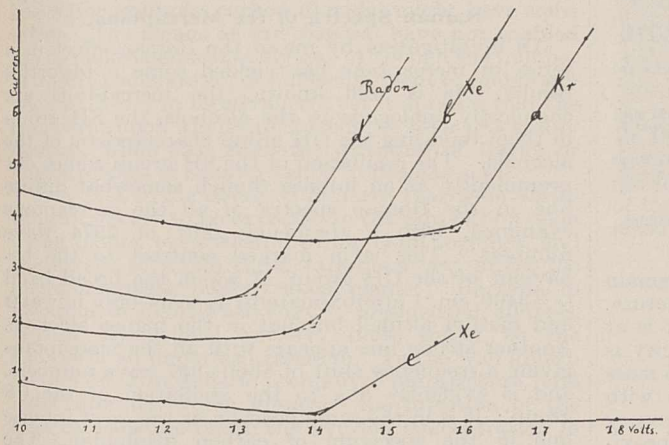

FIG. 1.

described by Hertz and Kloppers.[2] In the original apparatus of Hertz the accelerating grid forms a part of a box which receives the space-limited current from the chief cathode. We have modified this arrangement by introducing a separate accelerating grid which enabled us to measure directly the useful part of the subsidiary emission, that is, the number of electrons penetrating into the box. The contact potential correction of the apparatus was determined by calibrating it with pure xenon and krypton: it was found to be 2·6 volts.

The quantity of radon used in different experiments was of the order of 300 millicuries. The volume of the apparatus with auxiliary parts being equal to about 250 c.c., the calculated pressure of radon was of the order of 0·8 bar, and one might think at first that the method would not be sensitive enough for such small quantities of gas. Preliminary experiments have shown, however, that it is quite easy to determine the ionisation potential of xenon when present at a pressure of 1 bar, and the sensitiveness of the method increases in a marked way with the atomic weight of the rare gas used for investigation. It ought also to be mentioned that at such low pressures the number of ions produced by the α-rays is negligibly small compared to the number of electrons involved in the experiment, so that radon can be treated as any other inactive gas.

Another important point was to make sure that the possible impurities of radon would not mask the appearance of discontinuities due to this gas.

We performed, therefore, a set of measurements in which special stress was laid on the purification of radon but not on the exact determination of the critical potential. The method of purification was the same as that previously described by one of us.[3] These experiments put beyond doubt the existence of an ionisation potential due to radon. This potential, in agreement with theoretical expectation, was found to be somewhat lower than that of xenon and therefore of any other permanent gas.

This circumstance facilitates essentially the work with radon. The only impurity which really matters is mercury vapour. Therefore in the final experiments we did not aim at a complete purification of radon, but used a trap kept in a bath at $-120°$, in order to get rid of the mercury vapour and a tube with caustic potash for absorbing carbon dioxide. The other details of the arrangement will be given in a later publication.

Curves obtained in the final experiments are shown in Fig. 1. In order to make the method more sensitive, the electronic current was nearly balanced against a steady current given by a potentiometer. On the curves the difference between the two currents is plotted against the accelerating potential of the subsidiary electrons. Curve *a* refers to krypton at a pressure of 7·2 bars, curve *b* to xenon at a pressure of 15 bars, curve *c* to xenon at a pressure of 1·3 bars, curve *d* to 250 millicuries of radon. The values of the ionisation potential of these gases corrected for the contact potential are 13·3, 11·4, and 10·6 volts respectively. The last value, that of radon, is in good agreement with the value 10·7 volts deduced recently by Rasmussen[4] from an investigation of the spectrum of radon.

F. HOLWECK.
L. WERTENSTEIN.

Radiological Laboratory,
Scientific Society of Warsaw,
Aug. 5.

[1] Hertz, *Zeit. f. Phys.*, **18**, 307; 1923.
[2] Hertz and Kloppers, *Zeit. f. Phys.*, **31**, 463; 1925.
[3] Wertenstein, *Phil. Mag.*, **6**, 17; 1928.
[4] Rasmussen, *Zeit. f. Phys.*, **62**, 494; 1930.

Fine Structure in the Singlet Series of Mercury.

UP to the present no fine structure has been observed in the singlet series of mercury. In a recent communication to the Physical Society of London (*Proceedings*, August 1930) a description was given of the spectrum of mercury excited at low pressures by a high frequency electrodeless discharge. Amongst other effects it was found that the singlet series and intercombination lines due to transitions beginning on singlet levels, were strongly enhanced relative to the triplets. The line $6^1P_1 - 8^1S_0$ was examined for fine structure with a Fabry-Perot interferometer and found to be single and so narrow (half width $< 0{\cdot}004$ A.) as to render it of great value in interferometric work.

As a result of recent improvements in experimental conditions, three new components have been detected, one faint and two very faint, the intervals being approximately:

$$-0{\cdot}012 \qquad 0 \qquad +0{\cdot}009 \qquad +0{\cdot}031 \text{ A.}$$

Since these only appear when the main line is heavily overexposed, they have practically no effect on the visibility of the fringes when normal exposures are used, and therefore should not detract from the usefulness of the line as a source. The next member of the same series $6^1P_1 - 9^1S_0$ is also complex.

Many other strengthened lines involving singlet levels show a complex structure; for example,

$$7^1S_0 - 8^1P_1,\ 7^1S_0 - 9^1P_1,\ 7^3S_1 - 8^1P_1,\ 7^3S_1 - 9^1P_1.$$

Three of the lines are shown in Fig. 1, including the unclassified line λ6123·78, the plate separation being chosen to show the widths of the multiplets before overlapping of orders occurs. The intervals between adjacent orders are marked, giving an indication of the separations. The closer components are completely separated for bigger gaps. The structure is not due to reversal, since it remains the same when viewing end-on through depths of vapour varying from 2 mm. to 50 cm.

The two members of the series $6^1S_0 - m^1P_1$ have a sextet structure, thus indicating that both initial and final levels are multiple since the maximum number of possible components when one level is single, is three, assuming the usual selection principle to hold.

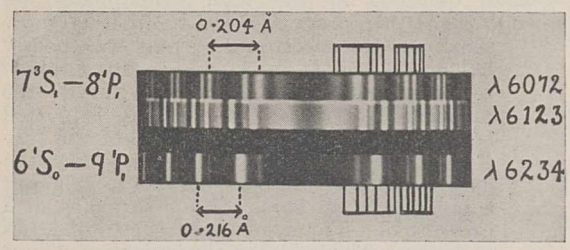

FIG. 1.—Fine structure in mercury spectrum. Fabry-Perot fringes, plate separation 9 mm.

As the final level is a $^1S_0$ level ($j = 0$) it ought to remain single, if nuclear spin is the cause of the fine structure. However, the observed structure shows that it is at least double. It is possible that this multiplicity is due to an isotope effect. This is not the simple mass isotope effect (variation in Rydberg constant with mass) as recently observed in neon, for in mercury this would give maximum separations of approximately 0·00001 A., which is very much smaller than that observed. Schüller and Brück (*Zeit. für Phys.*, **56**, 291 ; 1929) conclude that in a mixture of isotopes, only those with odd atomic weight possess nuclear spin. Assuming this true in mercury, then two $^1S_0$ levels will result, with f value $0 + 0 = 0$ for even atomic weights and $0 + i = i$ for odd. If i has more than one value, the level becomes still more complex. A detailed analysis of the observed fine structure will be published shortly. The intensity ratios of the components are also being investigated.

S. TOLANSKY.

Physics Dept., Armstrong College
(University of Durham),
Newcastle-upon-Tyne,
Aug. 11.

Spectra of Doubly and Trebly Ionised Thallium.

CONTINUING our previous work on Tl II and Pb III, the spectra of Tl III and Tl IV have been under examination by us for some time past. A preliminary attempt, by the application of the X-ray doublet-laws, revealed a number of regularities consisting of mainly the regular doublet terms. As a result of further attempts, it has now been possible to identify the inverted ^2D term ($5d^96s^2$) and the quartet terms of ($5d^96s6p$) and ($5d^96s6d$) configurations. The starting point for the discovery of the inverted ^2D term was given by the identification of ν 76150, 81834, and 100452 as $6s'^2D - 7p^2P$. The super multiplet accompanying the electron transition $6p' \rightarrow 6d'$ contains about forty lines in the ultra-violet. A few combinations due to transitions $6p \rightarrow 7s$ have also been established. The ($5d^96s^2$) ^2D term interval is found to be 18618. The combinations that could not be identified are either very faint or out of range.

Thallium IV: The spectrum of trebly ionised thallium was recently studied by K. R. Rao, by Pattabhiramayya, and by J. E. Mack, who have all identified the triplets due to the combinations of $6s^3D$ and ^1D with $6p^3PFD$ and ^1FPD. As a result of attempts by one of us, it has been found possible to extend the analysis and identify the super multiplet due to the combination of $6p^3PFD$ with $7s^3D$ and ^1D.

In both these spectra the line intensities, term differences, and interval ratios are of the right order expected. A complete report will be published shortly elsewhere.

A. L. NARAYAN.
P. PATTABHI.
A. S. RAO.

Kodaikanal Observatory,
India, June 25.

Raman Spectra of the Mercaptans.

AN investigation by me of the Raman effect in a series of mercaptans has yielded some noteworthy results. As is well known, the mercaptans are chemically analogous to the alcohols, the SH group in them replacing the OH group characteristic of the alcohols. The oscillation of the SH group comes out prominently as an intense though somewhat diffuse line in the Raman spectra of all the mercaptans examined, with a frequency shift of 2574 wave numbers. This is in marked contrast to the behaviour of the OH group, of which the broad band ($\nu = 3400$ cm.$^{-1}$ approximately) appears only in water and methyl alcohol but not in the higher alcohols. Another strong line appears with all the mercaptans giving a frequency shift of about 657 wave numbers, and is evidently due to the oscillation of the CS group ; it is in the same position as the most intense line in the spectrum of carbon disulphide. The analogous oscillation of the CO group with a frequency of about 1050 wave numbers appears strongly in methyl alcohol but only very weakly in the higher alcohols.

These differences in the behaviour of the SH and OH groups are sufficiently remarkable. Another notable feature is the unusual width and diffuseness of the lines ascribable to the oscillations of the carbon chain in the mercaptans. This character is presumably referable to the influence of the sulphur atom on these oscillations.

S. VENKATESWARAN.

210 Bowbazar Street,
Calcutta, July 12.

Hydrion Concentration of Rain and Potable Water.

FOR a study of the hydrion concentration of rain water New Milton appears to offer certain advantages. It is a small town equidistant between the Channel and the New Forest, about ten miles east of Bournemouth and seventeen miles south-west of Southampton, and it has the reputation of enjoying particularly pure and fresh air. For the past year and a half the hydrion concentration (pH) of the rain has been recorded together with the general direction of the wind, these observations having been made with the view to their possible value as part of the general problem of the influence of meteorological conditions upon plant diseases.

Indicators supplied by British Drug Houses, Ltd., were used to test the pH of rain collected from various plants and from two collectors about nine inches in diameter.

The pH of the water obtained from the collectors and from the plants varied between 5·5 and 7·6, with practically all intermediate values. The readings taken simultaneously from the collectors and from the

plants were sometimes identical and at other times very different values were obtained. The same remark applies to a comparison of the unboiled (*U.B.*) and the boiled (*B.*) water from the different sources. A few typical examples may be cited.

Date.	Wind.	Collector 1.		Collector 2.		Plant 1.		Plant 2.	
		U.B.	*B.*	*U.B.*	*B.*	*U.B.*	*B.*	*U.B.*	*B.*
Jan. 11	W.	7·2	7·2	7·2	7·2	7·2	7·2	7·2	7·2
Jan. 21	E.	5·0	5·0	5·0	5·0	6·4	6·4	6·0	6·6
Jan. 27	N.	5·2	5·2	6·2	7·0	5·2	5·2	6·2	5·2
Feb. 5	N.	6·0	6·0	6·0	6·0	7·0	7·4	6·0	6·0
Mar. 5	S.E.	5·2	5·0	5·0	5·0	6·2	6·4	6·0	6·0
May 13	W.	5·8	6·8	5·8	6·4	6·6	7·0		
June 22	S.W.	7·4	7·4	6·6	6·8	7·4	7·4	6·4	6·0

It is difficult to interpret the capricious variations obtained; possibly extraneous matter and dissolved gases (for example, carbon dioxide) might have some effect. The means at my disposal have not enabled me to make chemical analyses. Although the number of observations are not of sufficient extent to enable any general theory to be advanced, yet it appears that the rain borne upon winds direct from the sea is practically neutral, while that from the direction of towns or long stretches of country tends to become acid.

The data so far obtained indicate that wide variations in *p*H are to be expected in the rain falling upon living plants, even when growing close together, and the extent to which these variations may affect the micro-organisms present upon plants ("Bacteria in Relation to Plant Pathology", presidential address, British Mycological Society, 1909) might be the subject of an important research. To the well-known factors of atmospheric humidity, temperature, and light intensity which influence the infection of the host by parasitic fungi, the hydrion concentration of the surface moisture upon the plant may require to be added. This problem of the influence of the *p*H of a medium upon the germination of fungus spores is being made the subject of investigation by Mr. A. W. Bartlett, at Newcastle-upon-Tyne.

The hydrion concentration of potable water was tested by samples taken from various parts of England. The extreme readings were *p*H 5·0 and 9·0, the former obtained from wells which give good potable water, the latter from house pipe supply. Intermediate gradations were recorded in both these sources of supply, but good well water generally indicated more acidity than that from a pipe supply.

Often a great difference of *p*H is found between the unboiled and boiled samples from the same source. The pipe supply from one company varied from 6·8 to 8·2, while the boiled sample was practically always uniform at 9·0. It was found that an unboiled sample, as drawn from the tap, registered 7·4 but after standing some hours (protected from dust) it registered 9·0. It is of some interest to note that when breath was blown through the latter the original determination was restored. This fact is an indication that the hydrion concentration of a pipe supply may be affected by the carbon dioxide dissolved in the water. Thus, water from the same supply drawn directly from the tap or from an open cistern might have very different properties. Possibly the *p*H of a water under pressure in pipes might be a favourable medium for certain bacteria, while the same water after exposure to the air might be inimical to their activity.

While filtration has been shown to be of the highest importance in removing micro-organisms from water, the suggestion may be offered that the hydrion concentration should also be considered as a limiting factor for their growth.

M. C. POTTER.

Corley Croft, New Milton, Hants,
Aug. 16.

Animal Plasticity and Environment.

WHILE recently making a zoological collection in the Sevoke River in the Teesta Valley at the base of the Darjiling Himalayas, I observed remarkable differences between the individuals of a Cobitid fish, *Acanthophthalmus pangia* (H. B.), collected from two diverse 'niches' in the same habitat. In Fig. 1 are shown the two types of individuals. The chief difference, which is readily noticeable in the two drawings, is that in the lower drawing the ventral fins are present, while in the upper these structures are totally absent. There are also other differences of a minor nature; for example, the extent of the nasal flap and the form of the caudal fin. Two specimens * possessing ventral fins were obtained from among pebbles and shingle in a swift current, whereas 18 examples devoid of ventral fins were netted from among debris at the bottom of pools in the course of the stream.

It seems to me very likely that the structural differences in the specimens are correlated with the two types of environment in which the fish lives. If this be so, a very interesting taxonomic problem arises. In 1860, Blyth [1] established the genus *Apua* on two specimens which he distinguished from *Pangio* (=*Acanthophthalmus*) primarily by the total absence of the ventral fins. Both Günther [2] and Day [3] recognised Blyth's genus, and evidently regarded the

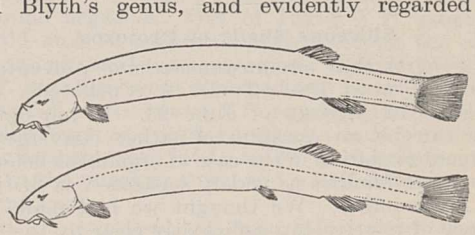

FIG. 1.—*Acanthophthalmus pangia*, ×1½.

absence of ventrals as a character of generic importance. Vinciguerra [4] considered *Apua* a synonym of *Acanthophthalmus*, and remarked that in the unique specimens of the former genus the ventrals must have been either overlooked or accidentally lost. In 1921, I published a note [5] on the occasional absence of paired fins in fishes and pointed out that *Apua* cannot stand distinct from *Acanthophthalmus*, and that the two specimens should be considered as abnormal so far as the absence of the ventrals is concerned.

Now arises the chief point for consideration. In view of the discovery of so many as eighteen examples from a specific habitat of *Acanthophthalmus pangia* without the ventral fins, what is the systematic position of *Apua*? Is *Apua* to be regarded as a distinct genus or should the specimens without the ventrals be considered as a 'habitat-variety' of *Acanthophthalmus pangia*? I am personally inclined to the latter view, and feel no justification in regarding the two kinds of individuals as separate species. As to the factors in the environment responsible for the loss of the ventrals, it is not possible to say much in the present state of our knowledge regarding animal ecology. It is probable, however, that the ventrals are an encumbrance for life among debris and are, therefore, suppressed. If this be so, then this case will be parallel to certain Chironomid and Trichopterous larvæ [6] that do not form their tubes or discard them when living in submerged debris. Some workers attribute the absence of the ventral fins in *Channa*, another genus of apodal fishes, to the habits of these fishes, but how far this is true I am unable to say at present.

* Special efforts were not made to obtain specimens possessing the ventral fins, as they are present in large number in the collection of the Zoological Survey of India.

The example cited above raises several important questions. Do these 'habitat-varieties' interbreed? If so, what is their progeny like? If not, then physiologically they are distinct species, though morphologically they are so similar. It is probable that after a freshet there is a mixing up of animals living in different habitats in a stream, and that on such occasions these two 'habitat-varieties' might interbreed. It is also known that torrential animals resort to slow waters (either in pools and puddles in the course of the stream or near the banks), and thus probably different 'habitat-varieties' come together at the time of breeding. If the progeny of these fishes include both types of individuals, how do they become segregated into their respective habitats? If, on the other hand, the progeny are alike, do some of them lose their fins after segregation into different habitats?

SUNDER LAL HORA.

Zoological Survey of India,
Indian Museum, Calcutta,
July 14.

[1] Blyth, *Jour. As. Soc. Bengal*, **29**, p. 169.
[2] Günther, *Cat. Fish. Brit. Mus.*, **7**, p. 371; 1868.
[3] Day, *Fish. India*, p. 611, pl. clv. fig. 6; 1878.
[4] Vinciguerra, *Ann. Mus. Civ. Stor. Nat. Genova*, **29**, p. 220; 1890.
[5] Hora, *Rec. Ind. Mus.*, **22**, p. 31; 1921.
[6] Hora, *Phil. Trans. Roy. Soc. London* (B), **218**, p. 265; 1930.

Siliceous Shells of Protozoa.

WE regret that circumstances have prevented an earlier reply to Prof. T. D. A. Cockerell's letter published in NATURE of June 28. In our opinion, there can be no question of either convergent or divergent evolution in the case of organisms belonging to separate families as widely separated as *Miliolina* and *Miliammina*. We thought we had made their absence of relationship sufficiently clear by the statement that *Miliammina* was a siliceous isomorph of *Miliolina*, isomorphism being understood among rhizopodists, at any rate, to mean the development of similar structures in unrelated organisms owing to unknown physical or biological conditions.

Even the American school of rhizopodists, who are so addicted to the construction of more or less imaginary 'family trees', would hesitate before suggesting a common ancestor for the two genera. At any rate we should have to go a very long way back, and probably to a theoretical non-testaceous reticularian, to find an organism capable of evolution into such widely differentiated structures, for the porcellanous Miliolidæ have existed since Carboniferous times, and *Silicosigmoilina*, a close relative of *Miliammina*, occurs in the upper Cretaceous.

The difference in the shell structures of the two genera is fundamental. The Milioline shell is normally smooth and porcellanous, but there are many species which habitually incorporate mineral particles to a greater or less extent in the outer coating of their porcellanous tests. Such a Milioline test consists of three distinct layers:

(1) an inner chitinous membrane surrounding the protoplasm;

(2) the normal porcellanous test formed of $CaCO_3$, and

(3) the outer siliceous coating.

The application of even a very weak solution of hydrochloric acid is sufficient to dissolve the middle calcareous layer, and the test is resolved into a little mud in which the chitinous membrane may be detected.

In the tests of the Silicininæ, however, there are but two layers, chitinous and sandy. Immersion in strong acid produces little or no effect.

Chapman evidently regarded his specimens from their external form as *Miliolina oblonga* (Montagu), and, very reasonably assuming that it was a local variety which had assumed the agglutinating habit (not previously recorded in *M. oblonga*), added var. *arenacea*. The fact remains that in the absence of chemical tests they were regarded by him, and by ourselves and others afterwards, as *Miliolina oblonga*, and we maintain that in removing his specimens to a different genus and family, we acted more correctly in conveying the specific name rather than a varietal name, which then became tautological and applicable indifferently to any of the species in the new genus.

We do not attach a great deal of importance to Prof. Cockerell's designation of *Miliammina arenacea* (Chapman) as the type species, but we regret that he should not have communicated with us before publication. Had he done so he would have learned that further investigations since the paper was written had shown that the distribution of Chapman's form was somewhat distinctive, and that it was intended to raise it to specific rank in the *Discovery* Report now in course of preparation. In that report it will appear as *Miliammina arenacea* (Chapman), while the much commoner and more widely distributed species, which is the true genotype, will become *Miliammina oblonga*, H. A. and E. (*non* Chapman).

EDWARD HERON-ALLEN.
A. EARLAND.

Discovery Investigations,
c/o British Museum (Natural History),
Aug. 27.

Transition of Kinetic into Vibrational Energy by Collisions with Particles.

IN the work of Leipunsky and one of us[1] it was shown that dissociation of hydrogen molecules by collision with positive potassium, sodium, and lithium ions occurs only with such energies of the ions that the part of their energy transmitted (according to the energy and momentum law) to the hydrogen molecule is not 4·3 volt (dissociation energy), but 12·4 volt (exciting energy).

Recently one of us has repeated this experiment, using a Pirani gauge, which increased the sensitivity of the method tenfold. The result obtained was the same as that mentioned above. According to the usual point of view, dissociation by collision with a massive particle is a result of transition of kinetic energy into vibrational energy of the atoms of which the molecule consists.

We are thus forced, by the results of the above-mentioned work, to admit that such an energy transition occurs, if at all, very seldom. It seems that the inverse process, recombination of hydrogen atoms by a triple collision, also occurs, not indeed at every collision, as well as recombination of bromine atoms, which is, by the by, effected by the addition of nitrogen and oxygen (diatomic molecules, which can receive vibrational energy), and not effected by helium and argon. It follows, therefore, that the transition of vibrational into kinetic energy also is not a process which proceeds readily.

To prove the correctness of the assumption that molecules dissociate by collisions with ions only when previously excited, we have tried to get dissociation of nitrogen by collision with positive ions. The exciting potential and the dissociation energy of nitrogen are very near one another. Accordingly, we have not observed any appreciable difference between the critical energy of the ions and the energy of dissociation of nitrogen. This shows that the results obtained for hydrogen are not experimental errors.

The necessity thus arises for a more detailed study of the mechanism of transition of kinetic into vibrational energy. It seems to us to be interesting (1) to study directly the distribution of speeds of the ions once reflected from monoatomic and diatomic molecules; (2) to study the critical potentials of the radiation of polar molecules excited by collisions with ions, and (3) to investigate the thermal capacity of a stream of diatomic gas, preserved from contact with the walls by a concentric stream of monoatomic gas.

We intend to carry out investigations in these directions. The question as to transition of kinetic into vibrational energy is a fundamental one in chemical kinetics. Therefore we intend also to determine the energy of ions at which begins the decay of some molecules, the kinetics of which follows the monomolecular law, as well as to determine at which energy of the ions some reactions begin which require a previous dissociation of one of the molecules.

N. SEMENOFF.
A. SHECHTER.

State Phys.-Tech. Institut,
Leningrad, July 14.

A. Leipunsky u. A. Shechter, *Zeit. f. Phys.*, **59**, 857; 1930.

Foaming of Beer.

SOME little time ago, seeking refreshment in a wayside tavern, I heard a man give an order in a most implacable manner, for a "half pint of bitter and in a dry glass if you don't mind". With great zest and concentrated attention this connoisseur drank his ale and departed, leaving me free to question the landlady on the merits of a dry glass. She explained that some people asked for a dry glass because they liked a head on their beer, and on occasion when Bass's, Guinness's, and the like were a bit fiery, they were compelled to wet the glasses to keep them down.

I have verified this fact by questions of other ale drinkers and I have discussed the matter with three physicists of standing to whom the matter was novel.

The froth on beer normally assumes a peaked cap, showing what might be the effects of a viscous drag on the sides of the glass, but the effect may not be due to viscosity so much as wetting action with film tensions against the glass walls. The matter is possibly worthy of investigation in connexion with industrial processes where foaming liquids are used, and more generally, in connexion with ebullition, the wetting of the walls by a liquid different from that contained in the vessel may be interesting or useful.

I confess that I write this with mischievous but respectful curiosity. Is there more than one very important journal to which such a contribution could be addressed?

H. S. ROWELL.

39 Spencer Road,
Chiswick, W.4.

THE foaming or frothing of beer has been discussed fairly extensively from time to time, although the point now raised by Dr. Rowell does not appear to have been specifically mentioned. The actual frothing is, no doubt, due to a lowering of the surface tension of the beer, but the primary cause of this lowering has not been definitely established. It is most likely due to the concentration of certain dissolved constituents, such as peptones and albumoses, being greater in the surface layers of the beer than in the bulk of the beer. The retention of the dissolved carbon dioxide in the froth may also assist in the formation of the 'head', although this view is not accepted by some observers. Very small traces of impurities, such as oil, grease, or higher alcohols, disturb surface tension, and the wetted surface of a glass may act similarly.

At the Government Laboratory we have carried out a few experiments with a number of ales and stouts, and the results agree with the facts stated in the early portion of Dr. Rowell's letter, although in some instances the difference between the size of the 'head' in the 'wet' and 'dry' glasses was not very marked.

R. ROBERTSON.

Infection of *Phlebotomus perniciosus* Newstead with *Leishmania infantum*.

ALTHOUGH a considerable amount of research has been carried out in recent years on the transmission of kala-azar in China and India, very little has been added to the problem of the transmission of infantile kala-azar in the Mediterranean basin, apart from the infection of *Phlebotomus papatasii*, *P. perniciosus* var., and *P. major* on cultures of *Leishmania infantum*.

Working in Catania in Prof. Longo's clinic, we were able to infect *P. papatasii* and *P. perniciosus* (wild and laboratory bred) on a Chinese hamster infected with local strains of *L. infantum* during the earliest stages of the infection.

Out of 18 ♀♀ *P. perniciosus* (5 wild and 13 laboratory bred), 15, that is, 83 per cent, became infected. Control, 319 ♀♀ wild *P. perniciosus* were dissected and found negative. Out of 123 ♀♀ *P. papatasii* (51 wild and 72 laboratory bred) fed on the same hamster, only one became infected. Control, 2694 ♀♀ wild *P. papatasii* were dissected and found negative.

In both *P. perniciosus* and *P. papatasii* the flagellates tended to adopt an anterior position; in *P. perniciosus* at a temperature of 29° C. to 30° C. flagellates were found in the pharynx three and a half days after the infecting feed.

Wild *P. papatasii* was also infected by feeding through membranes on infected human bone marrow. It was found that there was occasionally a slight infection rate if smears of the bone marrow showed an average of at least one Leishman-Donovan (L.D.) body per twenty fields (Oc. 4 Obj. $\frac{1}{12}$) and no infection with one L.D. body per forty fields. By culture methods we could demonstrate the presence of L.D. bodies in the circulating blood in almost 100 per cent of cases of infantile kala-azar (in some cases with only 5 c.mm. of blood), but a concentration as heavy as one L.D. body per forty fields in the blood has never yet been observed by anybody in this disease. *P. papatasii* can therefore be excluded as an important vector of *L. infantum*. Up to the present we have not succeeded in producing an infection rate of more than 26 per cent in wild *P. papatasii* after feeding on heavily infected bone marrow.

P. perniciosus takes on an average a much smaller feed than *P. papatasii*, and the high infection rate produced in *P. perniciosus* by relatively few L.D. bodies shows that *L. infantum* is particularly well adapted to this sandfly, which should be considered as a good carrier of kala-azar in Italy.

S. ADLER.
O. THEODOR.

Kala-Azar Commission of the Royal Society
and Hebrew University of Jerusalem.

The Quantum and Vision.

THE statement is frequently made that one quantum of light delivered instantaneously is just sufficient to excite the sensation of vision. We have made some measurements on the subject, and find that this is not the case.

By working with a pinhole aperture in a light-tight room, we found that a steady source equivalent to

one-tenth candle at one kilometre is just sufficient to excite vision. When a sector was rotated in front of the pinhole, a source 16 times as strong as this acting for $\frac{1}{11\frac{1}{2}}$ sec. or $\frac{1}{60}$ sec. according to the observer was sufficient to excite vision.

One-tenth candle at one kilometre delivers about $4{\cdot}51 \times 10^{-5}$ erg per sec. on a pupil of 45 sq. mm. area. Only about 1 per cent of this lies between $410\mu\mu$ and $760\mu\mu$. If we assume that the source has the same energy distribution as that of a black body at 2000° K, and use Hecht's values for the visibility of light to the dark adapted eye, we can obtain the distribution of the light of the source over the spectrum. About 0·21 of the whole light lies in the range 520-540$\mu\mu$, and about 0·017 of the energy between 410 and 760$\mu\mu$ lies within this range. The quantum at $530\mu\mu$ has the value $3{\cdot}71 \times 10^{-12}$ erg. sec. This gives the result that 9840 quanta per sec. of green light are required to produce the sensation of a continuous point source. For a flash to be visible 1400 or 2600 quanta of green light are necessary, according to the observer. If the flash is red or violet, a much greater number of quanta will be required. In making the calculation we have neglected the absorption of light in the media of the eye, but this cannot affect the result seriously.

There is a striking result connected with the visibility of small sources: visibility requires the same quantity of light, no matter what is the angle subtended by the source, up to an angle of one or two degrees. This is known as Riccò's law of foveal vision. It might be supposed that there is some connexion between this law and the quantum. But the numerical values show that there is none.

R. A. Houstoun.
Jas. F. Shearer.

University of Glasgow, July 24.

Effect of Magnetic Field on Dielectrics.

In a letter in the issue of Nature for July 12, Prof. P. L. Burns states that the power factor of certain dielectrics is decreased when a constant magnetic field is superimposed on the dielectric which is being subjected to an alternating electric stress. One would expect that on the Debye dipole theory of polar molecules in a viscous medium the power factor would be changed by a magnetic field.

The motion of the electrical charges, or, if the molecule contained a magnetic moment, the motion of the magnetic field in a superimposed electrical or magnetic field, would give rise to a loss of energy. The force acting on the molecule would be of a nature similar to the frictional force due to the viscosity of the medium. The relaxation time is given approximately by $4\pi\eta r^3/KT$. These forces could be considered to increase the value of η and hence increase the relaxation time. This would tend to shift the peak of the power factor against frequency curve toward lower frequencies. Therefore, depending on which side of the peak one was measuring the power factor, the power factor would be either increased or decreased by the magnetic field.

It would be interesting to know on what materials Prof. Burns found his results. It seems clear that power loss in dielectrics cannot be completely explained on the Debye theory. Some work has been done here considering the double layer surrounding colloidal particles and its effect on the power factor. Possibly these experiments of Prof. Burns would make it possible to distinguish between the two mechanisms.

John B. Miles, Jr.
Experimental Station
E. I. du Pont de Nemours and Company,
Wilmington, Delaware, Aug. 12.

The Space-Group of Strychnine.

In connexion with the recent work on strychnine described by Prof. R. Robinson in his recent Bakerian lecture, the results obtained from an X-ray investigation may prove of interest.

The substance forms extremely good crystals, for which I am very much indebted to Prof. Robinson.

Results:

Unit cell	$a = 11{\cdot}9_2$ A.	$b = 12{\cdot}1_3$ A.	$c = 11{\cdot}3_0$ A.
	Volume = 1634 A^3.		
Axial ratio	a :	b :	c
	0·983 :	1 :	0·931
	0·9827 :	1 :	0·9309 (Groth)
No. of molecules	4		
Space group	Q_4 (Astbury and Yardley, *Phil. Trans.*, A, vol. 224; 1924).		

The dimensions of the cell, and the space group, are such that four molecules of the disc-shaped form suggested by Prof. Robinson can be fitted into the unit cell. Owing to the complicated nature of the molecule, and to the fact that it is composed of comparatively light atoms which have approximately equal scattering power for X-rays, it is impossible at this stage to make any further assumptions as to its structure.

Thora C. Marwick.
The Davy Faraday Laboratory,
London, Aug. 11.

Occurrence of Mannitol in Spike Disease of *Santalum album* (Linn.).

While investigating the water soluble constituents of the spiked leaf of sandal, it was found that crystals of mannitol separated on slowly evaporating the extract after clarification with basic lead acetate. 2–3 per cent of the alcohol, calculated on the weight of the green material, has been found in all the samples so far examined (15), while in no case has it been detected in healthy samples. The significance of this fact at the present stage is difficult to understand, but it appears that mannitol is one of the metabolic products of the virus. Whether such characteristic products are formed during the course of other well-known virus diseases or not is a matter for future investigation, and workers in similar fields will, no doubt, be interested in this discovery.

M. Sreenivasaya.
Department of Bio-Chemistry,
Indian Institute of Science,
Bangalore, Aug. 25.

The Existence of the Cellobiose Residue in Cellulose.

The chemical evidence for the view that cellobiose is preformed in cellulose is considerably strengthened by some observations we have made on the acetolysis of trimethyl cellulose. Under mild conditions of treatment at low temperatures fully methylated cellulose suffers cleavage to give a diacetyl-hexamethyl cellobiose, which is readily transformed into crystalline heptamethyl β-methylcellobioside. The experimental conditions under which this derivative of cellobiose is isolated preclude its occurrence as a reversion product of the reaction. Moreover, the yield of the crystalline β-cellobioside is equal to that of cellobiose octa-acetate obtained by the direct acetolysis of cellulose.

W. N. Haworth.
E. L. Hirst.
H. A. Thomas.
University, Edgbaston,
Birmingham. Aug. 18.

Johann Kepler, 1571–1630.

THE great German astronomer and mathematician Johann Kepler, the tercentenary of whose death is being commemorated this year, was born at the little town of Wiel or Wielderstadt, not far from Stuttgart in Württemberg, on Dec. 27, 1571, and died at Ratisbon in Bavaria on Nov. 15, 1630, in his fifty-ninth year. A cenotaph to his memory was erected at Ratisbon in 1803, and commemoration celebrations will commence on Sept. 24 with an address before the memorial by Dr. von Dyck, of the Munich Technical High School.

Born at a time when his country was already torn by religious dissensions, Kepler lived to see it drenched with blood by one of the most disastrous of all wars. Altogether he lived under four Emperors, Maximilian II., Rudolph II., whose lack of capacity for government was in no way compensated for by his love of alchemy and astrology, Matthias II., anxious but unable to prevent the coming storm, and Ferdinand II., whose ingrained hatred of Protestantism led to a reign filled with persecution and strife. The Thirty Years' War had been in progress twelve years before Kepler died, but ere it had run its course the land had become a wilderness and in Kepler's native district of Württemberg it is said 58,000 families had disappeared, while the population had shrunk to one-sixth of its former numbers.

Save, however, that Kepler was a Protestant; that he once had to quit his chair on account of his religious views; that he became imperial mathematician to Rudolph; that he compiled the Rudolphine Tables, and that for many years he was dependent on the royal favour for his income, his life's work was little connected with the doings of Church or State. While princes and ecclesiastics schemed, quarrelled, and fought, Kepler steadily pursued his own course and by the exercise of his matchless intellect solved some of the problems which had baffled the greatest minds. Kepler's true contemporaries were such as Gilbert, Napier, Bacon, and Galileo rather than emperors and kings, and though students will long read of Wallenstein and of Gustavus Adolphus and pore over Schiller's famous history, Kepler's name is destined to be handed down to the remotest posterity.

If there was little in the character of the times favourable to scientific studies, neither was there in Kepler's parentage and environment anything conducive to the upbringing of a scholar. His parents, it is true, were of noble descent, but they were also in impoverished circumstances, a condition which perhaps had much to do with the unfortunate family differences. Kepler himself was a sickly seven-months' child and his boyhood was marked by serious illnesses. Yet for all that he was able to attend school at Adelberg and Maulbronn, and at the University of Tübingen in 1591 he gained his master's degree in theology. It was at Tübingen he also heard the German astronomer, Michael Maestlin (1550–1631), lecture on the theories of Copernicus. Theology by then had become of secondary importance to Kepler, and, at the age of twenty-three, through the tolerance of the Archduke of Austria, although a Protestant, he was made professor of mathematics at Gratz in catholic Styria, and it was there he began brooding "with the whole energy of his mind on the subject, inquiring pertinaciously why the number, the size and the motion of the planetary orbits were not other than they are". How he published his hastily conceived explanations; how he was advised by Tycho Brahe to obtain a solid foundation for his views from actual observations; how he met Tycho at Prague and through him was made imperial mathematician, has often been told.

Tycho only lived a year after meeting Kepler, but their association has left its mark on the history of astronomy, and it was Tycho's observations which provided the material for Kepler's researches. Of the thirty or more works published by Kepler, two stand out as epoch-making, his "Astronomia Nova", published in Prague in 1609, and his "Harmonia Mundi", published at Linz in 1619. It was in the former—published, it may be remarked, the year that Galileo first used the telescope—that Kepler enunciated his first two laws, that the planets describe ellipses round the sun with the sun at a focus of each ellipse and that a line drawn from a planet to the sun sweeps over equal areas in equal times, while it was in the second work he gave the world his third law, that the squares of the periodic times are proportional to the cubes of the mean distances of the planets from the sun.

On Kepler's many other works, his commentary on Vitellus, his book on Dioptrics, a copy of which Newton used as an undergraduate, his writings on logarithms and his Rudolphine Tables it is unnecessary to dwell. Neither is it necessary to follow him to Linz, to Sagen, to Rostock, or to recall the domestic afflictions which befell him or the miserable tale of his constant impecuniosity due to emperors whose performances did not keep pace with their promises. Through foul weather and fair alike, Kepler continued constant to the one aim, the advancement of natural knowledge, and in so doing left a great heritage to the world.

In personal appearance Kepler, as we know from his own words, was lank, lean, and spare, and that "for observations his eye was dull and for mechanical operations his hand was awkward". His delicacy of constitution, no less than his weak eyes, was sufficient to prevent him becoming a great observer. He was as remarkable for the exuberance of his imagination as for his powers of thought and his untiring industry. With these he joined an open-mindedness and candour that led him not only to record his wildest fancies but also to emblazon his greatest errors. A staunch Protestant, pinning his faith to the Confession of Augsburg, he was sincerely religious, but averse to controversies. In other directions he declared himself as "troublesome and choleric in politics and domestic matters", yet with all his frankness he was probably an easy

man to live with. His singular action when after the death of his first wife he sought another is one of the most humorous of matrimonial adventures. At his request his friends sought for a suitable companion. Eleven ladies with strangely diverse qualifications were passed in review, and of them, after much vacillation, Kepler chose Susannah Reutlinger, the daughter of a cabinetmaker. Of her he wrote that she had an education worth the largest dowry. "Her person and manners are suitable to mine—no pride, no extravagance. She can bear to work; she has a tolerable knowledge how to manage a family; middle aged, and of a disposition and capability to acquire what she still wants." For fifteen years Susannah shared Kepler's joys and sorrows and difficulties, and she bore him seven children.

In his work Kepler found the fullest satisfaction, and a discovery elated him as much as it did Davy. In Kepler there was none of the cold, passionless calm we associate with Cavendish. Like a Luther, he regarded himself as an instrument of the Almighty, and his studies were interspersed with prayer. He had once written a small treatise on the Divine Wisdom as shown in the Creation, and his subsequent works contain many passages of exaltation. When after seventeen years of searching he discovered the third of his laws his delight knew no bounds. "Nothing holds me", he said, "I will indulge in my sacred fury; I will triumph over mankind by the honest confession, that I have stolen the golden vases of the Egyptians, to build up a tabernacle for my God, far away from the confines of Egypt. If you forgive me, I rejoice; if you are angry, I can bear it. The die is cast; the book is written, to be read either now or by posterity—I care not which. It may well wait a century for a reader as God has waited six thousand years for an observer." Kepler's work, however, was appreciated immediately by his contemporaries, while of his discoveries the famous French physicist Arago once wrote: "Les lois de Kepler sont le fondement solide et inébranlable de l'astronomie moderne, la règle immuable et éternelle du déplacement des astres dans l'espace. La gloire de Kepler est écrite dans le ciel; les progrès de la science ne peuvent ni la diminuer ni l'obscurcir, et les planètes, par la succession toujours constante de leurs mouvements réguliers, la raconteront de siècle en siècle."

The Taxonomic Outlook in Zoology.*

By Dr. W. T. Calman, F.R.S.

THE anatomist, the physiologist, the field naturalist, the student of one or other of the innumerable specialisations of biological science, has always been inclined to regard with distaste, if not with contempt, the work of those whose business it is to denominate, classify, and catalogue the infinite variety of living things. The systematist is generally supposed to be a narrow specialist, concerned with the trivial and superficial distinctions between the members of some narrow group of organisms which he studies in the spirit of a stamp collector; happy when he can describe a new species, triumphant if he can find an excuse for giving a fresh name to an old one.

It would be idle to deny the truth that there is in these criticisms, just as it would be easy, although unprofitable, to point out that the substance of them might be directed against the practice of most other branches of research. The specialist, of whatever kind, has a tendency to mistake the means for the end, to become fascinated by technique, and to suffer from a myopia that blurs his vision of other fields than his own.

I think, however, that there are some signs of an increasing appreciation of the usefulness and even of the scientific value of taxonomy among the younger generation of zoologists. More particularly, those who are concerned with the applications of zoology to practical affairs are, for the most part, although not invariably, aware of the need for exact identification of the animals they deal with. They do not always realise the difficulties that may stand in the way of this identification. It is a common experience with us at the Natural History Museum to have some mangled fragments of an animal brought in by a practical man, who expects to be supplied with the name of it while he waits. I am afraid that he often goes away with a low opinion of our competence.

It may not be without interest, therefore, if I attempt, in the first place, to give some idea of how matters stand with this part of the systematist's task, the identification and description of the species of living animals.

When Linnæus published in 1758 the first volume of the tenth edition of his "Systema Naturæ", he named and described about 4370 species of animals. If we ask how many are known to-day, the diversity of answers we get is some indication of the confusion that exists. Some years ago, at the request of the late Sir Arthur Shipley, I endeavoured to get from my colleagues at the Museum estimates of the numbers of species in the various groups with which they were specially conversant. Some of the answers obtained were very interesting. With regard to mammals I was told "anything from 3000 to 20,000, according to the view you take as to what constitutes a species". For the most part, however, the authorities consulted were unwilling to suggest even an approximate figure, for a very different reason. They told me that great sections of the groups with which they were concerned were so imperfectly surveyed that it was quite impossible even to guess how many of the supposed species that had been described would survive reconsideration.

It may be worth while to consider for a little the

* From the presidential address to Section D (Zoology) of the British Association, delivered at Bristol on Sept. 4.

second of the two obstacles thus indicated as standing in the way of obtaining a census of the known species of animals. In the days of Linnæus, it is likely that a very experienced zoologist might have been able to recognise at sight any one of the four thousand species of animals that were then known, and when the expansion of knowledge had made such a feat no longer possible, the specialist who confined his studies to one section of the animal kingdom could still aspire to a like familiarity with the species of his chosen group.

With this kind of knowledge it is literally true that, as has been said, a systematist recognises a new species by instinct and then proceeds to search for the characters that distinguish it. Some of the great zoologists who were still working in the British Museum when I entered it more than a quarter of a century ago, men like Albert Günther, Bowdler Sharpe, C. O. Waterhouse, and Edgar Smith, had actually an amazing personal familiarity with vast sections of the animal kingdom. They had studied and digested all that had been written on their subject, and, if they did not carry the whole of this knowledge in their memory, they could, without searching, put their hand at once on the volume that would help them. They had no need of 'keys' to help them to run down their species: indeed, they rather distrusted such aids, for they knew how easily they betray the heedless.

Specialists of this type there must always be, and we may be thankful for it. Nothing can altogether replace that instinctive perception of affinity that comes from lifelong study. It has often happened that men such as those I have named were able, when confronted with new and aberrant types of animals, to allot them at once to a place in classification which subsequent research served only to confirm. As time goes on, however, the extent of ground that can be covered in this fashion by the most industrious worker is rapidly diminishing. The torrent of publications catalogued in the "Zoological Record" increases year by year, and the specialist, if he is not to be overwhelmed by it, must not allow his curiosity to stray beyond the limits of a narrow corner of the field.

By far the greater part of this literature is written by specialists for specialists, and much of it is unintelligible to anyone else. From the time of Linnæus, however, there have not been wanting publications that have a different aim. We have monographs, synopses, revisions, of all sorts and sizes, attempting to render possible the identification of species without demanding a lifetime of study for each special group. The ideal for such monographs would be, I assume, that they should be intelligible to, and render possible the determination of species by, any properly trained zoologist, even without previous experience in dealing with the particular groups of which they treat.

The Zoological Department of the British Museum may fairly claim to have done more towards this re-editing of the "Systema Naturæ" than any other institution in the world. The long series of monographs, of which the true character is somewhat concealed under the official title of 'catalogues', is a monument to the learning and industry of the great zoologists who planned and executed them. Though they remain indispensable to all serious students of the different groups, however, they are now, for the most part, long out-of-date, and, vast as is their scope, they cover only a fraction of the animal kingdom.

In 1896 the German Zoological Society began the publication of "Das Tierreich", afterwards continued by the Prussian Academy, which was planned to give nothing less than a revision of all the species of living animals. Here again, however, after thirty-four years, only a small part of the ground has been covered and already the progress of research has rendered many of the earlier parts obsolete. Col. Stephenson tells me that Michaelsen's revision of the Oligochæta, published in this series in 1900, deals with exactly half the number of species enumerated by the same authority in 1928.

Apart from these attempts at comprehensive revision, we have, of course, numerous surveys of local faunas on a larger or smaller scale, besides monographs of restricted groups, but scarcely ever do these fit together without leaving gaps, geographical or systematic.

The number of described species of animals has been estimated at something in the neighbourhood of three-quarters of a million. It is not at all improbable that between a quarter and a third of that number would be suppressed as synonyms or put aside as *species inquirendæ* by careful monographers, and that in many groups the proportion would be far higher.

The prospect is not one that can be contemplated with any satisfaction. The successively expanding volumes of the "Zoological Record" give us a picture of systematic zoology being smothered under the products of its own activity. The confusion will grow steadily worse unless systematists come to realise that the mere description of new species is a far less important thing than the putting in order of those that are supposed to be already known, and until, on the other hand, zoologists in general cease to regard taxonomy as a kind of menial drudgery to be done for them by museum curators.

I have alluded to another obstacle to obtaining an enumeration of the animal kingdom, in the divergences of opinion as to what constitutes a species. I am not sure that these divergences are not sometimes over-estimated. I think that it will be found that in most orders of animals there exists a considerable body of species regarding the limits of which there is no serious difference of opinion among competent systematists; but alongside these we find in almost every order, in most families, and even in many genera, a 'difficult' residue in which the delimitation of specific groups sometimes seems to be little more than a matter of personal taste. Mr. G. C. Robson has recently brought together a great deal of information on

this subject in his book "The Species Problem", to which I would refer anyone who needs to be convinced how complex the problem really is. For our present purpose it is enough to take the empirical fact that the majority of animals can, with more or less trouble, be sorted into assemblages or kinds that we call species. We have seen how imperfect and confused is the present state of knowledge even as regards the mere description and identification of these kinds.

The business of the systematist, however, does not end with identification. Even identification requires some kind of classification, if it is only the classification of the dictionary. Since the time of Linnæus, or rather, since the time of John Ray, zoological systematists have believed in the existence of a natural system of classification which it was their business to discover; since Darwin it has seemed plain that this natural system must be, in some way, based upon phylogeny. It is now realised that the relation between the two is not always so simple and straightforward as it once appeared to be. Dr. F. A. Bather, in his presidential address to the Geological Society in 1927, discussed the historical and philosophical bases of biological classification. He concluded that "The whole of our System, from the great Phyla to the very unit cells, is riddled through and through with polyphyly and convergence", and that "Important though phylogeny is as a subject of study, it is not necessarily the most suitable basis of classification". I am not sure that I quite understand what is implied by the second of these statements, but I do not suppose that even Dr. Bather would be prepared to suggest a system of classification entirely divorced from phylogenetic considerations.

Forty years ago the reconstruction of the evolutionary history of the major divisions of the animal kingdom was almost universally regarded as the chief end of zoological research. To-day, except among palæontologists, one might almost say that the phylogenetic period in the history of zoology has come to an end. When one recalls the extravagances of its later developments, the derivation of vertebrates from arachnids and of echinoderms from cirripedes, one cannot be surprised that zoologists of the modern school take little interest in it. If we accept this attitude, it follows that problems of affinity and relationship are not worth worrying about. We are told, in so many words, that our business as systematists is identification, not classification; that what we have to do is merely to devise some kind of key or card-index that will enable animals to be quickly and easily sorted into species. So far as the really scientific branches of zoology are concerned, an artificial system of classification is as good as, and may even be better than, any other.

It is quite true that the categories of the physiologist, the ecologist, the geneticist, and so on, often cut across the dividing lines of the most natural classification we can devise, but both the divergences and the coincidences are worthy of closer consideration than they sometimes receive. If there is any truth in the theory of evolution, it is obvious that functions and habits have an evolutionary history behind them, but it is no less obvious that this history has not been independent of the history of the organisms that display them. The details of this history we shall never fully know, and even its broad outlines may perhaps always remain misty. A natural system of classification expressing even these broad outlines may prove to be an unattainable ideal, but each step towards it holds out the promise of usefulness in other and possibly remote fields of research.

A great deal of current work and still more of current speculation in zoology seems to me to suffer from this neglect of the taxonomic outlook. In the zoology of the later nineteenth century the comparative method was still the chief tool of morphology. The relative importance of structural characters was measured by the extent of their persistence through larger or smaller divisions of the animal kingdom. This point of view tends to be lost sight of with the increasing emphasis on the experimental method. The systematic zoologist, in listening to the exponents of the modern lines of research, is apt to be impressed by the little account that is taken of the vast variety of animal life. To say this, is not to underrate in any way the advances that have been made in these lines within the present century or the revolutionary changes they have made in our views on many fundamental questions. Physiology, for example, is to-day a vastly different science from what it was thirty years ago, partly because the physiological laboratory has a more varied fauna than it had then. Nevertheless, the zoologist, conscious of the unending diversity of structure and of habits among animals, sees the physiologist's results against a background of which the physiologist himself seems to be sometimes forgetful.

One hesitates to suppose that the students of heredity are really so forgetful of this background as they sometimes seem to be. No doubt intense specialisation is needed for intense research: but the Poet of the Breakfast Table, laughing gently at the narrow specialism of the Scarabee, can scarcely have foreseen the day when a university in his own country would have upon its teaching staff an officer named in the university calendar as a 'Drosophilist'.

It is possible, however, that the prevailing lack of interest in questions of phylogeny may have a deeper significance. Those departments of biology that are being most actively studied at the present day are preoccupied with the interplay of forces acting here and now. They ignore the impressions that time may have left on the material of their study. It is as though a crystallographer, studying a pseudomorph, should endeavour to explain its form in terms of its chemical composition and the forces governing the arrangement of its molecules, without taking account of its past history.

From ignoring anything, it is but a short step to denying its existence, and here, it seems, we have already arrived. In a lecture delivered in

London in the early part of last year by that very distinguished experimental biologist Dr. Hans Przibram, he suggested that we might have to consider the possibility that every species of metazoan has developed independently of all the others from a distinct species of protozoan. The same view was set forth by him in a lecture delivered in Paris on the theory of apogenesis (*Rev. Gen. Sci.*, 11, No. 10, May 31, 1929, p. 293). As the English lecture has not been published, I will translate as closely as I can from the French one. "I do not think it likely", he says, "that a single substance can have given rise to a general phylogenetic tree according to the classical diagram representing the affinities of species and their distribution in space and time. All the facts would be explained more easily by supposing that there existed, at the beginning, many organised substances developing side by side into species, each of the latter passing through stages more and more advanced without actual relationship of descent between the different species."

Many authors have believed in a multiplicity of the primordial forms of life, but few have suggested an independent origin for grades lower than the main phyla. Przibram, with strict logic, has carried the same reasoning down to the individual species. Most biologists with whom I have discussed the matter refuse to take his suggestion seriously. This, I venture to think, is a mistake. Przibram has simply carried to their inevitable conclusion certain lines of thought that we meet with everywhere in current biological literature; that conclusion is either one of the most significant results of recent biology or it is the *reductio ad absurdum* of much contemporary work.

Geneticists have made us familiar with the doctrine of the inalterability of the gene, with its corollary of evolution by loss of factors, which, by the way, seems to differ little from Przibram's apogenesis. The experimentalists have proved (if it wanted proving) the plasticity of the phenotype, as, for example, when Przibram himself shows that the length of a rat's tail is a function of the temperature to which the individual and its immediate progenitors have been exposed. As for the inheritance of impressed modifications, the more unequivocal the experiments devised to demonstrate its reality the more clearly do they show it to be of so fugitive a kind as to have no significance in evolution. Palæontologists, as Dr. Bather has told us, have proved beyond the possibility of doubt the occurrence of parallel and even of convergent evolution, without telling us where we are to stop in applying the principle. Many supposed examples of adaptation fail to stand closer scrutiny, and therefore the whole idea of adaptation is declared to be a subjective illusion. All these results at any rate place no obstacles in the way of Prof. Przibram's suggestion.

It is to be noted that although the theory of apogenesis is called a theory of evolution, it does not deal at all with evolution as that word was used by Darwin. It has nothing to say on the origin of species. On this question it is no more than a doctrine of special creation at one remove. It has no light to throw on classification. If we are to abandon belief in community of descent, the whole architecture of the "Systema Naturæ" becomes meaningless.

Prof. Przibram claims that "All the facts would be explained more easily" upon his hypothesis, but there is one point on which he speaks with a hesitant voice, and it seems to me a very significant exception. "We cannot decide", he says, "whether the differing though related species that inhabit islands or isolated territories are descended from a common source or result from the accidental separation of species which formerly occupied the region together."

Let me recall the opening words of the "Origin of Species". "When on board H.M.S. 'Beagle' as naturalist, I was much struck with certain facts in the distribution of the organic beings inhabiting South America, and in the geological relations of the present to the past inhabitants of that continent." So Przibram ends where Darwin began. The geographical and geological distribution of organisms, which for the one are merely the negligible residue of unexplained facts, were for the other the very heart and core of the problem he set himself to consider.

It is worth remembering that among Darwin's other qualifications as an interpreter of Nature, he was an experienced taxonomist, and before he wrote "The Origin of Species" he had produced one of the finest systematic works ever written in his "Monograph of the Cirripedia". Those of us who were present at the memorable Darwin-Wallace celebration of the Linnean Society in 1908 remember how the veteran Alfred Russel Wallace discussed "the curious series of correspondences both in mind and in environment" which led Darwin and himself, alone among their contemporaries, "to reach identically the same theory", and how he gave the first place to the fact that both he and Darwin began by collecting beetles and thus acquired "that intense interest in the mere variety of living things" which led them to speculate upon the 'why' and the 'how' of "this overwhelming and, at first sight, purposeless wealth of specific forms among the very humblest forms of life". It might be worth while to inquire whether a training that proved useful to Darwin and to Wallace would not be of some value to students of zoology even at the present day.

The experimental method has answered many questions and it will answer many more, but there are some questions, and these well worth the asking, to which experiment will never find an answer. No one will maintain that taxonomy by itself will answer them, but it will often suggest where the answer is to be sought for, and it will provide a point of view from which both questions and answers will be seen in a true perspective.

Finally, I would recall a remark once made in my hearing by a wise old naturalist, the late Dr. David Sharp. Someone had been remarking on the

decline of systematic zoology and predicting the extinction of systematic zoologists. Dr. Sharp replied, in effect, "I have seen many passing fashions in zoology, many departments of research becoming popular and then falling into neglect; the one branch that will never fail to attract is the systematic one. The æsthetic satisfaction to be derived from contemplating the mere variety of animal forms, and from tracing the order that runs through all its diversity, appeals to a very deep instinct in human nature. There will always be systematic zoologists."

Obituary.

PROF. H. W. WILEY.

IN Harvey Washington Wiley, who died on June 30, we lose a man who was a great Uesanian warrior in the cause of pure food, a man of imperious character, officially a perfervid Puritan idealist and extremist, yet in the society of friends the perfect Yorick, "a fellow of infinite jest, of most excellent fancy". As first administrator of the American Food and Drugs Law, his own beloved child, he was nothing short of an all's-fair-in-love-and-war man: perforce, in fact, he had to adjust his methods of attack to the times and to those of his foes, as he was severely up against trade interests. He trod heavily upon not a few corns and it is clear that, occasionally, his pendulum swung beyond the limits of scientific reason; still, the end was one to justify almost any means. He had courage and, in large measure, won, as he definitely established a sound public opinion.

I first met Wiley in 1903, at his most active period, at a gathering of Agricultural Experiment Station workers, in Minneapolis, at which I was present as Lawes lecturer. He was the life and soul of a large meeting; ever full of resource. Thus, on one excursion, in a dry town on a very hot day, displaying a surprising geographical instinct, he took some of us poor sufferers to a pharmacy and tendered a prescription on our behalf: the medicine we got passed all the Brer Rabbit tests for good ale and no doubt saved our lives. A few years later he and I forgathered at Washington, in the Cosmos Club, an institution the worth of which will be known to many. We met one afternoon in the main square, to go out to the Country Club. He was carrying a parcel and there was a suggestive bulge at his hip. We were to pass the county border, into an arid region. The parcel and that bulge were of no slight aid to our evening's pleasant intercourse. There is an immoral to this tale. At the time of his retirement, late in life, he passed under petticoat rule, to become thereafter an exemplar of dryness. The injury done to him by his previous depravity—at least so his friends claimed—was made obvious by the arrival, without undue delay, of two healthy boys. Several months ago, hearing that he was very ill, I wrote to cheer him, suggesting that he set an example by repenting of his later sin. This amused him, I was told. The reply, bearing his signature, gave too much advice for the good of my soul to be his. I could only write back that John Barleycorn had not done much obvious harm to either of us. My old friend became in fact a first-class humbug in the matter of drink: probably he was never a man of really balanced, scientific judgment. We have to hold such men very much in mind, however, in taking stock of the States: too few realise how rigid the American outlook often is.

Only recently, the *Times* told us, an American Senator wrote to our Ambassador in Washington to protest against the exercise of his right to take liquor into the Embassy, suggesting that such action was likely to have the most serious effect upon our international relations. Do Americans recognise how entirely they are cutting us off from rational intercourse with them? We welcome them here in crowds and they do not seem to return habitual drunkards. Few of us go from this side as travellers—we only visit the States when compelled, either on business or when imported to join in colloid worship at Cornell or some similar academic frivolity. Few Uesanians understand how impossible it now is for us to risk travelling in their country—the danger of their soft drinks. Yet it is one that is full of beauty and interest, as I can vouch; the only difficulty is that there is so much of it. Whatever it be, it is a land in which, at times, every pore of you aches for beer; one where the hart ever pants for the cooling Milwaukee stream.

Straining at the gnat ethanol, to-day, Americans swallow the camel caffeine in canfuls: however, a missionary from here is now in Canada who will disabuse them (of course piously, on week-days) of this delight. As a matter of fact, Wiley, in 1912, warned the American public against the danger of too much caffeine. He was often here and always amusing. Describing once the activities of his Department, he told how advice was given which led to the need for water in one of the arid regions of Texas being overcome: this was done by growing onions between rows of potatoes; the eyes of the potatoes watered so much that artificial irrigation became unnecessary.

It matters little where a man like Wiley came from. *Pro forma*, let it be told that he was born in Indiana on October 10, 1844. In 1863 he went to College; in 1868 he began to study medicine, graduating M.D. from the Indiana Medical College in 1871. Probably medical education at that time was no great shakes. He then had a year in the Lawrence school at Harvard; became professor of chemistry in Butler College, in 1873; from 1874 to 1883 he was professor of chemistry at the Agricultural College, Purdue, Indiana, spending a year in Germany during this period. State chemist of Indiana in 1881, he was made chief of the Division of Chemistry in the U.S. Department of Chemistry in 1883. He was president of the American Chemical Society in 1893–94. In 1901 he was pro-

moted chief of the Bureau of Chemistry. Then it was that food reform became his master passion.

Wiley resigned in 1912, after great provocation. The Food and Drugs Law had been enacted after half a century of effort and discussion. The measure came into operation in January 1907. Almost at once, he has told us, he discovered that his point of view was fundamentally different from that of his superiors. During six years the feeling grew that the differences were irreconcilable and he became conscious of an environment which was essentially inhospitable. The fundamental principles of the Bill, as they appeared to him, one by one, were paralysed and discredited. It is easy to imagine what happened: the thorn he must have been in the side of the provision trade and the attempts that will have been made to unseat him. Convinced that he could work more fruitfully by rallying public opinion to the support of the cause he had so much at heart than by exercising the limited activity left to him in his official position, he resigned. On retiring into private life, he interested himself in his farm and became a diffuse, popular writer of food propaganda.

We have, I think, to quarrel severely with Wiley's extreme attitude towards preservatives in food. His view was that there should be no addition of any kind made to food. As the primrose to Peter Bell, every food spade, to the public, was to be a spade absolute, nothing more. His most celebrated work is the inquiry he undertook, with a set of young men as subjects, to ascertain the effect of preservatives, especially boric acid: the results were recorded in a very lengthy report of about 2000 pages. Grave exception has been taken to this work. He was probably not qualified, either as chemist or biologist, to undertake such an inquiry: he was far too much a victim of preconceived opinion and not sufficiently trained either as observer or as logician. He would have excluded every preservative. Owing, however, to Ira Remsen's intervention, whose higher scientific standing prevailed, benzoic acid was allowed. Wiley, I believe, managed later to persuade the President to subvert this decision.

As is well known, within recent years, our Ministry of Health, which is a hive of idealisms, has followed the American suit. No scientific proof has yet been given that, used as an antiseptic, boric acid does harm when added in the small amounts needed to preserve even so perishable an article as cream. The officials of the Ministry are no more competent than Wiley was to settle such an issue. The decision was taken by a Departmental Committee on idealistic grounds. As a result, the cream industry is severely dislocated, if not destroyed. The public have full right to complain, the more as sulphur dioxide is still allowed in some beverages: its evil effect is well known to many who go to public dinners. I hold no brief; my mind is open. I know what the danger is in lead works, when there is real exposure. I also know the great boric acid works in Tuscany; these reek of the acid in every direction—yet the workpeople are all healthy. If only in justice to Wiley's memory, we ought, without delay, to study the problem afresh scientifically, with complete thoroughness and detachment, so that we may either justify or cancel his finding. It is farcical for us to hold the cake of science and not eat it. We can't afford such extravagance to-day.

HENRY E. ARMSTRONG.

MRS. ALBERT HOWARD.

A SEVERE blow has been dealt to the progress of science in India through the death at the age of fifty-three years of Mrs. Albert Howard, which took place at Geneva on Aug. 18 last. Miss G. L. C. Matthaei entered Newnham College, Cambridge, in 1895 and secured the double distinction of a first class in both parts of the Natural Science Tripos. Thereafter she continued to reside at Cambridge, being elected a fellow, and later an associate, of her College. She was fortunate at that time in coming under the powerful influences of Miss Ida Freund and Dr. F. F. Blackman. Her work in association with the latter developed in her a capacity for patient pursuit of the elusive in research which was so marked a characteristic of her work to the last. That early work is to be found in the *Philosophical Transactions* of the Royal Society, and has found a permanent niche in the literature on vegetable assimilation.

From 1905, when she married Mr. Albert Howard, the scene of her activities shifted to India. With that marriage commenced a comradeship which, if not unique in the annals of science, is at least unique in that it received official recognition from the Government of India, for, in 1910, she was appointed personal assistant to her husband and, in 1913, Second Imperial Economic Botanist. She was also awarded, by H.M. the King, the Kaisar-i-Hind medal of the First Class.

It is not possible, even for one who has had the privilege of sharing in part of the labours of the Howards in India, to apportion merit between the two comrades. Their work stands, and is best left, as a joint record of their devotion to each other and to India. But Mrs. Howard's association with Pusa introduced a definite economic trend, absent from her earlier work but becoming more and more marked with time. In 1905 the Agricultural Department in India was but recently reorganised and the impetus given by the rediscovery of Mendel's work was still fresh. The earlier papers are tinged by these facts and many plant breeding problems in this new field were brought to solution by these new methods. But even at this period the economic aspect was not neglected, as the 'Pusa wheats', already entering into general cultivation, and now covering more than three million acres, witness. This earlier work culminated in the monograph on "Wheat in India", and thereafter an ever-widening field opened out. The logic of a position in a country where rotations are habitually practised cannot be denied; the whole field of crop production and the methods of applying science thereto becomes the centre of investigation. This urge to a wider field of

investigation is traceable through the large series of publications which have appeared. It is an urge which found its consummation in the foundation of the Institute of Plant Industry at Indore, where the last six years of her life's work have been conducted.

The same widening outlook found an outlet in the first proposals for the founding of an Indian Science Congress. In that movement Mrs. Howard took a deep personal interest and she presided over both the Botanical and Agricultural Sections. It is not possible to estimate the material benefit of her work to India—undoubtedly it has been great; but the greater loss is that which arises from the balanced judgment, on both scientific and practical problems, which she was ever ready to place at the disposal of all who sought it.

PROF. JEAN BRUNHÉS.

JEAN BRUNHÉS, the French geographer, who died at Boulogne-sur-Seine on Aug. 25 at the age of sixty-one years, was one of the leading exponents of human geography of his time. By his teaching and published works he did much to put the subject on a sound scientific basis, and to lift it from the narrow lines of geographical determinism into which it tended to fall some years ago.

Brunhés was born at Toulouse and studied law at the university there before turning to science at the École Normale. His first work was on the geographical conditions of irrigation in Spain and Northern Africa. This was published in 1902 and showed a grasp of geographical correlations and a width of outlook. Much of his later work was done during the sixteen years when he held the chair of geography in the University of Fribourg, to which he was the first appointment.

In 1910 Brunhés published his "Géographie Humaine", which immediately became a standard work and has remained so to this day. It was afterwards expanded into a much larger work, and it also appeared, with some changes, in an English edition. Brunhés was also responsible for the geographical chapters in Gabriel Hanotaux's great history of France. These constitute a whole volume entitled "Géographie humaine de la France". A third important work was his "Géographie de l'histoire". According to the *Times*, he was engaged at the time of his death on a history of races. Brunhés was elected a member of the Institut de France in 1927.

WE regret to announce the following deaths:

Mr. Walter Deane, a past president of the New England Botanical Club, who was known for his work on the flora of north-eastern North America, on July 30, aged eighty-two years.

Prof. Cornelius Doelter, emeritus professor of mineralogy in the University of Vienna, and author of works on chemical mineralogy and related topics, on Aug. 8, aged seventy-nine years.

Mr. Henry W. Henshaw, formerly chief of the Biological Survey of the U.S. Department of Agriculture, and author of "Birds of the Hawaiian Islands," on Aug. 1, aged eighty years.

Dr. Wyatt W. Randall, formerly chief of the Maryland Department of Health, and president in 1926 of the Association of Official Agricultural Chemists, on July 22, aged sixty-three years.

Mr. J. W. Wilson, from 1892 until 1908 president of the Society of Engineers and co-founder with his father of the Crystal Palace School of Engineering in 1872, on Sept. 3, aged seventy-eight years.

News and Views.

IN our last issue (NATURE, Sept. 13, p. 391) we referred to the measures which are being taken or are under consideration by the Commonwealth Government of Australia to ameliorate conditions among the aborigines. Of the suggestions which have been made, the most important is undoubtedly that which recommends that the aborigines as a whole should come under the control of the Commonwealth Government. It involves many difficulties and would entail numerous adjustments as between the Commonwealth and State authorities; the obstacles, however, should not be insuperable, and the advantages which would accrue are too great to be lost without determined effort. Not the least of these would be that continuity and uniformity in policy could be secured by one authority dealing with the aboriginal question as a whole; and further, a wider and more effective public opinion would be brought into play when any question affecting policy or any specific measure was under consideration. All competent observers are agreed that in present conditions the extinction of the aborigines is a matter of only a comparatively brief period. With the lamentable example of the extinct Tasmanians to point the moral, no measure, however difficult of achievement, should be left untried to avert a similar fate from the Australian tribes, in some cases, unfortunately, already reduced to the merest fragment.

THE question of the aborigines is more than a domestic matter which concerns Australia alone. Apart from humanitarian considerations, the question touches a wide circle of interests in the world of science. At the recent Bristol meeting of the British Association a resolution submitted to the Council pointed out that the Australian aborigines are now among the most valuable peoples available for scientific study, and offer opportunities of unequalled importance for research and future investigation in the early history of mankind. The resolution, while recognising the value of the measures now proposed by the Commonwealth Government, went on to ask the Council to urge upon that Government the need for anthropological training for officials entrusted with the administration of the affairs of the aborigines and the adoption of every means to prevent their extinction and the further disintegration of native society. Notwithstanding the economic and financial

difficulties in which Australia is at present involved, the time is favourable to the initiation of an enlightened policy. Under the Anthropological Research Fund of the National Research Council, now well on its feet after three years' work, the Government has a body of expert workers who are making an intensive study of the aborigines; in the existing system of Protectors of the Aborigines it has the machinery through which, given the requisite anthropological training, the results of that intensive study can be brought to bear upon the problems of administration; and lastly, in Papua and the mandated territory of New Guinea, the administrative officers of which receive an anthropological training in the University of Sydney, it has the example and the experience necessary for guidance in dealing with the problems of training and organisation.

EXCAVATIONS at Kent's Cavern, Torquay, have been continued during the past winter from October to May by the joint Committee of the British Association and the Torquay Natural History Society. According to the report of the Committee, the trench begun last year has been carried to a length of 60 feet and a depth of 7 feet below the upper stalagmite floor, bed rock being reached near the entrance of the Wolf's Cave. Finds, probably not in their original position, included a quartzite pebble of Budleigh Salterton Pebble Bed type, which had been used as a hammerstone, three flints showing signs of use, and an interesting bone implement shaped to a sharp and much used point. These finds were in the 'Sloping Chamber'. The fauna, all of late Pleistocene type, included horse, still predominating over hyena, rhinoceros, stag, mammoth, *C. Megaceros*, bear, bos, and wolf in the numerical order named. The deposit is of mixed ages, the middle crystalline stalagmite floor being absent. In deepening the Bear Den the base of the concrete breccia was reached, revealing a fine silt below apparently identical with the silt at the base of the deposit in the 'Gallery'.

A REPORT on Educational and Documentary Films prepared by a British Association committee, of which Sir Richard Gregory is chairman and Mr. J. L. Holland is secretary, was presented to the Education Section at the recent Bristol meeting. The committee has restricted itself to the consideration of four matters and makes suggestions on cinematograph films, cinematograph apparatus, illumination and eye-strain, and structural conditions. The most important recommendation is that for classroom use the film should be non-inflammable, as is usually the case with films of 16 mm. width. The difference between the nitrate base film and the acetate (or non-flam) film is, however, not so great in the sub-standard size as when the film is of a width of 35 mm. It is pointed out that the 16 mm. film gives excellent results in classrooms not exceeding a seating capacity of 80, and the limit is, or will be, reached in lecture rooms for 120–150. Recommendations are made as to the size of screen suitable for use with this film and the structural conditions desirable when the projector is installed. In an appendix a specification is given of a 16 mm. projector.

WHAT does not appear in the report is the evidence on which the selection of a 16 mm. film is based, as against either larger or smaller sizes, unless it is contained in the statement that "there is a large selection of reliable apparatus for producing such films made by firms of repute". This, of course, is a condition to be taken into account, but when there are only about three hundred schools in Great Britain with apparatus of any kind and probably not half a dozen where it is used in the classroom for teaching purposes, as distinct from school halls for general education purposes, it would be worth while to undertake experiments to determine the ideal size, say, for the classroom. If that size could not be obtained, then it would be time to fall back on the 16 mm. On the face of it, the statement that the 16 mm. film is suitable for classrooms with eighty seats suggests that it is at least unnecessarily large for classrooms of thirty or even sixty, the maximum class number, soon to be done away with. Further, for anything from 30 per cent to 90 per cent of the time a film is used in the classroom, again in distinction to the hall, it is standing still, and in the case of the 16 mm. this has to be accompanied by a diminution of the light or the film will scorch. As the 9 mm. is somewhat too small, it may be suggested that the ideal size is somewhere about 11 mm. or 12 mm.

THE importance of accurate survey as a basis for the utilisation of land in our African colonies was emphasised in the Hilton Young Commission Report. In the *Journal of the African Society* for July, there is printed in full a recent lecture to the Society by Col. H. L. Crosthwait, in which he advocates the use of aerial survey in east and central African territories. Ordinary ground survey in a large colony would entail many years of work and very considerable expense before results of value were available. Col. Crosthwait points out that aerial survey would not only be three or four times as quick, but would also give a far greater amount of information about the economic resources of the country. This was shown in the recent survey of the Zambezi region, where reliable data were obtained regarding the geological structure, the state of the rivers, forestry, and other matters. It must also be remembered that aerial methods overcome many difficulties in swampy, heavily forested, or unhealthy country. Again, location surveys for railways and roads can be carried out much more rapidly by means of air survey than would be possible by the older methods. In a subsequent discussion on the paper, Sir Humphrey Leggett pointed out how much the administrative work of district and provincial commissioners would be facilitated by adequate maps. Col. Crosthwait does not advocate that the aerial surveys should be undertaken by the local governments themselves, but gave reasons why it would be less expensive and give quicker results to utilise private enterprise in the work.

THE programme of the ceremonies by which the Royal Geographical Society will celebrate its centenary on Oct. 21 next and the two succeeding days has now been issued. All the principal geographical

societies and institutions of the world have been invited to send delegates to these celebrations and a very large number have responded. Addresses of congratulation presented by these delegates will be received by H.R.H. the Duke of York, representing His Majesty the King, who is Patron of the Society, at the inaugural meeting at 3 P.M. on Oct. 21, when the Duke will also declare the new Hall, Library, and other buildings open for the use of the Society. The centenary meeting will be held in the newly opened hall at 8.30 P.M. on the same evening, when a series of addresses on the history of the Society will be given by the president and others. On the following evening the president, council, and fellows will entertain the delegates and a large number of official guests at a reception at 9 P.M. in the Society's House in Kensington Gore. The centenary dinner of the Society will be held on the evening of Oct. 23 at the Connaught Rooms, when H.R.H. the Prince of Wales, Vice-Patron of the Society, will preside. The programme announces also a series of communications from British and foreign geographers on the topics of the habitable globe and incidents in the history of exploration, to be presented at meetings on the morning of Oct. 22 and the morning and afternoon of Oct. 23.

THE determination of the permissible practical load an electric motor or dynamo can carry, that is, the determination of the power at which it should be rated, is a practical problem of considerable difficulty. The temperatures of the various parts of a machine must not exceed the limits given in the specification after it has been running on load for many hours and has attained its steady thermal state. Owing to the long time taken before the temperatures of the various parts of a machine reach their steady values, many attempts have been made to devise methods of predicting the final values by taking observations over a brief period of time. Could this be done, substantial economies could be effected in manufacturing works. The theoretical methods attempted generally proceed on the assumption that the heat convected away depends on the square root of the velocity of the rotating part and is proportional to the difference in temperature between the conductors and the surrounding medium. The loss by radiation, being much smaller, is generally neglected. Practical tests have also been made on model machines but hitherto no satisfactory methods of shortening the time of heating tests have been devised. In the *Journal of the Institution of Electrical Engineers* for July, two papers by Dr. E. Hughes describe the results of heating tests on actual machines. He varies the losses and the speeds, and his results show that the conclusions arrived at by experiments on models must be accepted with caution. The machines were tested both when 'totally enclosed' and when cooled by an induced draught. Several empirical formulæ are given, one of which enables the effect of speed to be allowed for when estimating the temperature rise.

A VERY novel use of refrigerating machinery for the salvage of ships is described by D. Mettler in the April–June issue of the *Escher Wyss News*, a journal published quarterly by the well-known engineering firm of Escher, Wyss and Co. of Zurich. Some years ago a Berlin engineer, W. Kiwull, devised a method of sealing a leak on a ship by forming a coating of ice over the rent in the metal hull. In northern seaports in winter time it is quite customary to see the hulls of ships all iced over, and this apparently suggested the idea to him. A company was formed and plans for a test plant were made and elaborated by Messrs. Escher, Wyss and Co. The test plant was to have a gross refrigerating capacity of 120,000 British thermal units per hour, and the power consumption was to be 25 horse power. The specification stated that the plant was to be erected and worked at a depth of between 10 ft. and 15 ft. below the level of the lake of Zurich. It was then to be worked for a fortnight without a hitch, maintaining its guaranteed output continuously. The refrigerating plant was contained in a water- and air-tight iron casing, the electric connecting cables and the connecting branches for the evaporating apparatus coming through. Under these trying conditions, the plant operated at full load continuously for 336 hours, that is, fourteen days and nights. A careful examination showed that it had not suffered the least injury. Many thousands of readings were taken during the tests, and the results show that the mimimum guaranteed output had been largely exceeded. From time to time the ice formation on the evaporative tubes was checked by divers. Ammonia vapour was employed and full technical descriptions are given in the journal of the compressing plant.

THE Report of the Carnegie Institution of Washington for 1929 is noteworthy, apart from its indications of progress in research, for the inclusion of a series of addresses delivered at special meetings at Cold Spring Harbor and on the research ship *Carnegie*, to celebrate the completion of twenty-five years' investigation in the biological and physical sciences. In the course of one of these addresses, Prof. E. G. Conklin summarised the progress of biology as one of four great eras. The first was the era of exploration and classification, when emphasis was placed upon differences amongst species and greater groups, and botany, zoology, and physiology were regarded as distinct and independent sciences. Then came the era of comparative anatomy, embryology, and physiology, when emphasis was placed on resemblances rather than on differences, when botany and zoology were seen to have much in common, though morphology and physiology remained independent. The third era was marked by generalisation and speculation regarding evolution, heredity, and variation, when family trees sprouted like weeds, and hypotheses were erected upon foundations of sand. The last and, according to Conklin, the present era, is one of experiment, of both analysis and synthesis, of a union of morphology and physiology. But we should be inclined to go further than Conklin and say that since there is no certainty that the experimental method, which necessarily interferes with the natural habits of animals, is final in its decisions, an old method in much improved guise is developing alongside the experimental—the close, continuous, and

detailed observation of the habits of creatures in their own environment.

PUBLICATION of scientific books is on the increase. The same may be said of books in every department of literature—a curious commentary on trade depression and the reduced spending power of the nation. The increases are far from being insignificant. Comparing the numbers published in the first half of 1930 with those of the corresponding period of last year (from the tables in the *Publisher and Bookseller* of July 4), we find that, with the exception of poetry, publication in every branch of literature has increased by 20 per cent or more, and following 'essays and belles-lettres' with an enormous increase of 108 per cent, come scientific or technical books with 86 per cent, the actual numbers in these two cases being 115–239 and 124–231. Medical books are grouped separately and here the numbers for last year and this year are 195–246, an increase of 26 per cent. The increase in numbers, which over all the list amounts to 40·45 per cent, is spread over works at almost every price, but the indication is that the average price tends to rise. Leaving out three exceptionally expensive books (priced at £70), it would appear that this year the average price stands at 7*s*. 5½*d*., against 6*s*. 9½*d*. in 1929. The total number of books of all sorts published in the first half of 1930 was 8017, an average of 44 a day, including Sundays. Where do they all find readers ?

THE serious decline in the numbers of the wild fur-bearing animals of California is indicated in *California Fish and Game* for April (p. 164), where a computation has been made of the numbers of skins taken under the trappers' licence law. The grand total of skins for the season 1928–29 stood at 103,508, including 39,407 skunk and 10,758 racoon, against 167,202 in 1927–28. In spite of higher average prices, the value fell in these two seasons from 468,960 dollars in 1927–28 to 280,309 in 1928–29. Some of the creatures concerned seem to be approaching the danger zone of extinction: twenty-nine 'fishers' were taken two years ago, but in the past season only seven, and the wolverine no longer makes an appearance in the list.

THE second number of the *Hong Kong Naturalist* (May 1930) improves even upon the high standard of the first, but as we suggested in noticing the earlier part, the editors have already found that many of their readers demand a larger proportion of simple and popular articles. This is a natural wish, and since it is desirable that the magazine should foster an interest in Nature, as well as constitute itself a guide to the details of fauna and flora in the region, the editors have wisely interspersed amongst the more technical papers, such as those on the orchids and the birds of Hong Kong and the fishes of China, articles of more general appeal on a wide variety of Nature topics.

THE Czechoslovak Ministry of Agriculture, acting in consultation with the chief official, public, and other bodies concerned with land improvement, drainage, civil engineering, etc., has started the preliminary arrangements for holding a land improvement exhibition in 1931. The exhibition will form part of the annual exhibition of the Agricultural League and will take place during the international agricultural congress at the end of May and the beginning of June in Prague. The exhibition will represent fully the activities of the various schools, institutions, public offices, and other bodies concerned with land improvement. It will be supplemented by meetings and discussions, as well as by visits to inspect work in progress, etc. Further information may be obtained from the Agricultural League, Prague.

REFERENCE was made in NATURE recently to the first report of the Bureau of Contraceptive Advice, Baltimore. A second report, covering the period of about a year ending Sept. 26, 1929, has been issued by Prof. Raymond Pearl. Advice has been given to 232 patients, compared with 168 during the first year, and an increasing number of physicians make use of the clinic. The Bureau has been in operation too short a time to make any definite report on the effectiveness of the advice given on contraceptive methods, but a wealth of material for the statistical study of various medical and biological problems has been collected. The largest individual number of pregnancies observed among the 400 women who have attended the Bureau since its inception is 22, and the largest number of children born to one mother is 15; this figure occurred three times.

THE Right Hon. the Viscount Chelmsford will open the new building for the Mining Department of the University of Leeds on Sept. 30 next. The building, forming the first portion of the University's scheme of construction, stands facing Woodhouse Lane at the north of the main site of the University.

THE following appointments in the Colonial Agricultural Service have recently been made by the Secretary of State for the Colonies: Mr. R. M. Nattrass, to be mycologist, Cyprus; Mr. J. B. G. Savory, to be superintendent of agriculture, Nigeria; and Mr. T. R. Stodart, to be dairy instructor, Palestine.

FATHER H. V. GILL, Rathfarnham Castle, Co. Dublin, commenting on the correspondence in NATURE of Sept. 6, p. 351, reminds us that an English translation of Boscovich's "Theoria Philosophiæ Naturalis" by Mr. J. M. Child was published in 1922 by the Open Court Publishing Co., and a review appeared in NATURE of Dec. 30, 1922, p. 870. In this work Boscovich gives his views on the properties of matter and in one of the Supplements he goes so far towards the theory of relativity as to affirm the inconstancy of length of a measuring rod moved about in space. An article, entitled "A Jesuit Pioneer of Relativity", including quotations from Boscovich's work, appeared in the issue for July 1926 of the *Dublin Review*.

REFERRING to Dr. Dirac's suggestion with regard to 'negative energy', in his British Association paper on the proton, Sir Philip Hartog writes to recall Osborne Reynolds's theory that "matter represents negative mass" ("Sub-mechanics of the Universe", 1903, p. 3).

The theory was originally put forward, with experimental illustrations, in 1902, in his Rede lecture "On an Inversion of Ideas as to the Structure of the Universe". It is worth while supplementing this reminder by mentioning that in a letter in NATURE of Aug. 18, 1898, Sir Arthur Schuster suggested that potential or negative matter might exist, and in a further letter in the issue of Oct. 27 he directed attention to papers by Prof. Karl Pearson and A. Föppl on the same subject.

ARRANGEMENTS have been made for lectures during the forthcoming winter by Mr. H. V. Garner, the guide demonstrator, and other members of the staff of the Rothamsted Experimental Station, Harpenden, to chambers of agriculture and horticulture, farmers' clubs, farm workers' associations, agricultural societies, etc., on the Rothamsted experiments. No fee is charged for the lecturers' services, but any association engaging them would be expected to defray their travelling and hotel expenses, and to make such arrangements for the lectures as may be necessary. All communications regarding lectures should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden, Herts.

DETAILS of a course of lectures on modern methods of analytical chemistry to be given during the forthcoming session have been received from the Principal of the Hackney Institute (London County Council). These lectures cover a wide field, including gravimetric, volumetric, optical, electrical, gasometric, micro and biological methods. Owing to the rapid growth of organic and physical chemistry, the time left for the study of analytical chemistry is a diminishing quantity, and the graduate, possibly with a good honours degree, taking up a position in a laboratory, soon finds that there is a large gap between his academic knowledge and the requirements of practice. Such a course as that mentioned above, if accompanied by sufficient laboratory work, should help to fill this gap. The teaching of analytical chemistry in Great Britain is still far behind that given in the United States and Germany.

A JOINT committee of the Association of Special Libraries and Information Bureaux (Sir Frederic Nathan and Lieut.-Col. L. Newcombe, National Central Library) and the British Society for International Bibliography (Dr. S. C. Bradford, Science Library, and Prof. A. F. C. Pollard, president of the Institut International de Bibliographie) has been formed to advise and assist in the adoption and use in Great Britain of the Universal Decimal Classification of the Institut International de Bibliographie, which has proved to be a suitable system for international use and is already widely employed. The international adoption of such a standard system of indexing would enable references to information on any subject, whatever their source, to be brought into their correct places in a bibliography, and this would tend to the preservation and freer exchange of knowledge in every intellectual field. Any one interested is invited to communicate with the Association of Special Libraries and Information Bureaux, 26 Bedford Square, London, W.C.1.

WE regret that by an error the official spelling of Kanchenjunga was incorrectly given in a note in NATURE of July 12 (p. 69). The spelling now adopted by the Survey of India is that given above.

THE summer issue of *The Fight against Disease*, the journal of the Research Defence Society, contains the annual report of the Committee, and an appeal is made for additional support as the expenditure has been £400 in excess of income during the last four years. The fourth Stephen Paget memorial lecture, by Mrs. Edward Mellanby, on "Diet and Dental Disease", is reported, and gives an interesting survey of the subject, illustrated with plates, as well as demonstrating how much we have learned on this subject from experiments on animals.

THE Cambridge Instrument Co., Ltd., has published a catalogue (No. 162) of alternating current instruments suitable for high frequencies. Recent progress in radio telegraphy and telephony has produced a demand for accurate instruments of this type. In reading the catalogue, we were specially interested in the alternating current potentiometer, the standard mutual inductometer, and the capacitance bridge, all designed by Albert Campbell. We also noticed the thermionic voltmeter designed by E. B. Moullin, which has both scientific and industrial uses. It has the unique qualities of absorbing practically no power from the circuit and possessing very little capacitance. At low voltages it is about forty times as sensitive as an electrostatic voltmeter. The Cambridge Instrument Co., Ltd., has also published a very useful Supplement to List No. 162, describing the best methods of measuring inductance, capacitance, and resistance with the instruments given in the list.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant for work on virus diseases of the potato—The Establishment Officer, Department of Agriculture for Scotland, Queen Street, Edinburgh (Sept. 27). A city engineer and surveyor to the Urban Sanitary Authority—Chairman of the Health Committee, under cover to the Town Clerk, Municipal Buildings, Liverpool (Sept. 30). A principal of the Aston Technical College—Chief Education Officer, Education Office, Margaret Street, Birmingham (Sept. 30). An assistant inspector of education and agricultural assistant—Director of Education, Springfield, Maidstone (Oct. 6). A principal of the Constantine Technical College, Middlesbrough—The Acting Secretary, Education Offices, Middlesbrough (Oct. 8). A junior assistant (male) in the directorate of ballistic research—Chief Superintendent, Research Department, Woolwich, S.E.18. An advisory agricultural chemist under the scheme of the Ministry of Agriculture and Fisheries for the provision of technical advice to farmers—The Registrar, University, Reading. A full-time teacher of engineering at the Chelmsford School of Science and Art—E. W. Alston, Education Office, 80 Duke Street, Chelmsford. A water and sanitary engineer for the Public Works Department, Trinidad—The Crown Agents for the Colonies (quoting M/2269), 4 Millbank, S.W.1.

Research Items.

Maori Fortification.—The *Records of the Auckland Institute and Museum*, vol. 1, No. 1, contains an account of the examination of the Piraunui Pa at Matawhana, Waikato, N.Z., by Messrs. J. W. Delph and Gilbert Archey, director of the Institute. The elaborate terraces of the Maori fortification are situated on natural strongholds formed by series of rock-capped headlands of the high rhyolite plateau of Central Waikato. The general layout of the fortifications is as follows: (1) A flat portion of the *marae* high up on a broad spur, below which is (2) a series of terraces on either side of the steeper ridge formed by the narrowing spur, leading down to (3) a still narrower and much steeper sided ridge cut across by a deep fosse and so forming a strongly protected approach to (4) the stronghold and citadel, a rhyolite-capped, vertical-walled spur rising with precipitous cliffs above the Waikato valley. The *pa* is very rich in storage pits of both the subterranean and semi-subterranean type. The former are built on flat ground wherever available, the latter at the base of some of the terrace walls. The subterranean pits are 6–9 ft. in diameter and about 5 ft. to the dome. In one which was cleared it was found that the floor was divided into bins, which would indicate its use for the storage of roots. In one, the original door-frames were still in place, tightly fitting to keep out the loose soil. Resting on the upper edge of one was a slab, the wood being well cut and originally about 2 in. in thickness. These pits penetrated into the hard rhyolite, and it was possible to see the method of working. Blocks of stone were worked behind or undercut so as to enable large slabs of rock to be broken off. The finish showed a skill which would not disgrace the efficient tools of a modern mason.

Marine Mollusca of Islands of the West Coast of Mexico.—In three consecutive papers, A. M. Strong and G. D. Hanna give the marine molluscan faunas of some islands off the west coast of Mexico visited on an expedition sent out by the California Academy of Sciences in 1925 (*Proc. Calif. Acad. Sci.*, 4th Series, vol. 19). Each paper consists of a full list of all the known species with introductory illustrative remarks. Guadalupe Island, which lies about 180 miles south-south-west of San Diego, California, is represented in the Academy's collection by 87 species, of which 9 appear to be new. Almost all are shore or shallow water forms and some have a wide northern range. Their presence, the authors hold, can be most satisfactorily accounted for on the supposition that the fry or spawn were transported on masses of floating kelp by a current at some time running along the southern Californian coast and turning out to sea at an angle that carried it past the island. In the Revillagigedo Islands collections were made at Socorro and Clarion islands and 61 species are recorded, the bulk of which would seem more properly to belong with the faunas of the Galapagos Islands or Panama than with that of the Gulf of California. The Revillagigedo fauna has the character of a waif fauna arrived by chance. The islands have probably not been connected to the mainland, even by a shallow submarine ridge, during late geological time and do not seem to have existed at all for a sufficiently long period for the mollusca to have developed insular species. Tres Marias Islands, where the expedition made a short stay, have been comparatively frequently visited before, but the list of known forms of marine mollusca has now been brought up to 211 species.

"Starfishes of the Pacific."—A monograph of the Asteroidea of the North Pacific and Adjacent Waters", by Prof. W. K. Fisher of Stanford University, California, is published as *Bulletin* 76 of the United States National Museum. Part 1 was issued in 1911, Part 2 in 1928, and now the work is completed by a third part, in large quarto, of which 356 pages are numbered as such, while other intervening pages bear outline or half-tone illustrations on one or both sides and are numbered as 93 plates. These bear descriptions and figures of the subfamilies of Asteriidæ—Asteriinæ, Notasteriinæ, and Neomorphasterinæ—first of the northern hemisphere, then of the southern. There are 71 species recognised in the former and 76 in the latter. The former, however, receive much fuller treatment and occupy most of the volume. The Neomorphasterinæ appear to be confined to the southern hemisphere, while of the other two subfamilies, no southern genus is found without doubt in the northern hemisphere. Dr. Fisher establishes two new subgenera of *Leptasterias*—*Nesasterias* and *Hexasterias*, also *Bathyasterias*, a subgenus of *Diplasterias*, *Eremasterias* and *Neosmitaster*, new genera of Asteriinæ. The monograph contains useful keys and name-lists and the descriptions and diagnoses are drawn up with Dr. Fisher's customary care.

Philippine Land Shells.—An exceedingly useful and important "Summary of Philippine Land Shells" has been compiled by L. A. Faustino (*Philippine Jour. Sci.*, vol. 42) as supplement to Monograph 25 of the Philippine Bureau of Science in which his "Summary of the Marine and Fresh-water Mollusks" was given. The work in question consists of a list in systematic order of all species of land shells described or reported to occur in the Philippine Islands, with reference to the original description of each and the name of the individual island where it was found. There is also an alphabetical index to genera and synonymic notes, while occasion has been taken to append a small "Addenda to Monograph 25".

Earthquakes with Deep Foci.—The report of the Seismological Committee presented at the Bristol meeting of the British Association is the last drawn up mainly by the late Prof. H. H. Turner. One of its most interesting sections is that which relates to earthquakes with very deep foci. When the epicentres of these earthquakes are plotted on a map of the world, it is seen that they are not distributed at random but are confined to a comparatively small portion of the earth's surface. The boundary of this area, as drawn by Prof. Turner, is a roughly oval curve, reaching from the coasts of China and Japan to half-way across South America. The centre of the curve is on the equator in longitude about 150°. As the area covers the greater part of the Pacific, it is suggested that this distribution of deep-focal earthquakes offers some support to the theory that the moon was detached from the Pacific bed.

Dislocations of the Crust with the Japanese Earthquake of 1923.—Soon after this earthquake, the Military Land Survey re-levelled several routes in the central area. The results showed such remarkable changes that it was decided to measure the whole Kwanto district. The field-work was finished in 1927, re-observations of the primary triangulation-points having been carried out over an area of about 6500 square miles, and of the secondary and tertiary points over an area in the severely shaken region of about 3000 square miles. A summary of the results is given in English by R. Sakuryobu in the *Bulletin* of the Imperial Earthquake Investigation Committee (vol. 11, No. 4, pp. 1-80; 1930). The base-line lies

in one of the most devastated regions to the north of Sagami Bay. The new measurement made in 1924 showed that, since 1910, its length of about 3¼ miles had increased by 9·7 in. The greatest displacement of a primary point is that of 11 ft. 7 in. in the island of Oshima, but this is exceeded in five of the tertiary points, the maximum being 12 ft. 6 in. To the north of Sagami Bay and for about 14 miles inland, the ground was elevated, the greatest rise being 6 ft. 1 in. near Oiso. In the area of subsidence farther north, no point sank by more than 4 ft. 2 in. In the Boso peninsula, the change is usually one of elevation, the greatest rise being 6 ft. 3 in. at its southern end. Near the centre of the peninsula, however, there are a few small areas of depression, in one of which the ground has subsided by so much as 5 ft. 7 in.

Electrical Resistance of Ferro-magnetics.—The issue of the *Physikalische Zeitschrift* for June 15 contains an account of the measurements of the changes of electrical resistance of iron and nickel wires when magnetised longitudinally, by Dr. O. Stierstadt, of the Göttingen Institute of Applied Electricity. The wires were magnetised in a coil giving fields up to 250 gauss and their resistances were measured by means of a Kelvin double bridge. No influence of the direction or magnitude of the bridge current on the resistance of the wires in any field could be detected. The change of resistance on magnetisation was in all cases found to be an increase and the fractional increase was found for iron $10^{-20}B^4$ and for nickel $10^{-15}B^{3\cdot4}$, where B is the magnetic induction in the material. The changes of resistance show a small hysteresis effect which probably accounts for the fact that some observers have found a decrease of electrical resistance in weak magnetic fields.

Alternating Stresses and Single Crystals of Metals.—Studies of the behaviour of single crystals of metals subjected to alternating stress have hitherto been confined mainly to crystals of the cubic system. From a theoretical point of view, it is important to know whether the planes of greatest atomic density or the lines of greatest density are the principal determining factors in mechanical slip. For this reason special interest attaches to two papers by H. J. Gough and H. L. Cox in Vol. A127 of the *Proceedings of the Royal Society*, dealing respectively with the behaviour of single crystals of zinc and antimony under alternating torsional stresses. Antimony was chosen because the planes of maximum atomic density in this metal do not contain any of the lines of maximum density, but the results were inconclusive, as the specimen could not be made to deform by slip, but cracked along certain crystal planes. The experiment is to be repeated with bismuth, which has a greater degree of plasticity. On the other hand, zinc, which has a close-packed hexagonal lattice, has given very satisfactory results. Slip occurs, as in static testing, on the basal plane, and its direction is that of the most highly stressed primitive direction. The twinning planes have been accurately determined, and it has been shown that the occurrence of twins as well as of slip-bands is controlled by the criterion of maximum resolved shear stress on the slip plane. Twinning in zinc has many features of interest, some of which are explained and others noticed for the first time in this paper, which is very fully illustrated.

Pulsations in Rotary Converters.—About thirty years ago, Gisbert Kapp and Bertram Hopkinson wrote papers on the abnormal working of synchronous motors. Explanations were given of their irregular working in certain cases and formulæ were obtained for the pulsations which, superposed on the steady running motion, produce the phenomenon of phase swinging. Hopkinson's theory, which shows how these pulsations can be damped by suitable devices, has proved of great use in practice. The analogous problem of the rotary converter can be treated in a similar way. This device consists of a machine which acts both as an alternating current synchronous motor and as a direct current dynamo. It takes alternating current in at one set of terminals and delivers direct current at the other, the power lost in the transformation being at the most a few per cent. These machines when running on a fluctuating load sometimes run irregularly owing to the pulsations produced. H. Cotton, in the *Journal of the Institution of Electrical Engineers* for August, discusses theoretically the theory of the motion in this case. The violent pulsations are caused when the free and the forced periods or harmonics of either synchronise. Formulæ are obtained for them and a rough verification is given by experimental results. The particular case when the machine is short circuited is considered. The mechanical analogy given for this case is the motion of a ballistic pendulum. Incidentally, considerable light is thrown on the requirements for the quick-acting circuit breakers which are in common use on the direct current side of these machines.

The Glass Electrode.—The use of the glass membrane electrode in determining hydrogen ion concentrations, although it has recently been shown by McInnes and others to be liable to error, is extending, and the description of a triode value arrangement for use with the electrode, given by G. B. Harrison in the July number of the *Journal of the Chemical Society*, is therefore of interest. The preparation of a new type of glass electrode is also described in the article. The technique is fully described and the arrangement permits of an accuracy of 0·02 pH unit over the range 1 to 12.

Molecular Weight of Legumin.—An investigation of the molecular weight of the protein legumin from vetch (*Vicia sativa*) by the ultracentrifuge method is described by Sjögren and Svedberg in the August number of the *Journal of the American Chemical Society*. The two proteins, legumin and legumelin, were separated by a process described in detail. A study of legumelin showed that it is not a simple protein. Legumin, on the other hand, is homogeneous with regard to molecular weight, the mean value of which was found to be 208,000 in a phosphate buffer of $p\mathrm{H} = 6\cdot8$. This, and other constants determined, agree within the limits of experimental error with the values for five other vegetable proteins previously investigated. The molecules of legumin are spherical, with a radius of 3·96 $\mu\mu$.

Density of Carbon Dioxide.—Especial interest attaches to the density of carbon dioxide on account of its close relation to several equations of state. In the June number of the *Canadian Journal of Research*, Cooper and Maass describe measurements of the density of the gas of sufficient accuracy to permit of direct extrapolation to zero pressure so as to give the limiting density of the gas. From this, the atomic weight of carbon, $12\cdot0033 \pm 0\cdot002$, follows directly. It was found that the graph representing the apparent molecular weight at 0° plotted against the pressure was a straight line. Full experimental results are given in the paper. The value of the molecular weight at S.T.P. agrees very well with that obtained by Guye from the weight of a normal litre.

Philippine Archæology.

PROF. H. OTLEY BEYER, head of the Anthropological Department of the University of the Philippines, has collected important archæological material during the last four years. In 1926 the construction of a dam on the Novaliches River brought to light a prehistoric village and cemetery which within the space of four months yielded some eighteen thousand specimens. During the next three years extended reconnaissance and excavation in the neighbourhood, mostly within the province of Rizal, brought to light nearly a hundred sites and an enormous amount of material, running into scores of thousands of objects.

Previously to these discoveries, the archæology of the Philippines earlier than, say, a thousand years ago was a blank. Almost at a stroke it has been carried back at least to the early neolithic and possibly earlier. Although the material has still to be worked out in detail, certain broad conclusions are possible. These are summarised and their bearing upon the prehistory of Eastern Asia indicated by Prof. Roland B. Dixon in vol. 69, No. 4, of the *Proceedings* of the American Philosophical Society.

On the Novaliches site five archæological horizons were distinguished. Of these, the most recent contained celadons, porcelains, and other ceramics, some dating back to the early Sung dynasty. This was preceded by two strata belonging to the iron age, below which were two stone age levels, one characterised by polished implements associated with fairly good hand-made pottery, and the earlier by implements only partly polished, associated with a cruder type of pottery. The extended observations in the province of Rizal revealed two earlier stone age phases, of which one is marked by deeply patinated chipped implements identical with the so-called 'Bacsonian' of Tonkin and not accompanied by pottery, to which both stratification and typology justify the application of the term mesolithic; and a second in which typical microliths and deeply patinated Mousterian-like forms suggest, in Prof. Dixon's view, the conclusion that they are palæolithic, even though the evidence of stratification is lacking.

While it would be well to accept Prof. Dixon's final suggestion only with very considerable reserve pending further evidence, there can be no two opinions as to the great value of Prof. Beyer's contribution to Philippine archæology. Its full significance, however, will not become apparent until it has been correlated and studied comparatively with the archæological material which has been, and is still being, brought to light in China, Tonkin, the Malay Peninsula, and the Dutch East Indies. When the time is ripe for the collation of the material from the whole area, and further, when it is brought into relation with the material from India, it should throw a flood of light on the racial and cultural drifts of eastern Asia.

In commenting on the material from the iron age strata in the Philippines, Prof. Dixon points out the similarity, and in some cases identity, of the iron and glass objects to those found in the dolmen tombs and urn burials of southern India, and refers to similar finds in the Malay Peninsula, Java, and Borneo. As he goes on to urge the necessity for research in southern India as a 'way-station' between western Asia and the Philippines, it may not be inopportune to refer to the work of the Indian Research Committee of the Royal Anthropological Institute on the archæology of the bead in India. A collection of type series of Indian beads has been formed which is available for students, and the first instalment of the Committee's work, with coloured illustrations of beads from southern India and Sarawak, is, we understand, to be published as a special number of *Man* in October.

Seventy-fifth Annual Exhibition of the Royal Photographic Society.

THE annual exhibition of the Royal Photographic Society was opened at 35 Russell Square, London, W.C.1, on Saturday, Sept. 13, and will remain open until Saturday, Oct. 11, from 10 A.M. to 9 P.M. each weekday except Tuesdays and Fridays, when it will be closed at 6 P.M. The following lectures are being delivered during the exhibition, at 7 P.M. on the evenings stated: Tuesday, Sept. 16—"The Mystery Bird of Britain and other Stories from Birdland", by Oliver G. Pike; Tuesday, Sept. 23, "From Alp to Apennine", by J. Dudley Johnstone, president of the Royal Photographic Society; Friday, Sept. 26, the lantern slides selected for the exhibition will be projected on the screen; Tuesday, Sept. 30, a popular lecture on astronomical photography, by F. J. Sellers; Friday, Oct. 3, "Kew Gardens—Some of its Beauties in Colour", by F. R. Newens; Tuesday, Oct. 7, "Tunis to Algiers", by the Rev. H. O. Fenton; Friday, Oct. 10, the amateur cinematograph films on 16 mm. (sub-standard) film which have been selected for the exhibition will be projected on the screen.

This exhibition may be divided roughly into three classes: pictorial work, record work, and research concerning photographic materials.

The pictorial work shown is from all parts of the world and is, of course, first-rate. Practically all of the important methods of photographic technique in both colour and monochrome are represented.

Photographic recording is now used as an aid to a vast number of activities; teaching, advertising, and research all make use of it. The exhibition contains examples of all these applications. In the natural history section are many beautiful photographs of wild animals and birds in their natural surroundings, and also of other objects. Two striking prints by Mr. J. A. Speed show a field-mouse in the act of rescuing its young. Mr. D. P. Wilson exhibits a good series of marine subjects, including one of Golden Star corals found on the shore at very low water in Cawsand Bay, Cornwall. Mr. W. C. Davies has three prints of the fossil remains of some very large insects, one being a kind of dragonfly with a wing span of about 12 inches.

Archæologists will be interested in several series of photographs of the Roman Wall and other Roman remains shown by C. Mason and G. E. Peachey. Aerofilms Ltd. show a vertical view of Ashdown Forest on which may be noted the faint indication of a Roman road and an enclosure probably built sometime about the commencement of the Christian era. This print shows the way in which aerial observation assists in the search for ancient remains which are almost invisible at ground level.

As usual, cloud photography is very well represented, and for his work in this field Mr. G. A. Clarke has been awarded a medal.

Last year note was taken in NATURE of some very fine spark photographs by P. B. Quayle, who showed several records of bullets and shot clusters in flight.

In this present exhibition, Mr. Quayle shows the bullet just as it penetrates a steel plate and just after, its jacket stripped off and its lead core broken into fragments mingling with flying particles of the steel plate itself. The main part of his exhibit is, however, devoted to a study of guns at the instant of firing. It is shown that the 'high shooting' of revolvers is not nearly accounted for by change of aim due to recoil, but is due in part to an upward velocity given to the bullet as it leaves the muzzle. Another series of photographs shows the bursting of shot guns caused by plugs of clay inserted in the muzzle before firing, a fine object-lesson to the sportsman who is inclined to carry his gun carelessly over clayey country.

General Motors Research Laboratories show a photographic study of combustion in engines. The examples given are for various mixtures of fuels. Some of these show pressure diagrams obtained during detonation.

The very great extension of research in the photographic industry during recent years is well shown in this exhibition. Five pieces of apparatus are shown, each one being of considerable importance. Kodak Ltd. exhibit a sensitometer designed for testing sensitive materials; a colorimeter intended for checking the colour of materials, such as sensitive papers, wrapping papers, cards, etc.; a goniophotometer for studying the polar reflection curves for cinematograph screens and also a mirror arc for use with the Kodascope apparatus for projecting 16 mm. cinematograph films. The British Photographic Research Association shows the latest design of photoelectric density meter as now marketed.

Dr. F. C. Toy and G. B. Harrison have recently succeeded in making a very thorough study of the photo-conductance of silver bromide. By means of models they now show some of the principal facts arising out of their work. Included in the same exhibit are specimens of large single crystals of silver bromide. These were prepared by methods similar to those employed for making single crystals of copper. The samples shown are probably the largest single crystals of silver bromide which have yet been made.

Ilford Ltd. show some examples of the influence of dyes on the spectral sensitivity of photographic materials, together with a very fine example of a clear photograph taken on a misty morning by the use of a plate sensitised to the infra-red and with a so-called 'infra-red filter'.

An instructional exhibit of great interest is shown by the research laboratories of Messrs. Thomas Illingworth, Ltd. It illustrates how the development of the negative must be controlled in order to yield a good print on a given printing paper. For comparison, the original object is shown in its proper lighting by the side of various negatives and prints. The limitations of photographic prints on paper are emphasised by including with the prints a positive transparency. The latter is seen at once to be a much more faithful representation of the original. This was so striking to the writer that he at once went on to see again the pictorial lantern slides in the exhibition. These are arranged for viewing as transparencies, and when so displayed give a demonstration of photographic rendering of tone which is considered by many people to be far more beautiful than that obtained by any other method. It is unfortunate that much of the beauty is lost when the pictures are projected on to a screen.

S. O. R.

Recent Studies of the Foraminifera.

THE Foraminifera constitute a class of Protozoa which provides many problems of great interest for the morphologist, the systematist, and the palæontologist. Their remarkable life history, the beauty and elaboration of their shells, and the records of their occurrence in the rocks from the most ancient times have been the subjects of many elaborate and important treatises in recent times. It is difficult for anyone to follow the progress of our knowledge of the group in all these directions; but as in other groups of animals, it is the work of the systematists which is most usually set aside as suitable only for the perusal of the specialists.

Accurate description and illustration of the various forms of animal life whether species or varieties is the essential basis upon which the construction of reasonable morphological theories must rest, and it is not unreasonable, therefore, to direct attention to the excellent work that is being done in the Foraminifera by Heron-Allen and Earland [1] in Great Britain, and by Hofker [2] in Holland.

The time is past when a study of the external form of the shells was considered sufficient. Nowadays the use of sections for the observation of the canal system in their walls, in the case of the arenaceous forms, the use of skiagraphs, when possible, and the careful search for dimorphism or trimorphism are necessary for the accurate determination of genera and species.

The number of specific names that have been given to members of the Foraminifera is so enormous that there may be some misgiving as to the validity of many of the species. No doubt many of the old names will disappear, but it is always difficult to determine the degree of discontinuity between a new form and an old one which justifies the constitution of a new species, and particularly so in the lower orders of animals where variation is wide and breeding experiments at present impracticable.

The recent investigations of Heron-Allen and Earland, in which the most elaborate methods were used, lend support to the view that among the free unattached Foraminifera there may be a true specific discontinuity.

Globigerina cristata, for example, from the deep sea mud of the South Atlantic seems to be, undoubtedly, a good species. From the smallest immature forms 0·08 mm. in diameter through a long series to the largest mature forms, 0·18 mm., the characteristic features which distinguish it from the other species of the genus can be observed. The same may be said of *Ehrenbergina crassa* and several other species described and figured in these papers.

Among the forms which become attached to foreign objects at the bottom and lead a sedentary life the beautiful symmetries of the shell are lost and variations in growth and many other characters are rampant.

In the widespread and very common *Foraminifer Polytrema*, for example, with its endless varieties of ramification, there seems to be no specific discontinuity, and the same is probably true of the genus *Gypsina*.

This has led to a great deal of confusion in the systematics of the group and to the proposal for the suppression not only of species but even of genera, which is quite startling to some of those who have taken an interest in these forms. Thus Hofker in a recent very fine monograph has declared that *Ramulina herdmani* is identical with *Carpenteria utricularis*

and "Sporadotrema is nothing else than a typical Carpenteria".

Without fully accepting all Hofker's conclusions, it may be said that his work has brought additional and important evidence of the extraordinar variability of these sedentary Foraminifera as compared with that of their allies which remain free throughout life.

This does not necessarily lead to the conclusion that specific discontinuity does not occur in any of the sedentary Foraminifera. That would be an extreme view which is not warranted by the facts. Such species as *Sorosphaera depressa* and *Schizammina labyrinthica* described by Heron-Allen and Earland in these papers seem to be good species. But it does suggest that in some cases such discontinuity has been lost or, perhaps, has not yet been gained, and that their survival depends not on the evolution of specific characters but on their extreme adaptability to the environment by their great variability.

Space does not permit comment on many other interesting features of these papers, but attention may be directed to the account given of the remarkable family the Pegididæ which have an extraordinarily thick shell and an unusual system of apertures. In this paper there is a reproduction of Dr. Orbigny's original sketch for a drawing of *Rotalia dubia*, a long-lost species now included in the Pegididæ.

S. J. H.

[1] E. Heron-Allen and A. Earland. On the Pegididæ, *J. Roy. Micr. Soc.*, 1928. Vol. 48. Some New Foraminifera from the South Atlantic, Parts I., II., and III. *Ibid.*, 1929; 1930. Vols. 49 and 50.

[2] J. Hofker, Foraminifera of the *Siboga* Expedition, Part II.; 1930.

Angiosperm Origins.

G. R. WIELAND has a very interesting discussion of the origin of Angiosperms in the *Proceedings* of the International Congress of Plant Sciences held at Ithaca, vol. 1, pp. 429-456 (George Banta Publishing Company, Menasha, Wisconsin, 1929). Naturally this account contains a particularly interesting recapitulation of the main features of the discoveries in the Cycadeoideæ with which the author's name is now linked through the genus *Wielandiella*, established as the result of Nathorst's fine reconstruction of difficult Swedish and Yorkshire material; but this general account is particularly valuable as it synthesises the available material, in a problem which ranges the whole globe and a considerable part of geological time.

Wieland argues that the Jurassic was a time of leaf and carpellary change in the earlier Angiosperms, just as the Cretaceous was the time of continued stem and floral change in fully characterised Angiosperms. He points out that the abundance of Angiosperms in Cretaceous rocks is due not merely to the increasing complexity in the phylum, but also to the greater thickness of the more and more recent plant beds. From this point of view he advises the botanist not to take too seriously the geologists' suggestion that the Angiosperms originated locally and suddenly; rather this impression may be due to imperfections in the earlier plant record; thus he calculates that of Jurassic times our plant records represent perhaps a tenth of one per cent of the species then existent, and those recorded mainly by dissociated leaves, stems, etc., more rarely by flowers and fruits. Some impressions of interesting new, possibly Dicotyledonous, fruits are recorded from Rhætic plant beds of the Argentine. Wieland states that the fossil series of insects described from these beds "mark the Argentine Rhætic as one of the most important fossil localities in the world".

Wieland concludes that there is every reason to regard the Angiosperms, "so far as actual descent goes, as old, quite as old as pines, and polyphyletic". He points out also that, from studies of fossil forms, it is easy to get a false impression that giant forms predominated in fossil periods, where specialised types make up the bulk of the fossil series. But this conclusion is not justified; the Cordaites varied from types with leaves ten feet long to those with narrow grass-like blades. Wieland suggests that "the contrast between the flowers of *Drimys*, in some species about the size of those of the chickweed, and related flowers a foot across, has surely been paralleled many times in the geologic past", so that many small fleshy forms of megasporophylls were probably grouped into seed cones allied to *Wielandiella* in Rhætic times.

Fluctuations in Fisheries.

ON April 12, 1929, the Conseil Permanent International pour l'Exploration de la Mer held in London a special meeting to discuss the present state of our knowledge concerning fluctuations in the abundance of the various year-classes of food fishes. So much interest is now being taken in this important branch of fishery research that no less than nineteen papers were read at the meeting, a full report of which has recently been published.*

When the Council entered upon its international collaboration thirty years ago, an enormous amount of work had to be done in the systematic determination of the various species, in ascertaining their geographical occurrence and distribution, and in locating their spawning grounds. As this work advanced, and more refined methods of biological analysis were brought to bear upon the steadily accumulating masses of data, it gradually became clear that to think only in terms of species was inadequate, and new concepts of definite tribes or races of the various species had to be evolved in order more clearly to grasp the true state of affairs in Nature. Still further research revealed, moreover, that these newly discovered tribes themselves often occur in several more or less distinct groups, depending upon such factors as age, size, and sexual maturity.

These comparatively recent racial investigations, and especially the study of the varying age-distributions in the stock of our chief species of food fishes, have opened up new vistas of marine investigation. They have explained in many cases the amazing fluctuations in the yield obtained by the fishing industry from year to year, and, more important still, it has even been possible to forecast future fluctuations—an achievement of very considerable practical value.

A paper read by Dr. Harold Thomson outlining his work on the haddock may be taken as typical of this branch of marine research, and indicates the possibilities inherent in the results so far obtained. After discussing the incidence and amplitude of brood survival, Dr. Thomson proceeds to consider the

* Fluctuations in the Abundance of the Various Year-Classes of Food Fishes. Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès Verbaux des Réunions, vol. 65, pp. 188. (Copenhague: Andr. Fred. Høst et Fils, 1930.) 7.25 kr.

possible causes underlying them. The following are suggested :

(*a*) Variation in the locality of the spawning ground. In the case of the haddock, the main centre of spawning activity may vary in position by so much as almost 2° of latitude. The effect of this movement of location is probably mainly an indirect one in that it influences the primary distribution of the eggs and fry.

(*b*) The numbers and average age of the spawning fish. The spawning shoals are always composed chiefly of haddock from three to six years old, and therefore include a series of broods differing in themselves in initial numerical strength. As there is an appreciable difference between the spawning locations assumed by younger and older haddock, the outcome may well be that the eggs and fry resulting from the spawning of younger fish predominating in one year will drift in quite a different set of currents from those resulting from the spawning of older fish predominating in another year.

(*c*) Early food supply. There is reason to suppose that the food requirements of the earlier (fry) stages are highly specialised, and that the necessary food organisms fall short of the demand to a greater or less extent in certain years. This, possibly, is the main cause underlying the not unusual wholesale failure of a brood.

Finally, as a result of careful analysis of the existing composition of the North Sea haddock, Dr. Thomson has been able to formulate the following tentative estimate of the immediate (1929) outlook for the fishery. " As the 1927 brood has proved to be almost a failure, catches may be expected to dwindle below the normal from the late autumn until well into next year (1930). About August of 1930 there should be a marked increase in the catches owing to the upgrowth of the very successful 1928 brood. In 1931 still greater catches should accrue. This is as far as can be seen ahead, for by the autumn of that year the influence of the 1928 brood will be waning and the next determining factor will be the quality, as yet unknown, of the brood of 1929. Estimations are therefore necessarily restricted to about two years ahead in the case of the southern portion of the North Sea. If these general anticipations prove correct an attempt should certainly be made to form seasonal or even monthly forecasts for the main fishing grounds."

Dr. Johan Hjort, in a brief survey of the methods and general principles underlying investigations into fluctuations in the stock of fishes, lays great stress upon the importance of the work. He suggests the setting up of an international biological organisation for the regular observation of age-distribution in the stock of our food fishes and of the relative—in time perhaps even the absolute—numerical strengths of the year-classes. Such a biological service, dealing conjointly with both biological statistics and a biochemical study of the fluctuating conditions in the sea, would in due course throw new light on many problems, and render possible a trustworthy fishery prediction service.

Linnæus and the Production of Artificial Pearls.

LINNÆUS was a great naturalist, but one gathers a fresh idea of his manifold interests in Nature from the series of articles in *Svenska Linné-Sällskapets Årsskrift*, Årg. 13, 1930. One of the most curious of these papers, by Gustaf Drake, recounts an incursion of Linnæus into the artificial pearl trade. In the course of his journey through Lapland, Linnæus paid a visit to a pearl-fishery, where the pearls were derived from fresh-water mussels. Knowing that various species of mollusca, both fresh-water and marine, could produce pearls, he formed the opinion that theoretically they could be formed by any shell, and turned his attention to their artificial production. He carried out several successful experiments, and Beckmann records that in 1765 he was shown by Linnæus himself four or five real pearls lying within the shells of *Mya margaritifera*, with the proud announcement : "*hos uniones ipse artificio meo arcano confeci.*" Before this time, however, word had got abroad of Linnæus's pearl-making secret, and in 1761–62 he was induced to demonstrate his method to Parliament. As a reward he was allowed the right of nominating his own successor, and chose his only son. But he also had a tempting offer from a private person for the monopoly of his pearl-producing method, though he did not accept it.

It is interesting to recall that the manuscripts explaining the pearl-producing method of Linnæus came into the hands of Sir James Smith and to repeat the latter's strong opinion regarding the exploitation of such scientific researches, conveyed in a letter dated Nov. 28, 1821 : " The only *pearls* I ever expected from the possession of your illustrious countryman's literary treasures are *pearls of science*, in which I have not been disappointed. I am contented with these, and am happy that Sweden appears satisfied with what I have done for the honour of Linnæus and for the science to which I have devoted myself, in humble imitation of that great man. I believe I am possessed of manuscripts of his own explaining the secret of producing pearls. I have also in his own cabinet of shells specimens of pearls so produced, and of mussel shells in various states upon which experiments have been made. I have no intention of carrying out the scheme—still less of paying £500 for any further information, nor, in short, of entering at all on the subject, for which I have no leisure." Can any of our readers say whether the experimental shells referred to are still in existence, and if so, whether the public has ever had an opportunity of seeing so interesting an exhibit ?

The natural philosophy of Linnæus is the subject of another very interesting contribution in the same *Årsskrift*. The Rev. Dr. Elis Malmeström considers that although Linnæus scarcely formulated a natural philosophy of his own, his ideas moved in the direction of such a philosophy, and in the preface and introductions to his various works he often indicated the direction of his thoughts about the universe, creation, life and its purpose. Three transitional stages of development are observable. In the first, ending about 1735, Linnæus expressed in the first edition of " Systema Naturae " a static idea of Nature which he had gathered from the Bible and especially from the creation myths of the Old Testament. Such an idea is presupposed by the whole of his systematic work, and he never really forsook it. The second period, up to about 1750, saw an endeavour to unify the discrepancies which appeared to be increasing between creed and science. The fixity of species seemed less assured than formerly, but Linnæus stood firm against materialism, and adopted the physico-theology of his day. The third period, from 1750 until his death, marked a strong drift toward theodicy and a teleological view of Nature. He now adopted a natural theology, in which everything worked for the glory of God. Behind his thoughts on natural philosophy lay a religious craving for harmony.

Historic Natural Events.

Sept. 21, 1486. Sweating Sickness in England.—According to Holinshed, "in this year a new kind of sickness invaded suddenly the people of this land passing through the same from the one end to the other. It began about the one and twentieth of September and continued until the latter end of October being so sharp and deadly that the like was never heard of to any man's remembrance before that time. For suddenly a deadly burning sweat so assailed their bodies and distempered their blood with a most ardent heat, that scarce one amongst a hundred that sickened did escape with life."

Sept. 21, 1741. Shower of Gossamer at Selborne.—Gilbert White records ("Natural History of Selborne") that before daybreak "I found the stubbles and clover grounds matted all over with a thick coat of cobweb. . . . When the dogs attempted to hunt, their eyes were so blinded and hoodwinked that they could not proceed, but were obliged to lie down and scrape the encumbrance from their faces with their forefeet. . . . About nine, an appearance very unusual began to demand our attention—a shower of cobwebs falling from very elevated regions, and continuing, without any interruption, till the close of the day. These webs were not single filmy threads, floating in the air in all directions, but perfect flakes, or rags: some near an inch broad, and five or six long, which fell with a degree of velocity, that they were considerably heavier than the atmosphere. On every side, as the observer turned his eyes, he might behold a continual succession of fresh flakes falling into his sight, and twinkling like stars, as they turned their sides towards the sun. How far this wonderful shower extended, it would be difficult to say; but we know that it reached Bradley, Selborne and Alresford, three places which lie in a sort of triangle the shortest of whose sides is about eight miles in extent." The gossamer descended even on the highest part of the downs.

Sept. 23, 1834. The "Padre Ruiz" Hurricane.—This was the most severe hurricane on record in Santo Domingo; it takes its name from the fact that it began during the funeral service over a priest of that name. The loss of life and property was appalling; everything was laid waste, large areas of timber being torn up by the roots. Hundreds of houses were destroyed and many vessels were lost. The stone church of San Antonio was demolished, and its ruins have been left as a monument of the storm. The downpour of rain was so great that a fisherman was drowned in the principal market, as no one dared to go into the street to assist him.

Sept. 23, 1924. Inundation at Leningrad.—At 10 A.M. the waters of the Neva commenced to rise rapidly and by 7.15 P.M. stood 12 feet above their ordinary level. This flood was second only to that of November 1824 and caused enormous damage. The flood was caused by a deep depression over Finland, resulting in westerly winds over the Gulf of Finland, which heaped up the waters and impeded the flow of the Neva. The actual flood was due to sea water.

Sept. 25, 1909. Magnetic Storm.—A magnetic storm, of brief duration but of unusual severity, began abruptly at noon on Sept. 25 and ceased about 15 hours later. The ranges at Greenwich—193′ in declination and 1710γ in horizontal force—have not been equalled there for at least fifty years. An oscillation in declination of 3° within 15 minutes of time was recorded at Kew; at Stonyhurst an oscillation of $2\frac{3}{4}$° within 2 min., and one of 5° within 14 min. at Cheltenham, Maryland. An aurora accompanied the disturbance of the magnets; at South Kensington, in spite of cloudy or overcast skies, the green auroral line was easily seen with a spectroscope. A large sunspot crossed the central meridian on Sept. 23·8, and this was observed spectroscopically to be very active; about twenty-six hours before the commencement of the magnetic storm, the spot was for a time nearly obliterated by an overhanging cloud of brilliant calcium that probably represented a large active prominence.

Sept. 25, 1928. Waterspout off Deal.—An immense waterspout was reported over the sea about $4\frac{1}{2}$ miles off Deal. It was described as having a conical shaped top which was encircled by a large rainbow, with a remarkable background formed by heavy rolling clouds in which the sun was setting. It lasted for about ten minutes.

Sept. 26, 1902. Heavy Rain in Sicily.—On Sept. 25–27 a barometric depression travelled northwards from Tunis and settled over Sicily. It was accompanied by an extraordinary series of thunderstorms, in the course of which more than half the normal year's rainfall fell in five days. The most violent occurred at 7.25 A.M. on Sept. 26; it lasted only about half an hour but in that time several inches of rain fell. The total for the 24 hours at Linguaglossa was 16·7 in., and in five days (Sept. 25–29) 29·1 in. At San Alfio 23·3 in. fell in two days and 30·6 in. in five days. The storm of Sept. 26 was followed by extensive floods. At Modica, where three small streams meet, the flood was the first since 1833 and the worst on record; the water rose 10 to 20 feet above the level of the streets, and 111 persons lost their lives, while enormous damage was done. A rock weighing 90 tons was carried two-thirds of a mile by the force of the water.

Sept. 27, 1911. Tornado in Victoria.—A violent tornado, in the shape of a long inverted cone of cloud, appeared between Leichardt and Derby about 2.30 P.M. and travelled south-eastward, completing a course of 12 miles in about half an hour. Much damage was done by the wind to buildings, cattle, and agricultural machinery, and several persons were injured. The tornado was accompanied by heavy rain and hail, some of the hailstones weighing a pound.

Sept. 27, 1912. Heavy Rain.—At Wynaad in southern India an extraordinary rainstorm broke at 1.45 P.M., unaccompanied by wind but with a good deal of thunder and lightning. The storm lasted an hour, during which time the fall amounted to 9·75 in. The extensive lowlands were flooded to a depth of more than a foot.

Sept. 27-28, 1908. Floods at Hyderabad.—At Hyderabad in the Deccan, India, during the passage of a cyclone, more than 15 in. of rain, nearly half the annual total, fell in 36 hours, causing the river Musi to rise 60 feet. A considerable part of the city was ruined, more than 5000 persons lost their lives, and 100,000 were rendered homeless.

CORRECTION. Sept. 10, 1903. Gale over British Isles. Line 5, *for* 5 mb. (1·4 in.) *read* 5 mb. (0·14 in.).

Societies and Academies.

PARIS.

Academy of Sciences, July 28.—**Deslandres**: The *raies ultimes* of the alkalis and alkaline earths.—**Bigourdan**: The observatory of Courtanvaux at Colombes.—**L. Blaringhem**: The influence of the pollen on the movements which precede the opening of the flowers in poppies.—**J. Costantin**: The increase in resistance to disease (of plants) due to altitude. The resistance of cultivated plants to disease is increased when the plant is grown at a high

altitude. The results with potato, sugar cane, and coffee plant are cited.—**Ch. Gravier** and **P. Mathias**: The reproduction of a phyllopod crustacean of the group Conchostriaceae (*Cyzicus cycladoides*).—**Paul Pascal** and **Erling Botolfsen**: The synthesis of methane starting with carbon monoxide and steam. In presence of a nickel catalyst, the reaction between carbon monoxide and steam depends upon the temperature. At 275° C. the reaction is $4\,CO + 2H_2O \longrightarrow 3CO_2 + CH_4$, but at 750° C and upwards the well-known reaction $CO + H_2O \longrightarrow CO_2 + H_2$ occurs.—**E. Mathias** and **G. Grenet**: The daily variation of the electric field of the air at the observatory at the coast of Landais. The results agree with those obtained at the summit of the Puy de Dôme and at Val Joyeux in showing daily two maxima and two minima of unequal importance. The amplitude of the daily variation is considerable at the lower station, the ratio of the maximum to the minimum being 3 for the summer, 2·1 for the spring.—**Paul Delens**: The geometry of connected cycles.—**Jean Pierre Robert**: Limited formulæ of mediation.—**S. Sonoda**: Radiation resistance of a small antenna oscillating in half waves.—**L. Brillouin**: The electrons in metals and the rôle of the conditions of Bragg's selective reflection.—**Jean Thibaud** and **F. Dupré La Tour**: Study of the α and β crystals of the fatty acids.—**J. J. Trillat** and **A. Nowakowski.**: The orientation of the fatty acids in contact with a liquid phase. It is shown that using the method of the tangent drop, it is possible to follow the various factors which govern the formation of crystals and the orientation of the molecules of fatty acids in contact with various liquids.—**George I. Costeanu**: Batteries with a sodium cathode.—**Guy. Emschwiller**: The absorption of ultra-violet light by the alkyl iodides. Details of quantitative measurements by the photographic method, using the recording microphotometer of Lambert and Chalonge. The substances studied included methyl, ethyl, propyl, butyl, isopropyl, isobutyl, secondary butyl, and tertiary butyl iodides and iodobenzene: these were examined as liquids and as gases.—**Mlle. L. Popovici**: Naphthyl-β-glyoxylic acid and some of its derivatives.—**Albert Saint-Maxen**: The autoxidation of hydroquinone. To a solution of hydroquinone, sodium hydroxide is gradually added. Curves are given showing the light absorbed, the electrical conductivity, and the oxidation velocity as functions of the amount of alkali added.—**Ch. Courtot** and **V. Oupéroff**: The systematic study of the condensation of the aromatic monoketones with the tertiary aromatic amines, under the action of aluminium chloride.—**Jean Lugeon**: Ionisation and electric field at El Goléa: lightning visible at 800 kilometres: mirages seen from a motor car: condensations in the dunes of the Grand Erg.—**René Girard** and **Robert Lemesle**: Structural peculiarities of the floral axis of *Ramondia pyrenaica*.—**Mlle. Lucienne George**: Some anatomical peculiarities of *Gnetum*.—**Aug. Chevalier**: The mycocecidia of the gyrophore of *Arachis*.—**Fernand Mercier**: A new water soluble derivative of camphor and of sparteine: sparteine camphosulphonate.—**M. Javillier** and **Mlle. L. Emerique**: A method of purification of carotene and the vitamin activity of a purified carotene. A carotene purified by five repetitions of a process described, and melting at 185° (the melting point given by Drummond for his pure but physiologically inactive carotene), still possesses powerful vitamin properties.—**Edm. Sergent** and **H. Ducros-Rougebief**: The preservation in Nature during the winter of *Drosophila*, carriers of yeasts.—**A. Leulier** and **P. Sédaillan**: The affinity of the diphtheria bacillus for copper. The diphtheria bacillus is not injured by small proportions of copper sulphate and fixes this metal in notable amount.—**Charles Benoit** and **André Helbronner**: Photochemical therapeutics.

Brussels.

Royal Belgian Academy of Science, Letters, and Arts, Mar. 1.—**Cl. Servais**: The geometry of the tetrahedron (5).—**E. de Wildeman**: Concerning multiplication in the Conjugates.—**Laurent Joyeux**: New contribution to the anatomy and systematics of Asparagus.—**L. Godeaux**: Certain series of Laplace associated with a given Laplace series.—**Radu Badesco**: A functional equation.—**H. R. J. Germay**: The formula of Lagrange.—**R. H. J. Germay**; The application of a method of successive approximations to the solution of the Gauss equation $\sin(z-q)=m\ \sin^4 z$.—**A. De Waele**: Life conditions of the vinegar eel, *Anguillula aceti*.—**Jacques Van Mieghem**: Study of retarded potentials.—**Raymond Defay**: The thermodynamical study of surface tension. Affinity and adsorption velocity.—**Jean P. Bosquet**: Examples of the reduction of the second variation of an n-tuple integral.—**Raphaël Deladrière**: The parametric or homogeneous form in the calculus of variations.—**H. Van de Walle** and **V. de Landsberg**: The preparation of symmetrical bromiodoethylene. The nature of the reaction between acetylene and a mixture of bromine and iodine depends on the solvents used for the halogens (water, hydrochloric acid, chloroform). In the separation and determination of the amounts of bromiodoethylene, diiodoethylene, tetrabromethane, chlorobromoethylene, dibromethylene and chloroiodoethylene present, in view of the instability of these compounds on distillation, use was made of the properties of the azeotropic mixtures obtained by distilling with butyl alcohol.—**Marcel Winants**: Application of the method of successive approximations to the integration of certain linear trinomial partial differential equations of any order.

Washington, D.C.

National Academy of Sciences (Vol. 16, No. 6, June 15).—**E. M. East**: The origin of the plants of maternal type which occur in connexion with interspecific hybridisations.—**Dietrich C. Smith**: Melanophore pulsations in the isolated scales of *Fundulus heteroclitus*. The hydrogen ion concentration seems to be the most important single factor concerned.—**John H. Welsh**: Diurnal rhythm of the distal pigment cells in the eyes of certain crustaceans. Diurnal rhythm parallels changes of activity of animal. It continues even under constant illumination, but proximal pigment does not show same movement. Effects of chloretone and ligation of eye-stalk suggest that movements are controlled directly by blood and indirectly by nervous system.—**G. H. Parker**: The colour changes of the tree toad in relation to nervous and humoral control. The American tree toad is unable to adapt its mottling to the size of pattern on which it finds itself. The pattern becomes sharper or fainter but without modification of detail. Adrenalin makes the pattern light in colour and pituitrin makes it dark. Humoral rather than nervous control is suggested.—**Donald Statler Villars**: Equilibrium constants of reactions involving hydroxyl: a correction.—**G. A. Miller**: Groups of isomorphisms of an Abelian group.—**Arthur B. Brown**: (1) Coalescence of parts of a complex.—(2) An extension of the Alexander duality theorem.—**Richard C. Tolman**: More complete discussion of the time-dependence of the non-static line element for the universe. A theoretical development of the theory described in earlier papers.—**R. A. Millikan** and **I. S. Bowen**: The significance of recent cosmic-ray experiments. The experiments

discussed are (1) absorption coefficients on high mountains and at great depths in mountain lakes (Millikan and Cameron), (2) absorption of gamma rays in mountain lakes (Millikan and Bowen), (3) gamma ray absorption in the laboratory (Chao), and (4) coincidences in ionisation counters (Bothe and Kolhörster, and Curtis). The results are considered to favour the atom-building hypothesis of the origin of cosmic rays, which seem to be photons rather than electrons. On striking matter, these photons share their energy with an electron, producing beta rays of penetrating power of the same order of magnitude as the cosmic rays themselves.—**C. Hewitt Dix**: Motion on a lattice. A theoretical discussion.—**C. Y. Chao**: The absorption coefficient of hard γ-rays. Thorium-C″ is used as a source of γ-rays ($\lambda 4{\cdot}7$ X.U.) and a parallel beam is used. Measurements were made with a Millikan cosmic ray electroscope and also with an ionisation chamber connected with a vacuum electrometer. The ratio of absorption coefficient to number of external electrons per c.c. increased with atomic number of absorbing substance. This may be due to (*a*) scattering by electrons within the nucleus; (*b*) the fact that scattering of a tightly bound electron of atoms of high atomic numbers may be greater than that of a loosely bound electron; (*c*) true absorption due to the photoelectric effect.—**B. F. Skinner**: On the conditions of elicitation of certain eating reflexes. Rats were fed in a sound-proof box in a sound-proof room and the rate of feeding measured; the pieces of food are of uniform size and removal of each piece is recorded electrically. The graph of amount eaten against time is of the form $N = Kt^n$ where N = food eaten at time t and K and n are constants; K varies from animal to animal and day by day, but n is always approximately constant.—**Francis G. Benedict** and **Cornelia Golay Benedict**: The energy requirements of intense mental effort. Respiratory exchange was measured by a helmet which permits free vision and is without mouthpiece or nose-clip. The subject lies down after a 12-hour fast and remains quiet with as little mental activity as possible. Then he is asked to respond to ocular or auditory stimuli to determine the metabolic changes required by attention or alertness, and finally he is given three or four 15-minute periods of intense mental effort (mental multiplication). There is a noticeable increase in heart rate, increased volume of air passing through lungs, and slight increase in oxygen consumption. The effects are not cumulative, and increase in heat production, even with intense mental effort of this type, is only of the order of 3 or 4 per cent.—**William Hovgaard**: Bending of curved tubes. Formulæ for displacements and stresses previously obtained were tested on pipes from $4\frac{1}{2}$ in. to 12 in. in diameter. Good agreement was obtained while the bends were well within the elastic limit. Plastic flow occurs along well-defined longitudinal zones.

Official Publications Received.

BRITISH.

Forest Department, Trinidad and Tobago. Notes on the Silviculture of the more Important Timber Trees of Trinidad and Tobago, with Information on the Formation of Woods. By R. C. Marshall. Pp. 50+6 plates. (Trinidad: Government Printing Office.) 2*s*.

Joint Board of Research for Mental Diseases, City and University of Birmingham. Annual Report of the Laboratory for the Year ending March 14th, 1930. Pp. 11. (Birmingham.)

Imperial Institute of Agricultural Research, Pusa. Bulletin No. 203: The Description of a New Fluke found in the Indian House-Crow (*Corvus splendens*). By V. R. Phadke and Amarnath Gulati. Pp. 8+1 plate. (Calcutta: Government of India Central Publication Branch.) 3 annas; 4*d*.

Records of the Geological Survey of India. Vol. 63, Part 1. Pp. 187+4 plates. (Calcutta: Government of India Central Publication Branch.) 2.12 rupees; 5*s*.

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 16: Technological Report on Banilla Cotton, 1924-30. By Dr. A. James Turner. Pp. ii+12. (Bombay.) 6 annas.

Department of Agriculture, Straits Settlements and Federated Malay States. Scientific Series, No. 1: A Preliminary Account of Three Rice Stem Borers. By H. T. Pagden. Pp. iv+30. (Kuala Lumpur.) 50 cents.

Department of Agriculture, Ceylon. Bulletin No. 87: The Cultivation and Commercial Possibilities of the Robusta Types of Coffee. By T. H. Holland. Pp. 19. (Peradeniya.) 40 cents.

Indian Lac Association for Research. Reports of the Committee and of the Director, Indian Lac Research Institute, Nankum, Ranchi, for the Year 1st April 1929 to 31st March 1930. Pp. ii+51. (Nankum.)

The Indian Forest Records. Entomological Series, Vol. 14, Parts 5-8. Part 5: The Indian Species of Palorus Muls (Coleoptera: Tenebrionidae) and some associated Beetles, by K. G. Blair; Part 6: Two New Species of Coleoptera from India, by E. Fleutiaux; Part 7: Some New Indian Cerambycidae, by J. C. M. Gardner; Part 8: Some Records of Indo-Malayan Psyllidae, by F. Laing. Pp. 44. (Calcutta: Government of India Central Publication Branch.) 1.2 rupees; 2*s*.

Canada. Department of Mines: Mines Branch. Investigations of Mineral Resources and the Mining Industry, 1928. (No. 710.) Pp. ii+57+2 plates. (Ottawa: F. A. Acland.)

Proceedings of the Royal Society of Edinburgh, Session 1929-1930. Vol. 50, Part 2, No. 17: The Distribution of Gene Ratios for Rare Mutations. By Dr. R. A. Fisher. Pp. 205-219. 1*s*. 6*d*. Vol. 50, Part 2, No. 18: The Definite Integrals of Interpolation Theory. By Dr. E. T. Copson. Pp. 220-224. 9*d*. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Cordwainers' Technical College, Eagle Court, St. John's Street, E.C.1. Prospectus of Classes in Boot and Shoe Manufacture and Making, and Leather Goods Manufacture. Day and Evening Classes, Session 1930-31. Pp. 43. (London.)

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series B, No. 6: Studies in the Sampling of Cotton for the Determination of Fibre-Properties. Part 1: Introductory and Experimental; Part 2: Frequency Curves for various Fibre-Properties. By Ram Saran Koshal and Dr. A. James Turner. Pp. ii+46. (Bombay.) 1 rupee.

Department of Public Instruction, Technical Educational Branch: New South Wales. Technological Museum: Curator's Annual Report for Year ended 31st December 1929. Pp. 7. (Sydney, N.S.W.: Alfred James Kent.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 7, July. Abstracts Nos. 1291-1495. Pp. 237-274. (London: H.M. Stationery Office.) 9*d*. net.

Ministry of Agriculture and Fisheries. Marketing Leaflet No. 23: The Bacon Industry; Interim Report by the Pig Industry Council. Pp. 8. (London: Ministry of Agriculture and Fisheries.)

Indian Journal of Physics, Vol. 5, Part 1, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 14, Part 1. Conducted by Sir C. V. Raman. Pp. 112. (Calcutta.) 2.4 rupees; 3*s*.

Survey of India. Geodetic Report, Vol. 5, from 1st October 1928 to 30th September 1929. Pp. xiv+156+29 charts. (Dehra Dun.) 3 rupees; 5*s*. 3*d*.

The Hundred and Eighth Report of the Commissioners of Crown Lands, dated 25th June 1930. Pp. 35. (London: H.M. Stationery Office.) 1*s*. 6*d*. net.

Transactions and Proceedings of the New Zealand Institute. Vol. 61, Part 1, March. Pp. v+215+38 plates. (Wellington, N.Z.)

South Australia: Department of Mines. Mining Review for the Half-year ended December 31st, 1929. (No. 51.) Pp. 100+9 plates. (Adelaide: Harrison Weir.)

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1316 (Ae. 453): Charts for Aircraft Performance Reduction. By H. L. Stevens and A. E. Woodward Nutt. (T. 2949.) Pp. 19+3 plates. (London: H.M. Stationery Office.) 1*s*. net.

Report on Damage to Plumbing Work caused by Frost. Prepared by a Conference convened by the Science Standing Committee of the Royal Institute of British Architects. Pp. 8. (London.) 3*d*.

British Museum (Natural History): Department of Botany. Exhibition of a Selection from the Historical Collections. (Fifth International Botanical Congress, 1930.) Pp. 23. (London.)

The Linnean Society of London. Exhibition of a Selection from the Linnean Collections. (Fifth International Botanical Congress, 1930.) Pp. 12. (London.)

East African Agricultural Research Station, Amani. First Annual Report, 1928-29. (Colonial No. 50.) Pp. 20. 6*d*. net. Second Annual Report, 1929-30. (Colonial No. 51.) Pp. 36. 1*s*. net. (London: H.M. Stationery Office.)

Report of the Third Imperial Entomological Conference, 17-27th June 1930. Pp. 59. (London: Imperial Institute of Entomology.) 2*s*. net.

Transactions of the Institute of Marine Engineers, Incorporated. Session 1930, Vol. 42, August. Pp. 475-565+xxxviii. (London.)

Hull Municipal Publications. No. 75: Guide to the Birds in the Hull Municipal Museum. By T. Sheppard. Second edition. Pp. 91. (Hull.) 4*d*.

FOREIGN.

Field Museum of Natural History. Report Series, Vol. 8, No. 1: Annual Report of the Director to the Board of Trustees for the Year 1929. (Publication 271.) Pp. 265+20 plates. Zoological Series, Vol. 17, No. 6: Reptiles of Marshall Field North Arabian Desert Expeditions, 1927-1928. By Karl P. Schmidt. (Publication 273.) Pp. 221-230+plate 2. Anthropological Series, Vol. 17, No. 2: Ethnology of the Mayas of Southern and Central British Honduras. By J. Eric Thompson. (Publication 274.) Pp. 23-213+24 plates. Geology Memoirs, Vol. 1, No. 1: Studies of Fossil Mammals of South America. A Partial Skeleton of Homalodontotherium from the Santa Cruz Beds of Patagonia, by Prof. William Berryman Scott; New Carnivorous Marsupials from the Deseado Formation of Patagonia, by Prof. William J. Sinclair; Results of the Marshall Field Paleontological Expeditions to Argentina and Bolivia, 1922-1927, Elmer S. Riggs, in charge. Pp. 39+8 plates. (Chicago.)

United States Department of the Interior: Geological Survey. Water-Supply Paper 615: Surface Water Supply of Hawaii, July 1, 1924, to June 30, 1925. Pp. iv+155. 20 cents. Water-Supply Paper 616: Geology and Water Resources of the Kau District, Hawaii (including parts of Kilauea and Mauna Loa Volcanoes). By Harold T. Stearns and William O. Clark; with a Chapter on Ground Water in the Hawaiian Islands, by Oscar E. Meinzer. Pp. ix+194+33 plates. 85 cents. Water-Supply Paper 629: Surface Water Supply of the United States, 1926. Part 9: Colorado River Basin. Pp. v+138. 20 cents. Water-Supply Paper 632: Surface Water Supply of the United States, 1926. Part 12: North Pacific Slope Drainage Basins. A: Pacific Slope Basins in Washington and Upper Columbia River Basin. Pp. v+154. 20 cents. Professional Paper 156: Revision of the Lower Eocene Wilcox Flora of the Southeastern States, with Descriptions of New Species, chiefly from Tennessee and Kentucky. By Edward Wilber Berry. Pp. iv+196+50 plates. 75 cents.. (Washington, D.C.: Government Printing Office.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 99: A Note on Two Marssonina Diseases on Willows. By Dr. R. M. Nattrass. Pp. ii+19+18 plates. (Cairo: Government Press.) 6 P.T.

Proceedings of the American Academy of Arts and Sciences. Vol. 64, No. 7: An Equation of State for Gas Mixtures. 2: A Study of the Methods of Combination of the Constants of the Beattie-Bridgeman Equation of State. By James A. Beattie and Shikao Ikehara. Pp. 127-176. Vol. 64, No. 8: The Anonymous La Conquista del Peru (Seville, April 1534) and the Libro Vltimo del Svmmario delle Indie Occidentali (Venice, October 1534). Edited, with an Introduction and a Bibliography, by Alexander Pogo. Pp. 177-286. 1.75 dollars. (Boston, Mass.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 254: Zeeman Effect of Neon. By Kiyoshi Murakawa and Tatsuro Iwama. Pp. 203-291. 20 sen. No. 256: Studies on the Coagulation of von Weimarn's Au_F Sols, II. By Elichi Iwase. Pp. 11. 20 sen. Nos. 257-259: Über die katalytische Reduktion des Kohlenoxyds unter gewöhnlichem Druck, 5: Die Einflüsse von Titanoxyd, Zirkoniumoxyd und Ceroxyd auf den Kobalt-Kupferkatalysator, von Shinjiro Kodama; On the Promoter Action in the Catalytic Oxidation of Methane with Steam, by Bennosuke Kubota and Tatsuo Yamanaka; The Separation and Determination of Gallium, 2: The Separation of Gallium and Aluminium from each other, and the Determination of these Elements, by Sunao Ato. Pp. 13-47. (Tōkyō: Iwanami Shoten.) 55 sen.

United States Department of Agriculture. Technical Bulletin No. 198: Relative Insecticidal Value of Commercial Grades of Pyrethrum. By C. C. McDonnell, W. S. Abbott, W. M. Davidson, G. L. Keenan and O. A. Nelson. Pp. 10. (Washington, D.C.: Government Printing Office.) 5 cents.

U.S. Treasury Department: United States Coast Guard. Bulletin No. 18: International Ice Observation and Ice Patrol Service in the North Atlantic Ocean, Season of 1929. Pp. iv+141+17 plates. (Washington, D.C.: Government Printing Office.)

Ministry of Finance, Egypt: Coastguards and Fisheries Service. Report on the Fisheries of Egypt for the Year 1928. By R. S. Wimpenny. Pp. x+86+4 plates. (Cairo: Government Press.) 5 P.T.

The Peking Society of Natural History. Bulletin, Vol. 4, Part 4: Yenching Science Conference Papers. Pp. 101. (Peking.) 1.50 dollars.

U.S. Department of Agriculture. Leaflet No. 59: Hints on Coyote and Wolf Trapping. By Stanley P. Young. Pp. 8. 5 cents. Circular No. 130: Traps for the Japanese Beetle. By E. R. Van Leeuwen and F. W. Metzger. Pp. 16. 5 cents. (Washington, D.C.: Government Printing Office.)

Société des Nations: Institut International de Coopération Intellectuelle. Coordination des Bibliothèques: Guide des services nationaux de renseignements du prêt et des échanges internationaux. Pp. 50. (Paris.)

University of California Publications in American Archaeology and Ethnology. Vol. 24, No. 7: The Carver's Art of the Indians of Northwestern California. By Isabel T. Kelly. Pp. 343-360+plates 103-119. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.) 40 cents.

University of California Publications in Zoology. Vol. 32, No. 4: Osteology of the California Road-Runner Recent and Pleistocene. By Leigh Marian Larson. Pp. 409-428. 25 cents. Vol. 32, No. 5: Notes on the Range and Life-History of the Pacific Freshwater Turtle, *Clemmys marmorata*. By Tracey I. Storer. Pp. 429-441. 25 cents. (Berkeley, Cal.: University of California Press; London: Cambridge University Press.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 255: Isotope Effect in the Spectrum of Neon, I. By Hantaro Nagaoka and Tadao Mishima. Pp. 293-316+plates 34-38. (Tōkyō: Iwanami Shoten.) 60 sen.

Publikationer og mindre Meddelelser fra Københavns Observatorium. Nr. 70: Das kritische Massenverhältnisse bei der Bewegung um L_4 und L_5 im Problème Restreint. Von Elis Strömgren. Pp. 14. (København: Bianco Lunos Bogtrykkeri A.-S.)

Collection des travaux chimiques de Tchécoslevaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 2, No. 8, Août. Pp. 489-544. (Prague: Regia Societas Scientiarum Bohemica.)

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 29, Part 1: Die biologischen Gruppen der Rhynchitinen, Attelabinen und Apoderinen. Von Hiromichi Kôno. Pp. 36+4 Tafeln. (Tokyo: Maruzen Co., Ltd.)

Proceedings of the Imperial Academy. Vol. 6, No. 7, July. Pp. xxiii-xxiv+243-295. (Tokyo.)

Memoirs of the Geological Survey of China. Series A, No. 6: The Geology of the Kalgan Area. By Prof. George B. Barbour. (Contributions from the Department of Geology, Columbia University, Vol. 42, No. 2.) Pp. xi+148+14 plates. (Peking.)

CATALOGUES.

Cambridge Alternating Current Instruments for Supply Frequencies. (List No. 161.) Pp. 28. The Grassot Fluxmeter. (List No. 173.) Pp. 8. (London: Cambridge Instrument Co., Ltd.)

Diary of Societies.

MONDAY, SEPTEMBER 22.

CERAMIC SOCIETY (Refractory Materials Section) (at the Building Trades Exhibition, Olympia), at 2.30.—W. J. Rees and J. H. Chesters: The Application of Tensile Tests to the Study of the Bonding of Refractory Materials.—C. R. F. Thelfall: Grog.—H. T. S. Swallow: The Influence of Atmosphere on the Load-bearing Capacities of Firebricks.

CERAMIC SOCIETY (Building Materials Section) (at the Building Trades Exhibition, Olympia), at 2.30.—F. L. Brady and E. H. Coleman: Influence of Firing Conditions on the Soluble Salt Content of Burnt Brick.—J. Williamson: Continuous Kilns for Burning Clay.—W. Emery: Red Roofing Tile Kiln Report.

TUESDAY, SEPTEMBER 23.

CERAMIC SOCIETY (Refractory Materials Section) (at the Building Trades Exhibition, Olympia), at 10.30.—W. Hugill: The Structure of Diatomaceous Earths in Relation to their Uses.—R. J. Sarjant: Works Tests on Refractories and Service Conditions.—W. Hugill and W. J. Rees: Effect of Repeated Burning on the Structure and Properties of Lime-bonded Silica Bricks. Parts II. and III.

CERAMIC SOCIETY (Building Materials Section) (at the Building Trades Exhibition, Olympia), at 10.30.—Ambrose W. Cross: British Bricks for British Roads.—G. A. Hodson: The Manufacture of Bricks for Road Paving in U.S.A. and Holland.—J. Bentley, jun.: A Few Observations on the Causes of a Particular Type of Crack encountered in the Manufacture of Plastic Machine-made Roofing Tiles.—W. Emery: Blue Brick Kiln Report.

INSTITUTE OF MARINE ENGINEERS, at 6.—Lieut.-Comdr. Sir August B. T. Cayzer: Presidential Address.

WEDNESDAY, SEPTEMBER 24.

CERAMIC SOCIETY (Refractory Materials Section) (at the Building Trades Exhibition, Olympia), at 10.30 A.M.—Council and General Business Meeting of Refractory Materials Section.

CERAMIC SOCIETY (Building Materials Section) (at the Building Trades Exhibition, Olympia), at 11.30.—Council and General Business Meeting of Building Section. The following papers will be communicated by title:—W. J. Rees and W. Hugill: The Effect of Iron Oxide and a Reducing Agent on the Rate of Inversion of Quartz.—W. J. Rees: Note on the Effect of Iron Oxide in Quartz Inversion.—J. W. Mellor: A Study of Pan Grinding.

THURSDAY, SEPTEMBER 25.

INSTITUTION OF LOCOMOTIVE ENGINEERS, at 6.—H. Kelway Bamber: Presidential Address.

SATURDAY, SEPTEMBER 27.

SOUTH-EASTERN UNION OF SCIENTIFIC SOCIETIES (Autumn Meeting).—Visits to St. Paul's Cathedral and the Natural History Museum.

THURSDAY OCTOBER 2.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section) (in the Chemical Department, The University, Bristol), at 7.30.—Prof. J. W. Hinchley: Air and Water.

FRIDAY, OCTOBER 3.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—S. J. Crispin: The Development of the Bridge.

SATURDAY, OCTOBER 4.

ROYAL SANITARY INSTITUTE (in the Assembly Room, Town Hall, Hereford), at 10 A.M.—Councillor Mrs. Luard: The Place of Women in Local Government.—G. H. Jack: The Preservation of the Countryside.—Councillor J. R. Barker: The Health Authority and the Milk Supply.

CONGRESS.

SEPTEMBER 29 TO OCTOBER 1.

FARADAY SOCIETY (in Laboratory of Physical Chemistry, Cambridge).—Discussion on Colloid Science applied to Biology.

Monday, Sept. 29, 2 to 4 and 4.30 to 7.—Equilibrium in Protein Systems. In Chair—Sir William Hardy, who will introduce the Discussion.

Prof. A. V. Hill: Membrane-Phenomena in Living Matter—Equilibrium or Steady State.

Dr. R. A. Gortner: The State of Water in Colloidal and Living Systems.

Prof. E. J. Bigwood: Distribution of Diffusible Ions in Gels.

Prof. W. Pauli: The Behaviour of Proteins towards other Colloids and towards Electrolytes.

Prof. F. F. Nord: The Biological Significance of the Physical Influence of Gases on Colloids.

Tuesday, Sept. 30, 10 A.M. to 11.15 A.M., 11.30 A.M. to 1 P.M., 2.30 to 4, and 4.30 to 7; and

Wednesday, Oct. 1, 10 A.M. to 1 P.M.—In Chair—Sir F. Gowland Hopkins, who will introduce the Discussion.

Dr. Honor B. Fell and Dr. Wilmer, followed by Kinematograph Studies of Living Cells by Dr. Canti: The Structure, Behaviour and Physiological Characteristics of Vertebrate Cells cultivated *in vitro*.

Prof. E. Faure-Fremiet: The Kinetics of Living Matter.

Prof. R. A. Peters: Surface Structure in the Integration of Cell Activity.

Prof. O. Warburg: Surface Reactions in Living Cells.

Prof. H. Pfeiffer: Isoelectric Point of Cells and Tissues.

Dr. A. von Muralt and Dr. J. Edsall: Double Refraction in Protein Systems.

Dr. J. H. Quastel: The Mechanism of Bacterial Action.

Other speakers will be: Prof. E. F. Burton, Prof. J. Duclaux, Prof. H. Euler, Prof. H. Freundlich, Prof. H. R. Kruyt, Prof. H. Lundegardh, Dr. P. Lecomte du Nouy, Prof. W. J. V. Osterhout, Prof. Wo. Ostwald, Prof. and Mme. Jean Roche, Dr. Straub, and Prof. T. Svedberg.