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British Woodlands.

THE seventh Annual Report of the Forestry Commissioners [1] recently issued summarises the work which has been accomplished in Great Britain up to Sept. 30, 1926. Interesting data are given of a census of the woodlands of Britain undertaken with commendable persistence by the Commissioners. This census has shown that the existing woods amount to 2,958,630 acres, less than half of which can be considered productive. The latter fact appears to have come as a surprise to the Commissioners. The few experts having a knowledge of the forestry conditions of Great Britain could have foretold the result with considerable certainty, and probably not a few of the proprietors also, in the absence of any expert knowledge to guide them.

It was common knowledge that considerable areas were maintained as game coverts, questions of their value for timber production being entirely subordinated to the premier object. The late Sir William Schlich often directed attention to this fact during the forty years he advocated an afforestation campaign in Britain. The heavy fellings made in the utilisable coniferous areas during the War have admittedly intensified the need for an afforestation programme, but have scarcely changed it. The question still remains one upon which the Government and public, but chiefly the latter, must definitely make up their minds. The problem is a pressing one, but the costs of afforestating the several million acres which the experts are unanimous in admitting can be made more productive under trees will be very much higher than would have been the case had the work been done before the War. The present sanctioned programme comes to an end in 1929, and the Commissioners, in the report under review, express anxiety as to the continuance of the work and advise that it should be carried out on an enhanced scale. The report, in fact, is far more than a mere enumeration of the work of the year. It is more concerned with placing before its readers the work achieved to date and the lines upon which, in the view of the Commissioners, the next ten-year programme should be drawn.

The arguments for and against the enhancement of the afforestation programme are weighty; for the true interests of the country, economic and otherwise, support the plea of the Commissioners for an enhanced programme. Those against are

[1] Forestry Commission. Seventh Annual Report of the Forestry Commissioners, Year ending September 30th, 1926. Pp. 45. (London: H.M. Stationery Office, 1927.) 1*s.* net.

chiefly concerned with the great expense involved, and the added factor that an experienced forest service has yet to be built up. After the wars of a century ago, prices remained high for a considerable period and gradually dropped. It may be hoped that the future, how distant none would dare to say, will see a similar reduction. This would mean that plantations now being made at £5 : 16*s.* to £7 : 10*s.* an acre might cost only half the amount. The cost of buildings, etc., for small-holdings would likewise be reduced; and so forth throughout all the various branches of forest work. Up to Sept. 30, 1926, 186 small-holdings (the average cost of 63 new buildings during 1926 was £623 apiece) had been completed. It is hoped that 750 small-holdings will be completed or in process of establishment (the limit in sanctioned cost is £800 apiece) by the end of 1929. It is stated that their number could be increased to 3000 or 4000 in the next ten-year period. The Commissioners admit that they have only had two and a half years' experience of this form of rural settlement. Experts in Great Britain disagree as to whether such a form of settlement is practicable. It is a common method in France; but small-holders there work 10 hours a day as a minimum during the spring and summer and are far thriftier than our people.

The cost of 'planting' is shown in a curious way in the Report. All expenses during the first year of formation, including weeding, are termed the cost of 'planting.' If 50 per cent. of the plants fail and have to be replaced, this operation is shown under 'establishment' of the plantation. Presumably if the whole of the trees under 'planting' failed, the replanting of the plantation would be shown under 'establishment,' a somewhat complex puzzle to set the forest officer in charge, say, fifty years hence. The Report shows (Table E. 5) that during the seven years £132,767 were spent on planting and £35,061 on 'beating up,' *i.e.* replacing failures in the plantations. This amounts to something more than 25 per cent. failures in the first plantings. For 1926 the figures are £28,621 and £13,071, slightly less than 50 per cent. failures. No private proprietor could afford to plant if 'beating up' on this scale had to be faced. It is scarcely a justification for speeding up the planting campaign during the next ten years, which is so warmly advocated in the Report.

That much good work has been accomplished by the hard-working officers of the young service under the Forestry Commissioners is undeniable. That experience can only come with increased knowledge and practice is equally undeniable.

Modern Alchemy.

Atomzertrümmerung: Verwandlung der Elemente durch Bestrahlung mit α-Teilchen. Von Hans Pettersson und Gerhard Kirsch. Pp. viii + 247. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1926.) n.p.

THE artificial disruption of many of the chemical elements can be regarded as a direct outcome of the study by Geiger and Marsden of the scattering of α-particles by matter, and the formulation, in 1911, of the nuclear theory of the atom by Sir Ernest Rutherford. Theoretical work of Darwin on collisions of α-particles with the nuclei of atoms was supplemented by the experimental work of Marsden and Lantsberry, who discovered the production of H-rays in hydrogen when α-particles collide with the nuclei of hydrogen atoms. The later development of this work by Sir Ernest Rutherford revealed the production of H-rays when nitrogen is bombarded by α-particles, and in this we have the first instance of the artificial disintegration of an element by α-rays.

Since 1919, the subject has been actively pursued by Rutherford and Chadwick in the Cavendish Laboratory at Cambridge, and the ejection of H-particles from the nuclei of many of the lighter elements has been established, the effects being most marked for elements of odd atomic number. Unfortunately, experiments of this nature require the use of appreciable quantities of radium, and this undoubtedly accounts for the fact that so fascinating a study has not been taken up in many more laboratories. In 1922, however, the authors of the present monograph commenced work on similar lines at the Vienna Radium Institute, which, since it was opened in 1910, has been an active centre of radioactive research, and possesses ideal facilities for such work. During the last five years these workers have gathered together a band of enthusiastic researchers, who have made valuable contributions to the subject under consideration.

As a result of the investigations carried out at Cambridge and Vienna, our knowledge of the effects of α-bombardment of the elements has reached a state which justifies the appearance of a monograph of the type under review. In writing it, the authors' aim was to arouse the interest of physicists in this fascinating branch of research, and to stimulate others to take an active part in its development. But, alas, the lack of strong radioactive preparations is a real difficulty. To those who are more fortunately placed in this respect, however, the book will be found of great

value in making readily accessible not only the experimental methods and results, but also their interpretation. The number of substances so far investigated is relatively small, and the methods of attack used at Cambridge differ in many respects from those used at Vienna. In consequence, the results obtained in the two laboratories are not always directly comparable, and in some respects show lack of agreement. Nevertheless, the authors have endeavoured to be impartial in their treatment, and science owes them a debt of gratitude for presenting such an excellent review of the subject.

In the opening chapter the question of transmutation in general is treated historically, and the authors wisely refrain from a discussion of recent claims in this field. We are then introduced to the main properties of α- and H-rays, and pass in review the relevant theory and the experiments carried out to test the validity of the nuclear theory of the atom. Chapter iii. deals with the earlier experiments on atomic disruption carried out at Cambridge and Vienna, and discusses the results of investigations on the α-particles of long range emitted by the *C*-products of radium and thorium. By the introduction of the method of observation of the atomic fragments in a direction perpendicular to that of the bombarding α-particles, it became possible to count scintillations much nearer the source of disruption, for both the number and range of the scattered α-particles are greatly reduced in this way. This method has been successfully applied both at Cambridge and Vienna, and the various results are given in the same chapter. The results of observations in the backward direction by the 'retrograde' method are also described. This method has been extensively used at Vienna and permits of a still closer approach of the counting screen to the material under examination. The more recent investigations on collisions with the nuclei of atoms are reviewed in Chapter iv.

Since the intensity of the scintillations produced by α-particles falls off considerably near the end of the range and the brightness of H-scintillations is much less than that of scintillations due to normal α-particles, the correct allocation of feeble scintillations is often a matter of difficulty. Pettersson and his co-workers have developed the technique of identification by direct comparison of α- and H-scintillations, and this is described in Chapter v., where an interesting account of the photographic action and absorption of H-particles is also given. This chapter also contains a description of Stetter's ingenious adaptation of the mass-spectrograph, by means of which the value $e/m = 9560 \pm 300$ was found for the H-particles from paraffin wax. Chapter vi. is devoted to the various unsuccessful attempts which have been made from time to time to influence the rate of decay of radioactive substances, whilst the following chapter deals with various theoretical considerations on such topics as nuclear collisions and the size of the nucleus. For any one contemplating work on the subjects of this volume, Chapter viii. is a veritable mine of useful information. It contains most valuable details on the preparation of sources of radiation, the application of the scintillation method, the optical devices used in work on disruption, the preparation and calibration of absorption screens, and other matters of technique. The book closes with an interesting chronological review of the work on atomic disruption, and a complete list of the relevant references to the literature.

From the results of the Vienna workers, the phenomenon of disruption by α-particles would appear to be of much more general applicability than the Cambridge results indicate. Moreover, whereas the latter school finds that disruption is not effected by α-particles of smaller range than about 4·9 cm., the former claims to have obtained positive results with α-particles of range less than 4 cm. (*e.g.* with polonium). The yield of H-particles found in Vienna is also considerably greater than that found at Cambridge. Such discrepancies do not appear surprising when we consider the great strain associated with the counting of such feeble scintillations as those produced by H-particles, so clearly revealed on p. 225 of the book under review.

It is unfortunate that observations have usually been made on the side of the scintillation screen remote from the zinc sulphide surface, as this must involve a distinct diminution in the brightness of the flashes, and render counting more difficult and less certain. Naturally, both schools have great faith in their own results, and whilst Kirsch and Pettersson have obtained evidence that the observed differences are attributable to the different optical arrangements used, Chadwick has directed attention to the difficulty of ensuring the absence of scattered α-particles of low velocity in experiments at short range. In our opinion, the position of the Viennese workers has been greatly strengthened by their more recent confirmatory evidence obtained by other methods, and it is to be hoped that before the appearance of a second edition of this valuable book the existing discrepancies will have been satisfactorily removed, and the main features of this fascinating subject firmly established.

R. W. L.

The Breeding and Rearing of Farm Animals.

Breeding and Improvement of Farm Animals. By Prof. Victor Arthur Rice. (McGraw-Hill Publications in the Agricultural and Botanical Sciences.) Pp. xiv + 362. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1926.) 17*s.* 6*d.* net.

IT is becoming more and more realised that it is a matter of primary importance to the stock-breeding industry to possess an understanding of the processes of reproduction and development. Of our existing knowledge of this subject in its relation to the breeding of farm animals, some was acquired long since by direct practical experience and has been handed down for countless generations. It follows that such knowledge, although generally sound—for otherwise it could scarcely have stood the test of time—was necessarily limited and uncorrelated, for it existed without reference to scientific system and is not founded on scientific principles. In recent years, however, a great deal of attention has been paid to the science of breeding, and although it cannot be said that research methods have led as yet to any spectacular developments of economic importance, nevertheless a great number of observations have been made and deductions arrived at which in the aggregate are already having an important effect upon practice.

The present volume has been written as a text-book on the breeding and rearing of farm animals. While it is in many respects severely practical, the author has succeeded in giving it a definite scientific bias, and much of the recently acquired knowledge which has been won by physiological and genetic investigation is duly included. Moreover, by giving a connected account of the different departments of the subject, the author points the way to further progress in the improvement of the various classes of stock.

The opening chapter, among other matters, deals with the derivation and history of the domestic animals, and the author, in common with other writers, takes the view that most of the species have had a multiple origin, but Prof. Ewart's extended researches on this subject are not alluded to. Chapter ii. is on the physical basis of inheritance, and the chromosome theory is adequately described. Here the author definitely identifies the genes or factors with the 'beads' which comprise the chromosomes. In a later chapter he goes even further and suggests that the genes are either proteins or enzymes (or both), merely making the reservation that "it is not known" which of the alternatives is true. Such a statement is much too crude for a scientific text-book, and we fail to see what advantage is gained, in the present state of knowledge, for any theory of heredity by identifying the mechanisms of transmission with definite chemical compounds or agencies.

The third and fourth chapters contain useful descriptions of the male and female genital organs, and the processes which occur in them, but the almost complete absence of any account of the œstrous cycle is a strange omission in a text-book on animal breeding. Such information as is given is confused and contradictory. Thus, the author quotes Williams as saying that "if a cow is bred during a heat period and does not conceive she will subsequently menstruate, while if she does conceive she will not menstruate." Here Williams's reference to 'menstruation' was clearly intended to refer to the sanguineous discharge which sometimes takes place shortly after œstrus and really represents the termination of the preceding œstrous cycle. Prof. Rice, however, in the very next sentence proceeds to state that "the menstrual period lasts for about 24 to 48 hours in cattle," etc., and that "this is a most important season, because it is apparently only during this time . . . that a mare, cow, ewe, or sow can be successfully impregnated." The use of the term 'menstruation' as synonymous with œstrus is quite unjustified.

In the next chapter, on fertility, there is some further allusion to the œstrous periods (p. 54), but the distinction between the monœstrous and polyœstrous conditions is not drawn and there is no reference whatever to the short (dicestrous) cycle either in pigs or sheep. This is also omitted in the summary of the "Chronological Order of Reproductive Processes" (p. 47), where we find a further confused statement as to menstruation (in cattle). Again, it is not correct to describe the absorption of the corpus luteum as occurring at a later stage of the cycle than "nutrition of young." It is a mistake also to describe the vasa deferentia as the homologues of the Fallopian tubes, as these have a different origin in embryonic development. There is an interesting description of the American work on the vitality of the ova and the spermatozoa, but no account is given of Hammond's more extended investigations published in 1925, and the author does not appear to realise the practical possibilities of transmitting semen from a distance or the importance of what has actually been accomplished.

The succeeding chapters on sterility and reproductive efficiency deal with many matters of

practical importance besides pointing the way to further lines of work. It is interesting to note that some of these (for example, the question of the time of ovulation in the mare) have already been taken up. The sections dealing with parturition, genetic problems, grading, inbreeding, etc., are also full of interest, and the analysis of the show-yard records of the leading animals of different breeds contains much information which is not otherwise readily accessible. The chapter upon the development of farm animals includes many useful hints as to management and feeding. The last chapter, entitled " Fitting for Sale and Selling," is entirely practical, and directs attention to sundry matters of importance to every breeder who would market his products successfully.

The book is well illustrated, many of the figures being photographs of outstanding specimens of farm animals. There are appendices on biometry and inheritance in horses, cattle, etc., besides a list of Pedigree Register Associations and a bibliography of references. In the second edition, which ought soon to be called for, these should be made more complete and the results of the latest researches incorporated. F. H. A. MARSHALL.

The Mathematics of Intelligence.

The Abilities of Man: their Nature and Measurement. By Prof. C. Spearman. Pp. viii+416+xxxiii. (London: Macmillan and Co., Ltd., 1927.) 16*s*. net.

PROF. SPEARMAN'S new book, embracing his researches for some years past, is an exceedingly difficult book to review, and this for more than one reason. In the first place it is distinctly written for the layman, and he is expected to take many things on faith. He has to trust Prof. Spearman's mathematics and still more Prof. Spearman's arithmetic. Now we can scarcely call upon the author of a popular book of this nature to justify either arithmetically or mathematically all his statements, but we do think that without overcrowding his pages he might have given us more of the numerical data on which his conclusions are based, so that we could test their adequacy without an immense amount of labour. This point is all the more to be emphasised because Prof. Spearman claims to have made by his investigations a " Copernican revolution in point of view." He tells us that he has " not — as all others — set out from an ill-defined mental entity the ' intelligence ' and then sought to obtain a quantitative value characterising this. Instead, we have started from a perfectly defined quantitative value ' g,' and then have demonstrated what mental entity or entities this really characterises " (p. 411).

Now in order to test the justification for this statement that a Copernican revolution has been made in the study of the human mind, it is certainly needful to check not only the arithmetic but also the mathematics on which the claim is based, and neither of these are light matters, especially in such a brief review as this must necessarily be. But without some reference to the mathematics of the subject the real basis if our author's Copernican revolution cannot be rendered clear, nor without some arithmetic can we determine whether the values he gives are to be accepted straight off.

With much of the author's criticism of the definitions of intelligence hitherto proposed, we must undoubtedly agree; it is ably and amusingly written. But Prof. Spearman escapes any like criticism of himself by giving no definition of intelligence at all. He hypothecates that the measurement of a mental ability (A_n) is a function of two factors, a general factor g and a specific factor s_n, the former being a factor of all a person's mental abilities and the latter varying from ability to ability. g is independent of the s_n's, and the latter are independent of each other. Mathematically

$$A_n = \phi\,(g, s_n)$$

where ϕ is a function as yet undetermined. Prof. Spearman then proceeds to replace this general functional relation by a purely linear one; he in fact writes

$$A_n = c_0 + c_1 g + c_2 s_n$$

and all his conditions and his treatment depend on this linearity. Now the mind is a complicated organism, and quite as complicated as many physical phenomena, which do not obey any such linear relationship. What real justification is there for the adoption of such a form?

" The answer to this question is that our proof has depended upon usage of Taylor's theorem, according to which all mathematical functions, however complex, can, in general, be expressed in the above simple additive form with some approximation. This theorem has supplied the main foundation for the whole theory of correlation, from the original work of Bravais onwards; indeed, it is among the main props even of physics " (p. xv, Appendix).

We do not know how many physicists would agree with such a statement, but we presume that if they have adopted a linear relation, it is because it has been demonstrated experimentally

to hold within some limited range. In the same way the only justification for linearity of regression is not Taylor's theorem, but observation and experiment. With our knowledge of the innumerable cases in which regression is non-linear, it is neither possible to assert that linearity is the main foundation of the whole theory of correlation, nor to accept it without foundation on experiment as a justification. Some light might have been thrown on the matter had Prof. Spearman provided a distribution of g's for a population of reasonable size.

Accepting for the time this linear relationship, what flows from it? Without doubt, if a, b, c, d are four measurable abilities, the vanishing of what Prof. Spearman terms their tetrad differences, *i.e.*:

$$r_{ac}r_{bd} - r_{ad}r_{bc} = 0.$$

Of course, in actual statistics this vanishing will depend upon the error of random sampling of a tetrad, and ultimately this error depends on the number (p) of individuals on which the correlations have been based. When p is small and the correlation r is large, the distribution of r does not follow the normal curve of errors; it is very far indeed from doing so. Correlations as high as 0·60 based upon 37 individuals deviate widely from the normal law, and many such occur in the chapter entitled "Proof that G and S exist." But whether the distribution of correlations be normal or not, it is perfectly certain on the basis of Prof. Spearman's own data that the distribution of tetrads is *not* normal. What it really is, even if the original mental ability correlations followed a normal law, no one at present knows. We are simply ignorant, and it is impossible to consider that any confirmation of the theory of two factors can be reached by placing a normal curve on top of the distribution of tetrads and judging merely by the eye of the goodness of fit. For example, the most ample data discussed by Prof. Spearman are those of Holzinger, involving 378 tetrads, and those of Simpson involving 3003 tetrads. If we apply to these distributions the normal curves for the theoretical standard deviations of these systems of tetrads, *i.e.* the actual values, not those computed by the approximate formulæ of Holzinger and Spearman from the mean correlation, we find for the first distribution, only one random sample in ten would be as bad a fit to the normal curve, and again for the second, that not one random sample in a million would give as bad a fit. Now we do not complain of these distributions failing to be normal curves, because we hold that they ought not to be. But we do complain of Prof. Spearman assuming them to be normal distributions, and using this as an argument in favour of his two-factor hypothesis. Indeed, after placing a normal curve on his data in the last case, Prof. Spearman writes (p. 146):

"This time, the two distributions, curve and rectangles, far from being totally discrepant as before, display instead one of the most striking agreements between theory and observation ever recorded in psychology. Indeed, it would not be easily matched in any other science."

These words seem unfortunate not only because of the high improbability of the curve fitting the data, but also because there exists no theoretical reason why it should do so.

Prof. Spearman starts with rendering his distribution of tetrads symmetrical, *i.e.* making each tetrad once positive and once negative. Hence he naturally has something that looks like the familiar cocked hat shape of the curve of errors. Further, he can in this manner reach no test whatever of whether they are zero within the limit of random sampling. He has made his mean tetrad difference value zero artificially. For Simpson's data the diagram has attached to it a scale lettering, in which 0·020, 0·030, 0·035 are printed where we ought to have 0·20, 0·30, and 0·35, that is, the tetrad differences are accidentally, but very unfortunately, given one-tenth of their true values, and accordingly appear very small. Underneath the diagram we read: *Probable error* = 0·061, *Observed median* = 0·062. This latter is the only real test provided of the agreement of theory and observation. It is not quite clear how Prof. Spearman has obtained these figures. The actual theoretical mean value of the 3003 squared tetrads is 0·007,887 corresponding to a theoretical standard deviation of 0·088,809, or if we use the term probable error, although the distribution is not normal, we have the value 0·059,901 instead of Prof. Spearman's 0·061. If we understand by *Observed median*, the observed quartile of the symmetrical tetrad difference distribution, it is 0·0581, not 0·062 as given on p. 146. The question would then be whether 0·060 and 0·058 are in good agreement. But a better way to approach the problem is probably to note that the theoretical mean squared tetrad is 0·007,887, while the observed value is 0·009,817. The difference between observed and theoretical mean is thus 0·001,930. If we could measure the probable error of the mean in the usual way on 3003 observations with a standard deviation of 0·017,769, it would be 0·000,219, or the deviation

would be some 8·8 times the probable error. We should accordingly conclude on these data that the new Copernican theory, so far from being in "striking agreement" with observation, signally failed.

While, however, we know the theoretical mean squared tetrad value—always, alas! on the basis of variates following a normal distribution—we do not know the true probable error of this squared tetrad value. The reason for this is that the tetrads are not like the individuals of an ordinary frequency distribution merely correlated by the fact that the size of the sample is fixed. On the contrary, there is correlation produced by the fact that in this case the 3003 tetrads are functions of only 91 individual correlations, and this correlation is very high in the case of the triplet of tetrads based upon sets of four correlations. To determine the true probable error of the sum of the squared tetrads will be a problem which will task the ablest mathematician, even if he assumes (i) that the original mental variates follow the normal law and (ii) that the correlation coefficients follow—which we know they do not—the same law. At present no one can say whether or not the sum of the squared tetrads differs from its theoretical value by amounts which can be accounted for on the basis of random sampling. But we can say that what Prof. Spearman considers proofs of his theory are not proofs, and that much mathematical work remains to be done before we shall even be in sight of a proof. With the failure of Chapter x., that is, "Proof that G and S exist," the very backbone disappears from the body of Prof. Spearman's work. Even if the correlations of mental abilities were taken to vary at random with a given standard deviation round a given mean, the distribution of the resulting tetrads would form an approximately normal system, and many tetrads would vanish or nearly vanish; it would be idle to pick these out as special illustrations of *g*. But this is in fact what occurs in the later chapters of "The Abilities of Man."

We have confined our criticisms to one point; there are others, especially in the mathematical appendix, where we hold Prof. Spearman's analysis to be defective. But it seems to us that there is one main question: Is the experimental proof of the existence of a general and of specific factors on which the author bases his discussions in this work valid? Prof. Spearman holds that it is; we hold that it is not. The truth can only be ascertained by lengthy arithmetical and mathematical investigations, unsuited to a review of the present kind.

One advantage of the publication of this book will be that the attention of mathematicians will be directed to the real difficulties of the analysis, and this should lead, in conjunction with the psychologists, to a fitting series of tests in which probably some fifteen to twenty abilities should be measured on four or five hundred individuals. In particular, the abilities must be selected beforehand, and none rejected after analysis because they do not satisfy the condition of zero tetrad difference. Prof. Spearman has had the merit of directing attention to the subject, but his book will do more harm than good if it leads the non-mathematical psychologist to believe that the author has proved his hypothesis. It may possibly turn out to be true, but the proof will have to be far more rigid than anything so far provided in "The Abilities of Man."

The Exploitation of Tropical Africa.

An African Eldorado: the Belgian Congo. By T. Alexander Barns. With an Introduction by Sir Louis Franck. Pp. xv + 229 + 23 plates + 4 maps. (London: Methuen and Co., Ltd., 1926.) 15*s*. net.

Out in the Blue. By Vivienne de Watteville. With a Preface by the Hon. William Ormsby-Gore. Pp. xvi + 254 + 65 plates. (London: Methuen and Co., Ltd., 1927.) 18*s*. net.

THESE two volumes deal with two different aspects of the exploitation of central Africa. Mr. Barns is chiefly concerned with the development of the mineral and agricultural resources of the Congo basin, particularly those parts under Belgian control; Miss de Watteville sees tropical Africa through the eyes of a naturalist. Mr. Barns paints an illuminating picture of the fertility of tropical soil, the scope for the development of the wealth of its natural vegetation, its metalliferous ores and precious stones, and indicates the respective rôles of the white man and the native in this development. Miss de Watteville's only concern is the exploitation of the fauna of the tropics in the interest of the Berne museum, by the authorities of which she and her father, the late Bernard de Watteville, were commissioned. Within the compass of 225 pages Mr. Barns deals with most of those aspects of African life and travel which interest most of us, whatever our peculiar interest may be, whether geology, botany, zoology, history, or anthropology. Miss de Watteville devotes the same amount of space to a straight tale of systematic killing of wild animals and the preparation and preservation of their hides for a museum.

Lingering yet in our memory is the account given by the late E. D. Morel of the horrors of the Leopold regime in the Congo, an account which aroused the peoples of Europe to effective protest. Now, according to Mr. Barns, Belgian administration in the Congo is characterised by as much regard for the welfare and progress of the natives as the British administration in West Africa. Sir Louis Franck, former Belgian Colonial Minister, who contributes a preface, describes the official attitude thus: "We believe in the progress and future of the black man, and we want to pave the way for him towards a better standard of life, a great improvement in health and efficiency, and a higher civilisation. . . . We are absolutely opposed to anything like colour bar or race discrimination in the opportunities offered to black labour."

The difficulties of the Belgian administrators are common to all aliens in tropical Africa. They are faced with great difficulties of communication which the mighty waterways do not altogether surmount, with multitudinous insect pests—a constant menace to man and beast—the conservatism of the natives, the diversity of tribes and languages, pygmies in close proximity to giants, and the shortage of capital. On the other hand, they have certain special advantages. "All its eggs are in one basket." The upturned edges of the basin of the Congo are a storehouse of mineral wealth in amazing abundance, while in the well-watered plains the oil-palm, rubber, rice, cotton, sisal, and other economic plants flourish, and there is rich pasturage for cattle on the slopes of the basin. In the south there are mountains of copper in the Katanga Copper Belt, with gold, tin, radium, and cobalt in close juxtaposition. In the Mandated Territory of Ruanda, on the east of the Rift Divide, is one of the most populous and richest cattle countries in Africa, the cattle possessing the advantage of immunity from East Coast fever. In the north-east are the Kilo and Moto gold mines, and again to the south, in the Kasai, extensive diamond fields are being worked. On the material side, therefore, Mr. Barns regards the Belgian Congo as "an Eldorado," a country which promises a rich return for men of small means as well as for development companies with large financial resources.

The main interest of this arresting volume lies, however, not so much in the author's description of the material resources of the country, as in his description of the scenery, of the peoples, their habits and customs, their arts and crafts, of the flora and fauna, and his incidental notes, some of which are of particular interest to scientific workers. For example, in the high country in the Kivu craterland, there are no tsetse-fly, but the cattle suffer from tsetse-fly disease. In the fly-districts around Lake Edward and along the Semliki river, man and his domesticated live-stock have managed to hold their own against the epidemics of nagana and sleeping-sickness that have so often ravaged the district. The African elephant, he tells us, "is very free from disease, can thrive at all elevations from the sea to 13,000 feet (the equatorial snow-line), can stand alike either cold or heat and can obtain nourishment from a greater variety of vegetation than any other animal." Mr. Barns's book, with its beautiful photographs, will add to his already considerable reputation as a charming and accurate observer of the Africa he loves.

To those who are interested in the details of a 'collecting' expedition, and wish at the same time to read an amazing story of a girl's pluck and persistence after the tragic death of her father in an encounter with a lion, Miss de Watteville's book can be recommended. A. G. CHURCH.

Our Bookshelf.

The Chemistry of the Natural and Synthetic Resins. By T. Hedley Barry, Alan A. Drummond, and Dr. R. S. Morrell. (Oil and Colour Chemistry Monographs.) Pp. viii + 196. (London: Ernest Benn, Ltd., 1926.) 21*s*. net.

THIS volume is divided into two sections, dealing respectively with the natural and the synthetic resins. Perusal of the former of these sections gives the impression, only too correct, that our knowledge of the chemistry of the natural resins consists mainly of information concerning botanical sources, methods of collection, and of a few variable 'constants.' Practically only in the case of colophony, the commonest resin, has any approach been made towards elucidation of the chemical constitution of complex bodies present in these natural products; it is not surprising, therefore, that the author has allotted to this particular topic one-third of the space in this section.

Following a brief account of the botanical origin and nature of resins by Dr. Willis, the first two chapters deal with general physical and chemical properties. Only resins of interest to the varnish maker are considered, and these are classified under the following headings: hard and semi-hard resins, spirit-varnish resins, colophony, soft resins, true lacquer, and shellac.

Despite systematic attempts at the conservation of sources of supply, the partial exhaustion of the natural resin constitutes a danger which should not be overlooked; the introduction of the synthetic resins, therefore, is most timely. Although our knowledge of the chemical processes

involved has lagged behind the technical side of the subject, investigations during the last few years have afforded considerable insight into the various causes and stages of resinification; these are well set out in the volume under notice. The synthetic resins, other than those obtained by treatment of the natural varieties (*e.g.* by esterification of colophony and copal) which are also dealt with in this section, fall broadly into two classes, the condensation resins and the polymerisation resins. These are considered under their respective headings; other products, such as the treated phenol-formaldehyde resins and those from urea and thiourea, are considered separately. The section concludes with a brief chapter on the methods of testing synthetic resins.

The book covers a very large field, and certainly presents in modest bulk a useful summary of our present knowledge of the products discussed. The index is adequate, although one or two omissions have been noted. Unfortunately there is an unduly large proportion of misprints, mainly in the first section; names mis-spelled in the text persist in the index, whilst some references are incorrect.

B. A. E.

Spectroscopy. By Prof. E. C. C. Baly. (Text-books of Physical Chemistry.) Third edition. In 4 volumes. Vol. 2. Pp. viii + 398 + 3 plates. (London: Longmans, Green and Co., Ltd., 1927.) 18*s.* net.

PROF. BALY'S well-known work on "Spectroscopy," which formed a single volume in the first edition of 1905, as well as in the second edition of 1912 and 1918, has now begun to grow so rapidly that the third edition is to appear in four volumes instead of the two volumes that were originally contemplated. This expansion is an almost inevitable sequel to the amazing growth of the subject since Bohr first introduced the quantum theory into spectroscopy in 1913; and no one will grudge the author more space in which to expound the wider knowledge that has been gained during the subsequent years. These topics, however, are not included in the present volume, which contains only one indexed reference to Bohr, and none to the quantum theory.

The subjects dealt with are: (i) interference methods, (ii) methods of illumination, (iii) the nature of spectra, (iv) fluorescence and phosphorescence, (v) the photography of the spectrum. Thus a detailed account is given of the use of an interferometer in the study of double stars, with diagrams of the apparatus used at Mount Wilson, which look rather like a 'Meccano' model, until it is seen that the beams are made from 10-inch and 12-inch steel channel. The methods of illumination range from flame spectra to the 'explosion' of wires by means of a condenser discharge. The chapter on the nature of spectra deals mainly with the structure, width, and sharpness of the lines, *e.g.* the resolution of the green mercury line into a dozen components and the classification of these components into three triplets and three remaining unrelated lines. The chapter on fluorescence and phosphorescence covers a wide field, including Wood's work on resonance spectra and on fluorescence, the work of the two Becquerels and of Nichols and Howe on the fluorescence of uranyl salts, Stewart's experiments on Tesla luminescence spectra, and a large amount of work on phosphorescence and luminescence of various types. The final chapter on photography includes a considerable amount of information supplied by Dr. Kenneth Mees, and also a section on sensitisation written by him.

The author is to be congratulated on completing his second volume, and preparing the way for the description in Vol. 3 of those modern developments which have given to spectroscopy a predominant position in atomic physics, comparable to that which it held when Bunsen first applied the spectroscope to the study of the chemical elements.

Über die Natur und Bildungsweise der marinen Eisensilikate, insbesondere der chamositischen Substanzen: ein Beitrag zur chemischen und mechanischen Sedimentation. Von Dr. Karl C. Berz. (Fortschritte der Geologie und Paläontologie, Heft 11.) Pp. viii + 365-522 + 6 Tafeln. (Berlin: Gebrüder Borntraeger, 1926.) 12 gold marks.

DURING recent years considerable progress has been made in the description of ferriferous sediments. Works by Hayes on the Wabana iron ore (1915), by Cayeux on the French secondary ores (1922), and by Slavik on the Czechoslovakian deposits have contributed substantially to the elucidation of the chamosite-bearing rocks, while corresponding researches have been carried out on the English iron ores by the Geological Survey of Great Britain since 1920 (see "Summary of Progress for 1922" (1923), and Special Reports, vol. 29 (1925)). The present work contains a review of this question on similar lines to the above, dealing in some detail with the German deposits. The author limits himself to the discussion of existing literature on the subject, with a few additional descriptions, and provides a useful account of many rather inaccessible papers on local ores. In dealing with general literature the author has evidently been somewhat at a disadvantage, for of the works above mentioned not one appears in the bibliography, though there is passing reference in the text to the report by Hayes.

The views advanced are substantially in agreement with those generally current, the ores being regarded as primary sediments. Interesting sketches are given of the tubular organisms sometimes found in the ooliths; the author does not regard them as having played an essential part in the formation of the oolith, but rather as parasitic growths accidentally preserved in the inorganic structure. Chamosite is described in detail from the mineralogical viewpoint, but the corresponding account of glauconite is scarcely adequate, and more space might perhaps have been given to the discussion of the glauconitic sediments. As is perhaps inevitable in a work of compilation, the tone of the discussion appears somewhat speculative,

for the origin of these rocks has been the subject of a great variety of conflicting theories; but many useful observations are recorded. The microstructures are illustrated by twelve photographs of chamositic sandstones and oolitic ores from French, Belgian, and German localities.

A Survey of American Chemistry. Vol. I.: July 1, 1925, to July 1, 1926, including Reports from Scientific Committees, Division of Chemistry and Chemical Technology, National Research Council. Edited by William J. Hale, in co-operation with Clarence J. West. (Published for National Research Council.) Pp. 257. (New York: The Chemical Catalog Co., Inc., 1927.) 2 dollars.

THIS compilation will afford actual assistance to chemists in so far—only so far—as its prearranged national limitations have been ignored by the authors of its thirty-four chapters. Summaries of the literature of chemistry are increasingly acceptable to the chemist, whether investigator, teacher, or student, provided that it may reasonably be supposed that relative scientific value is the only criterion of the consideration or rejection of subject matter. Moreover, the student of American history would obviously be better served if he could be provided with some means of ascertaining whether the numerous reports of investigations which are here admirably chronicled and discussed were as American in origin as the name of the journal in which they appeared would indicate; if, too, he could gauge the extent of the lacuna represented by the publications of Americans in European journals. It will be obvious, also, that the granting of a patent is no guarantee that the work is indigenous.

In any case, both chemists and historians will regret the absence of an index; not even a list of authors is provided. In some chapters, however—the net is spread very wide over pure and applied chemistry—it is evident that an attempt has been made to present a summary not only of considerable interest but also of permanent value. A. A. E.

Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 19: Wismut und radioaktive Isotope. Pp. xxii + 229. 33 gold marks. System-Nummer 20: Lithium. Pp. xxiv + 254. 37·50 gold marks. (Berlin: Verlag Chemie G.m.b.H., 1927.)

THE parts of Gmelin's new "Handbuch" which deal with lithium and bismuth, like the earlier parts, show abundant evidence that a painstaking and exhaustive review of the literature up to July 1926 has been made. Following the general plan of the work, the parts open with notes on the history and distribution of the elements. Then follows a comprehensive survey of their physical, electrochemical, and chemical properties, and a similar scheme is adopted in dealing with compounds of these elements with such other elements as precede them in the scheme (see NATURE, Mar. 5, p. 346). That the search through the literature has been thorough may be inferred from the fact that the description of one salt alone (lithium chloride) occupies fifty pages and contains detailed numerical data relating to hydrates, to solutions in water and in organic solvents and to complex ammine-chlorides. A summary of recent work on the atomic dimensions, atomic structure, and isotopes of lithium is given, whilst the radioactive isotopes of bismuth are fully described in a special section, which includes not only detailed references to recent papers but also a synopsis of the general literature on the subject.

Ancient Egyptian Materials. By A. Lucas. Pp. viii + 242. (London: Edward Arnold and Co., 1926.) 7*s.* 6*d.* net.

IN his preface Mr. Lucas points out that it is only in recent years that the archæologist has availed himself of the assistance of the chemist. With certain reservations this is correct, and it is true that a great deal of detailed work has still to be done. A reference to the sections in the present book which deal with the use of metals will show to what an extent questions relating to the source and early history of copper and bronze must remain in suspense until analyses of specimens of these materials from early sites and early workings have been made. Whence came the tin which was imported into Egypt? Mr. Lucas thinks that it may have been Spain, and inclines to the view which relegates Cornwall as a source of copper to the Middle Ages. If the edict of Sargon is correctly interpreted as referring to a "land of tin," this would give a mention of that metal earlier than that in Homer quoted by the author; but Spain seems a far cry from Mesopotamia at so remote a date as 2750 B.C.

This is one only of a number of problems which is raised by Mr. Lucas's book. Each of the materials used by the ancient Egyptians is taken in turn and described, its nature or composition examined, and its use, and wherever possible its place of origin and the date of its first employment given. Appendices deal with chronology and, what will prove especially helpful, give a number of analyses of metals and other materials. One point brought out very clearly by this method of treatment is the indebtedness of Egypt to western Asia.

The Aborigines of the Highlands of Central India. By B. C. Mazumdar. Pp. vi + 84. (Calcutta: The University of Calcutta, 1927.) n.p.

THIS is a small but valuable contribution to our knowledge of some hill tribes in central India. The author, who is lecturer in cultural anthropology at the University of Calcutta, has first-hand experience of the Sabara Kols and other neighbouring tribes. The pamphlet contains a description of the customs and organisation of these natives, as well as an attempt at tracing the historical relationships of these aboriginals to the other inhabitants of mid-India.

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 in the Upper Atmosphere.

THE more important agencies which may conceivably cause the ionisation of the upper atmosphere of the earth are the ultra-violet light, α- and β-particles, all of solar origin, the penetrating radiation of cosmic origin, and the ionising radiations from terrestrial sources. The last mentioned may perhaps be ruled out immediately because of the fact that the conductivity of the lower atmospheric strata increases rapidly with the height for the first few kilometres. The possible effects of these ionising agencies have been considered in papers by Chapman and Milne, Benndorf, Elias, Lassen, and others. Recently, experiments with the electromagnetic waves of wireless telegraphy, together with theories of the propagation of these waves over the surface of the earth, have led to more definite information about the ionisation in the upper atmosphere, and it has been of interest to examine again the causes of the ionisation.

The experiments of Breit and Tuve with 70 metre waves, of Heising with 57 and 111 metre waves, of Wagner and Quäck with 15 and 16 metre waves, and the experiments of Taylor on the skip distances of waves below 50 metres and the theoretical considerations of Taylor and Hulburt of these skip distances, show that the electron density N increases with the height Z above the earth, reaching a value of about 4×10^5; above the height where N has this value, nothing is known of the electron density except that it does not go on increasing. Although the wireless data are none too extensive, it may be taken that in summer (for the north temperate zone) the height where N is of the order 10^5 is roughly 150 km. at midday, rising to 300 km. at 2 A.M., and in winter is around 200 km. at midday and 600 km. at night. To this may be added an interpretation from the experiments of Appleton with 400 metre waves that N is of the order of 10^3 at about 100 km. for a June night in England.

Because of the diurnal variation in the ionisation, we chose the ultra-violet light of the sun as being the ionising agency deserving first consideration. In order to make an explicit calculation of the ionisation of the temperature, the pressure, and the constituent gases and their partial pressures, must be known at each height in the upper atmosphere. These we may take as given completely in the classical thermodynamic isothermal equilibrium theory of Humphreys, Jeans, and others. There is a question as to the existence of hydrogen in the upper atmosphere, but the conclusions given later are much the same whether hydrogen is there or not. There is also the question of ozone, or oxygen, which may be of great importance.

Further, the law of the recombination of the electrons with the positive ions must be known. When the electron collides with a positive ion, in order for recombination to occur, energy must be dissipated in some way, either (*a*) by a third body, such as another molecule—this is J. J. Thomson's theory of recombination, and complete formulæ are available—or (*b*) by radiation (simple formulæ for this case are easily derived). We must also recognise the possibility of the electron attaching itself to a neutral molecule, for when it does this, thereby producing a negative ion, it is no longer as energetic a refractor of the wireless rays. The oxygen molecule is the only important one in this connexion, and the values of the attachment coefficient measured in the laboratory for pressures of 10 mm. of mercury and above must be extrapolated to pressures below 10^{-2} mm., perhaps a questionable extrapolation. Using all these things with (*a*) and making entirely acceptable assumptions as to the amount of ultra-violet light from the sun in the spectral region useful for ionisation, the N, Z curve rises rapidly from $N = 0$ at $Z = 100$ km. to $N = 4 \times 10^5$ at $Z = 150$ km.; above this height N falls off slowly. With (*b*) the N, Z curve is much the same as with (*a*), but N falls off more rapidly with Z above 200 km. Either of these N, Z curves is in fair accord with the wireless data for full daylight conditions. One might be content with the agreement, for the present, were it not for what happens at night. At night, after the removal of the sun's ultra-violet radiations, the calculated N, Z curve sinks down somewhat towards the Z axis, but with no great change in the height at which N rises to 4×10^5. This is distinctly contrary to the indications of the night-time wireless data, which require the electron bank to move up, so that the height at which $N = 4 \times 10^5$ at midnight may be roughly twice the midday height.

In an endeavour to bring the calculations into accord with the wireless experiments, we may abandon the classical pressures, increasing them by a factor of 10^2 or 10^3 for heights above, say, 150 km., and at the same time increasing the partial pressure of the oxygen at these heights. In this way we can obtain the electronic densities at night and day required by the data of the shorter wireless waves. In increasing the classical pressures we are doing exactly what Lindemann was led to do in his theories of the meteors. He has suggested that the formation of ozone, with its attendant strong absorption from 2000 Å.U. to 3000 Å.U., may be a sufficient cause of temperatures and pressures higher than the classical ones. The existence of oxygen in the higher levels is supported to some extent by the recent identification of the auroral line with oxygen. There remains, however, a difficulty with the 400 metre waves of Appleton. A simple smooth increase of the total gas pressure and the partial oxygen pressure, which yields an ionisation satisfactory for the shorter waves, wipes out the night-time ionisation below $Z = 130$ km.

A way out is to assume an irregularity in the pressure-height curve; for example, to assume that the pressure drops off with the height, then increases to a maximum at 80 km. or 100 km., and decreases thereafter. Or, one may assume an ozone layer at this height and that the ozone does something peculiar to the ionisation, such as disintegrating slowly to oxygen during the night, thereby in some way maintaining the ionisation. Chapman has pointed out this possibility. Further, one may put aside hypotheses of the kind just mentioned and assume that the pressures of the constituent gases of the upper atmosphere are those of the classical calculation and that other agencies of ionisation exist besides the ultra-violet light, which are effective by night as well as by day. It seems that such a view meets with no immediate objections. For example, the number of α-particles from the sun necessary to produce the desired ionisation, if they are similar to those of radium-*C*, requires a small and quite permissible amount of radium at the solar surface. One can speak less definitely of β-particles of solar origin and of cosmic radiation. In a final summing up one may have to reckon with all of these possibilities.

E. O. HULBURT,

Naval Research Laboratory,
Washington, D.C., June 16.

The Total Reflection of X-rays.

As has been discovered by Compton,[1] X-rays falling on a polished surface at small glancing angles are totally—or at least nearly totally—reflected. This phenomenon was explained by Compton as being due to the fact that the index of refraction of X-rays is a little *less* than unity: $n = 1 - \delta$, where δ is small compared [2] with unity.

Indeed, applying Fresnel's well-known expression for the intensity of reflection, we find in this case for small glancing angles ϕ the formula

$$\frac{I_r}{I_0} = \left| \frac{\sqrt{\phi^2 - 2\delta} - \phi}{\sqrt{\phi^2 - 2\delta} + \phi} \right|^2 \quad . \quad . \quad . \quad (1)$$

for the fraction of the incident energy which is reflected. A graph of this function (for $2\delta = 6 \times 10^{-5}$) is given in Fig. 1 (curve A); it shows that below a certain critical angle ϕ_0, given by $\phi_0 = \sqrt{2\delta}$, the reflection is total, whereas for angles $> \phi_0$ the reflecting power falls down rapidly.

Since its discovery the phenomenon has been studied by several authors, but so far as I know it has not occurred to any one of them that this theory needs some extension in so far as the *absorption* has also a considerable influence on the reflection. According to elementary wave-theory we may take this into account [3] by putting in Fresnel's formula the complex value $n = 1 - \delta + \epsilon i$ for the index of refraction, where 2ϵ is the absorption coefficient (for the energy) taken for $1/2\pi$ times one wave-length. Instead of (1) we then get:

$$\frac{I_r}{I_0} = \left| \frac{\sqrt{\phi^2 - 2\delta + 2\epsilon i} - \phi}{\sqrt{\phi^2 - 2\delta + 2\epsilon i} + \phi} \right|^2 \quad . \quad . \quad . \quad (2)$$

This function is given in the curves B and C of Fig. 1.

The values taken for the constants, $2\delta = 6 \times 10^{-5}$, $2\epsilon = 0{\cdot}2 \times 10^{-5}$, and $1{\cdot}5 \times 10^{-5}$ correspond to the reflection by iron of wave-lengths a little greater and a little smaller than 1740 X.U., this being the wave-length of the K-absorption discontinuity of iron.

I have performed some experiments showing the dependence of the reflection upon the absorption in a marked manner. The device used was a very simple one. Two identical rectangular mirrors of stainless steel [4] were put together, their optically polished surfaces confronting each other. These surfaces were kept parallel and at a distance of 50μ apart from each other by putting small pieces of aluminium leaf between them at the four corners.

The 'slit' so formed was then put horizontally between the focal spot of an X-ray tube and the vertical slit of an X-ray spectrograph—the method being not unlike the 'method of crossed prisms' in optics.

Fig. 2 is a reproduction of a photograph obtained in this way (tungsten target; exposure 20 hours); it contains the spectral region on both sides of the K-absorption discontinuity of iron ($\lambda = 1740$ X.U.).

If there were no such phenomenon as reflection against the steel plates, we should have obtained a spectrum of exceedingly short lines the height of which would be determined by the distance between the steel plates. Owing to the reflection against these plates the lines are much higher, their intensity in vertical direction giving a measure of the reflecting power of the steel at the corresponding angle. A complication is introduced by the fact that the radiation corresponding to relatively great angles is *repeatedly* reflected at the plates before leaving the 'slit.' Fortunately, the number of reflections is recorded on the plate by the horizontal striæ (these striæ being due to irregularities at the edge of the

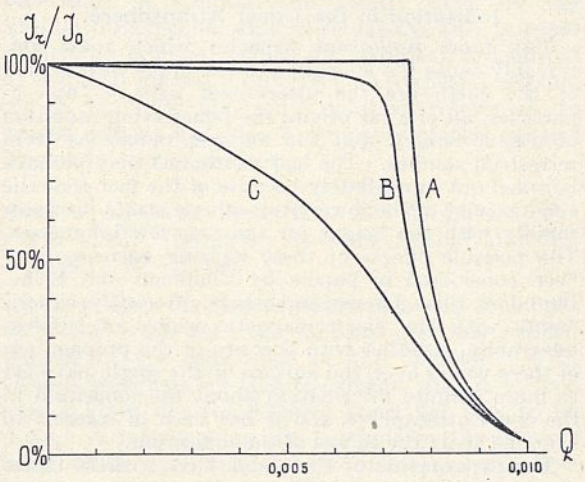

FIG. 1.—Theoretical curves for the reflecting power of iron for X-rays as a function of the glancing angle ϕ (in the figure Q stands for ϕ): A, when the absorption is neglected; B, with weak absorption (long wave-length side of K-absorption discontinuity); C, with strong absorption (short wave-length side).

plates). If we wish to compare the distribution of intensity in vertical direction with the theoretical curves B and C, this influence may be taken into account. When this is done, the agreement between theory and experiment is sufficient, the limit of visible blackening corresponding to a little less than the angle for which, according to theory, the intensity should be reduced to half its initial value.

So far we have considered only the influence of the wave-length on the reflection caused by a change of ϵ (formula (2)). The quantity δ, however, also changes with the wave-length. If we look apart from the neighbourhood of the absorption-edge, this should cause the 'critical angle' of reflection (in our experiment the height of the spectrum) to be proportional to the wave-length. This has been verified already by Compton, and is confirmed by my experiments (covering spectral regions from 0·5 Å.U. to 2 Å.U.), with considerable accuracy.

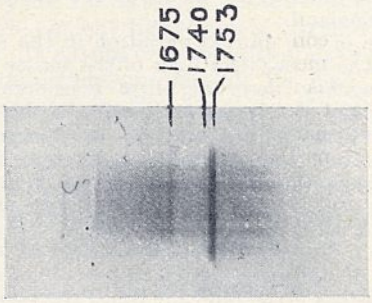

FIG. 2.—Photograph showing the reflecting power of iron for X-rays on both sides of the K-absorption discontinuity: 1675 = W Ll; 1740 = Fe K-abs.; 1753 = Fe $K\beta_1$.

In the immediate neighbourhood [5] of the discontinuity, however, we should expect a decrease of

[1] A. H. Compton, *Phil. Mag.*, **45**, 1121; 1923.
[2] W. Linnik and W. Laschkarew, *Zeitschr. f. Phys.*, **38**, 659; 1926.
[3] My attention was first directed to this point by Prof. Kramers.
[4] The mirrors were supplied by Messrs. Ottway and Co., Ealing.
[5] H. Kallmann and H. Mark, *Ann. d. Phys.*, **82**, 585; 1927.

the height of the spectrum, the rate of this decrease being particularly large quite near to the edge. Whether such a phenomenon exists or not is a question which our experiments as yet are not able to settle; but it is hoped to get evidence on this point in the near future.[6]

In conclusion, I wish to thank Prof. Coster and Prof. Kramers for the kind interest they have shown in this investigation.

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A Sonic Interferometer for Liquids.

FROM thermodynamical considerations alone it should be possible to calculate the number of degrees of freedom, and consequently the association of molecules in the liquid state, if one could only determine the numerical difference between the specific heats at constant pressure and at constant volume. It is practically impossible, however, to obtain direct measurements of liquids at constant volume because of the elasticity of the walls of the containing vessel. But this difficulty can be obviated if the velocity of a compression wave in the liquid can be ascertained with sufficient precision, because the numerical difference between the specific heats can, by the aid of Newton's equation, be expressed as a function of the temperature, the coefficient of expansion, and the velocity of a compressional wave.

With these thoughts in mind, and taking advantage of the work being conducted in this laboratory by R. W. Wood and A. L. Loomis on the physical and biological effects of high-frequency high-intensity-sound waves, we have constructed a 'sonic interferometer' capable of measuring the velocity of compressional waves in small quantities of liquids with an accuracy of one part in three thousand. This instrument is in many respects the sonic analogue of the Perot-Fabry interferometer.

Corrections for the elasticity of the containing vessel can be entirely eliminated by using a sufficiently high frequency so that the wave-length is small in comparison with the diameter of the radiating source. We use, as a radiator, a piezo-electric crystal quartz disc 100 mm. in diameter and 12 mm. thick carefully ground and polished plane parallel, which we cause to oscillate at frequencies from 200,000 to 400,000 cycles per second, producing waves from 3 to 8 mm. in length. The frequency of the oscillating circuit is determined with a precision wave meter. Contrary to the usual practice with piezo-electric crystals of allowing them to oscillate at their own natural frequencies, we have found that much more precise measurements can be obtained if the crystal is driven at certain frequencies well removed from the natural frequency of the crystal, for then the crystal resonance does not partially mask the exact moment when resonance is established in the liquid. The small glass vessel containing the sample of liquid under investigation is placed on the oscillating crystal. When properly adjusted, the compressional waves pass upward through the plane parallel bottom of the vessel into the liquid and, because of the shortness of the waves compared with the dimensions of the vessel, pass upward in the liquid as strictly plane waves. They are then reflected from a plane surface immersed in the liquid and made parallel with the quartz disc. By carefully adjusting the distance of this surface with a fine micrometer screw standing waves can be produced. It is thus possible to measure 20 or more half wave-lengths with a precision of 1/100 mm. At each nodal point a small neon light loosely coupled to the circuit is extinguished, due to the reaction of the system of standing waves upon the crystal.

Characteristic results are presented in the accompanying table. These results are subject only to a revision of our wave meter calibration, and are of a self consistency one order higher than the number of places here presented. No variation in velocity with frequency can be detected within the frequency limits which we have employed, nor can any difference be detected when we vary the material and dimensions of the containing vessel.

VELOCITY OF SOUND WAVES IN LIQUIDS IN METRES/SEC.

Material.	*Temperature.*			
	5°	15°	25°	35°
Distilled Water .	1439	1477	1509	1534
1·0% NaCl sol. .	..	1487	1520	1542
2·5% " " .	..	1510	1539	1561
5·0% " " .	..	1540	1569	1589
Mercury. . .	..	..	1469	1468
Carbon Disulphide	1215	1184	..	..
Chloroform . .	1066	1027	..	..

The data published on the velocity of sound in liquids are for the most part in very poor agreement, and the methods employed, with the exception of direct determination in open water, involve serious corrections, the wave-lengths in general being large in comparison with the containing vessel. It is of interest to note that careful and laborious measurements have been made of the velocity of sound in the open sea by ascertaining the time of travel of a compressional wave for a distance of 53 nautical miles (E. A. Eckhardt, *Phys. Rev.*, **24**, 452; 1924). The velocity thus obtained is 1492 metres/sec. at 13° C. As a check we found at the same temperature a velocity of 1480·5 metres/sec. for a 1·0 per cent. sodium chloride solution and 1503 metres/sec. for a 2·5 per cent. sodium chloride solution. It is of interest to compare these results with that for distilled water from which substantially all the air has been removed, which at 13° C. we found to be 1470 metres/sec. The presence of small quantities of dissolved air materially affects the velocity.

We are at present engaged upon a comprehensive study of water and of its solutions with several salts, and of a number of organic compounds and their mixtures, which we expect to publish shortly, together with a detailed description of the instrument.

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The Flying Fox Pest in Australia.

THE Council for Scientific and Industrial Research is finding difficulty in devising methods for coping with the large fruit-eating bats, commonly known as "flying foxes," which are a most serious menace to fruit growers in Queensland and New South Wales. There are five species in Australia, the commonest by far being *Pteropus poliocephalus*. Nocturnal in habit, and very gregarious, these animals live in large camps of hundreds of thousands of individuals. They migrate according to season and food supply, but

[6] From my photographs may be concluded that this effect is at any rate smaller than Kallmann and Mark's theory would lead us to expect.

usually return to the same camps in successive seasons. In the daytime they cling to the branches of trees in dense numbers; they are restless and alert and a single gun-shot will put a whole camp to flight. At night they depart in search of food such as fruit, berries, eucalyptus flowers, and honey. They are particularly fond of cultivated fruit, and the damage that they can do in an orchard in one night is appalling. The amount of fruit actually eaten is relatively small; the ground is strewn with fallen material which has been merely nibbled or claw-marked.

Many obvious methods of destruction have been tried. Shooting is expensive. Strychnine poisoning in the orchard is successful to an extent. Poison gases in the camps are not effective because of the timidity of the bat: it is almost impossible to give a lethal dose before they take wing. Infection with *Bacillus typhi marium* is said to have cleared Samoa of the pest some years ago, but we have failed to verify the report and it is understood that Samoa is still badly infested. A small 'flammenwerfer' has been tried but, besides being dangerous and expensive, it is not suitable for general use.

All these, and other, methods have been more or less successful in killing the creatures, but in every case the scale of possible operations is hopelessly inadequate. Wholesale slaughter must be achieved if the pest is to be minimised or even merely kept from increasing. Perhaps the most effective attack will be by biological means. Can any biologist suggest a sound line of investigation which the Council for Scientific and Industrial Research might follow?

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Meteorology: Ancient and Modern.

I DO not disagree with those who hold that a review is not an appropriate subject of correspondence for the reviewed; but a paragraph by Mr. W. H. Dines in the issue of NATURE for June 25, puts so compactly, as it were in a nutshell, a question of importance to a wider circle than that which is interested in the study of weather, that I may venture to ask for a little space in which to crack the nut and get at the kernel. Mr. Dines writes (p. 917):

"The author prefers to measure radiative energy in a dynamical unit and states that he finds kilowatts per square dekametre the most convenient. The more usual unit is a gram calorie per square centimetre per minute, but something may be said in favour of gram calories per day, since a gram calorie is more generally understood than a joule and the day is the natural meteorological unit."

This raises the very important question of systematic units for the geophysical sciences. One of my reasons for preferring the kilowatt per square dekametre to the gram calorie per day is precisely that very few people understand what a gram calorie means, and the day that Mr. Dines refers to is not, in fact, a natural unit of time.

Like the questionist who could not define a parallelogram, though he would know one if he saw it, I could not myself say, off-hand, what exactly a gram calorie is for the purposes of computation. I venture to think it doubtful if Mr. Dines could, and would be prepared to risk a little upon the chance of not finding a single member present at a meeting of the Royal Meteorological Society, or (if I might whisper it) of the Royal Society itself, who could give, without reference to a book, an arithmetically workable reply to the question: What is a gram calorie? If any one were fortunately so encyclopædic, the probable answer would be 41·8 million ergs.

I have also a deeper reason than that. The grand achievement of the first half of the nineteenth century was the discovery that heat had a dynamical equivalent and that energy is always conserved. From that principle we have learned that the energy of a hailstone in the clouds, of a lightning flash, and of a beam of sunshine, are all convertible one into another, perhaps through heat. If, therefore, we really mean what we say in enunciating the principle of conservation of energy, it is urgently desirable that we should keep their identity always in view by expressing all in simple multiples of a single unit.

Now estimating the energy of a lightning flash in gram calories simply 'is not done.' We naturally run to ergs for lightning, and if the lightning will not go to heat for its unit, heat might go to the lightning; and the more reasonably, since the heat unit only becomes a commensurable member of the family when it also is expressed in ergs.

There is no such ambiguity or uncertainty about the kilowatt or the joule. I go so far with Mr. Dines as to say that I am sorry that the names Watt and Joule, or any other name that does not explain itself, should have been attached to 10^7 ergs. I am sometimes exasperated by having to get down a book of reference to confirm or contradict my memory. A kilowatt-hour is an ugly unit; but it is what I, and many others, have to pay 7*d.* for, so I suppose even if I do not understand it and Mr. Dines does not, the Board of Trade as well as other consumers must think they do.

The word 'hour' leads me to the other lobe of the kernel, the day as a natural unit for meteorology. What, after all, is a day? In another part of his review Mr. Dines rallies me about a chapter on the Kalendar not being, strictly speaking, meteorology. Yet I am quite sure that without that chapter Mr. Dines and I would not understand each other as to what is meant by a day; and with that chapter to refer to I believe I should be able to convince Mr. Dines that by 'a day' he does not really mean a day but an arbitrary unit of clock time, 86,400 seconds, which is only a real day four times in a year.

These things are perhaps of little importance in the physics that is sheltered by a laboratory roof, and indeed the idiosyncrasies of things like calories and days may be transformed into *scientiarum materia disciplinae puerilis etsi non scientiae ipsissimae*; but for the open air study that aims at tracing the connexion between the hailstone, the lightning flash, the sun's radiation, and the strength of the blizzard, equivalence and uniformity, if not everything, are at least the beginning and the end of everything; and there is no question that is of more vital importance to meteorology than a system of units with a common measure of energy as its foundation.

NAPIER SHAW.

June 29.

I DO not wish to enter into a discussion upon the general subject of units with Sir Napier Shaw, although I believe that my opinion and his do not greatly differ, but I will explain why I prefer gram calories per day to watts.

It seems to me that gram calories can be more easily explained to an ordinarily intelligent person than ergs, because the latter require some prior knowledge of dynamics before the explanation can be commenced. Also the gram calorie lends itself very readily to the expression of the first result of radiation, namely, to changes of temperature; thus by easy mental arithmetic the thickness of ice that can be

melted, or of water that can be evaporated, or the change in temperature of a given layer of air is readily calculated. Sir Napier's book is so interesting that it is likely that many people ignorant of dynamics will read it, and I think such readers have a claim to have the difficulties that arise from the inevitable use of technical terms reduced as much as possible.

I agree with what Sir Napier says about the principle of the conservation of energy, excepting that I do not see why it should be belittled by the use of a heat unit as well as a dynamical unit. We commonly use gallons and cubic feet without confusion according to which is the more convenient.

The day as a unit is open to objection, inasmuch as there are three kind of days, polar, mean solar, and astronomical, but I think that if the term 'day' be used without comment, few would suppose that it meant anything excepting a mean solar day.

I must confess to having had to look up the definition of a gram calorie in a book of reference; I found three definitions, but they all give the same factor for converting gram calories into joules to the third significant figure, so that the ambiguity in the value of the unit is not at present such as to be of much importance in the measurement of radiation.

W. H. DINES.

The Reflection of Atomic Hydrogen from Ice Crystals.

DAVISSON and Germer (NATURE, April 16, p. 558) have shown that electrons are reflected from a nickel crystal in the directions which would be taken by X-rays of wave-length $\lambda = h/mv$ if they were reflected from a slightly modified crystal lattice. This result, which is in accord with the ideas of L. de Broglie, indicates that the diffractive nature of the reflection is to be associated with the momentum rather than with the structure of the electron. One is therefore led to think that the same phenomenon may exist when atoms are reflected from a crystal surface. Although the investigation of this reflection is not yet completed, the preliminary results support this view and are therefore thought to be of sufficient interest for immediate publication.

The experiment consists in finding the intensity of reflection in different directions when a narrow beam of hydrogen atoms strikes a surface of small ice crystals oriented at random. The geometrical arrangement of the collimating slits, reflecting surface, and the detecting plate is shown in Fig. 1. Atomic hydrogen

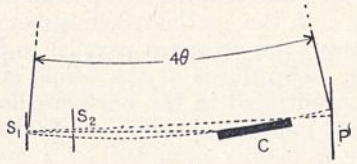

FIG. 1.

from a Wood tube is formed into a beam by the slits S_1 and S_2 in a manner similar to that used by Phipps and Taylor (*Phys. Rev.*, **29**, 309; 1927). The detecting plate P is also similar to that used by the same authors. The reflector C is a plane polished glass surface cooled by liquid air and covered with a thin coat of frost which, to prevent contamination, is continually renewed by the condensation of water vapour supplied by a suitably cooled side tube containing water.

The result of a typical exposure is represented by Fig. 2. The shading shows the relative intensities of the hydrogen beams. The lower dark line is the upper edge of the primary beam which passes above C without reflection. The other darkened portions, which are due to reflected atoms, exhibit the following principal features. There is an undarkened band at deflecting angles less than 6° followed by a relatively intense dark band between 6° and 12° which shades off into a uniform darkening at larger angles. The position of the intense reflected band is not affected by changing the inclination of C from 30′ to 3° 30′, but there is a somewhat doubtful change in definition, the line appearing sharper with C set at the larger angles. This point is not quite certain, however, because of a possible illusion due to the difference in the intensities of various plates. In this regard it is well to point out that if the surface C is placed tangentially to a circle passing through S_1 of such a radius that an arc 4θ is included between S_1 and P, all specular reflections from the individual crystal surfaces of glancing angle θ will come to a focus on P. If the reflected band corresponds to intense reflection at some critical angle between 3° and 6°, a sharper focus would be expected with C set at 3° 30′ than at any other smaller angle.

FIG. 2.

Calculating the wave-length of the average hydrogen atom at the probable discharge tube temperature of 400° C., we find $\lambda = h/mv = 0{\cdot}98 \times 10^{-8}$ cm. The exact structure of the ice crystal is not well known and still less certain is the nature of the reflection, for it seems reasonable that the surface structure of the crystal should play a more important part than in the reflection of X-rays. If we take 4·3 A.U. (the probable edge of the unit cell of ice) as the distance between reflecting centres, a wave of the above length should be intensely reflected at a deflecting angle of about 12°, agreeing with the upper edge of the reflected band.

Although more accurate measurements are necessary to establish the exact nature of the phenomenon, it is now quite certain that some sort of a selective reflection is present at small angles. These measurements are being extended, together with an investigation of the effect of the discharge tube temperature on the position of the reflected band. It is also desirable to study the phenomenon with uni-velocity atoms, and it is thought that this may be possible.

THOMAS H. JOHNSON.
Sloane Laboratory, Yale University,
New Haven,
Connecticut.

Biological Fact and Theory.

WITHOUT the slightest hope of modifying or mollifying Dr. Charles Walker's opinions, yet may I point out to readers of NATURE that my previous letter (July 2, p. 12) was not intended to explain or defend in detail the chromosome theory of Mendelian inheritance, as that has been done more or less adequately in every recent text-book dealing with cytology or heredity. I merely directed attention to the fact that this theory is the only one in the field and that it is proving of great service in stimulating biological research. Its value to the student of practical breeding is acknowledged by Prof. Adametz in his "Lehrb. d. allgem. Tierzucht" in the following words: "Die zytologische Begründung der Mendelschen Vererbungstheorie erwies sich, wie im folgenden . . . kurz gezeigt werden soll, von ausserordentlich grossem Wert für das Verständnis verschiedener bis nun wenig verständlicher Vererbungsvorgänge."

J. S. DUNKERLY.

Past Climates.[1]

By Dr. G. C. SIMPSON, C.B., F.R.S.

THERE is undoubted evidence that at some period or periods in the earth's history the climate in polar regions was much less severe than it is at present. In the Arctic there are indications of a climate when vegetation similar to that which is now found in subtropical regions flourished in Greenland and Spitsbergen. Geologists have generally supposed that during these periods the temperature over the whole earth was much more uniform than at present, so that the temperature difference between the equator and the poles was very small, if it existed at all. These conditions are explained as the consequence of vast oceanic currents carrying warm water to polar regions. The Gulf Stream Drift now maintains a mean annual temperature off the coast of Norway in latitude 70° N., which is 10° C. higher than the mean temperature of the latitude, and it is supposed that if its volume, velocity, or both were increased, and other streams introduced, even higher temperatures could be maintained over the whole of the north polar regions. This supposition is based on an entirely wrong conception of the physical causes which maintain the existing climatic zones.

The primary cause of the difference of temperature between the equator and the poles is the shape of the earth, which results in higher latitudes receiving less solar energy per square kilometre of surface than lower latitudes. But the distribution of solar energy alone does not determine the temperature at the surface; if it did the temperature near the poles would fall to near the absolute zero during the long polar winter. During the whole year, especially during the winter, the temperature in high latitudes is governed mainly by the heat conveyed from low to high latitudes by the general circulation of the atmosphere. On the other hand, the general circulation of the atmosphere is caused and maintained by the temperature gradient along the meridians. Reduce this temperature gradient and the general circulation decreases; increase it and the general circulation becomes more active. No one has yet estimated with any certainty the relative amount of heat transported by oceanic currents and by the atmosphere; but whatever the relative amounts, they both depend on the general circulation of the atmosphere, for the heat-carrying oceanic currents are all wind-driven surface currents. Thus, if we reduce the temperature difference between high and low latitudes, we reduce the amount of heat transported by both vehicles.

If a second Gulf Stream were introduced into the northern hemisphere by, say, cutting a wide channel across the middle of Asia similar to the Atlantic Ocean, heat would be carried into the polar basin, where the temperature would rise. But this rise in temperature would diminish the temperature difference between the equatorial and polar air on which the cyclones of the North Atlantic depend. The winds associated with these cyclones are, however, the chief vehicle for transporting warm air into, and cold air out of, the polar basin; in addition they are the chief factors in driving the present Gulf Stream Drift along its path. Thus the opening of a new supply of heat to the polar region would be accompanied by a reduction of the old supply and the final result would be little or no change in temperature.

This reasoning is admittedly qualitative and alone would carry no great weight; but the existing temperature conditions are conclusive evidence of its correctness. It would be difficult to imagine any distribution of land and sea more different, from the present point of view, than that which exists to-day in the two hemispheres. In the northern hemisphere the land and sea masses are arranged parallel to the meridians, and one ocean extends in an uninterrupted sweep from the equator to the pole; in the southern hemisphere the land and sea masses are arranged parallel to the circles of latitude. Two-thirds of the whole land of the earth is concentrated in the northern hemisphere, mainly about middle latitudes; while the southern hemisphere is mainly occupied by a great ocean which extends almost unbrokenly around the earth between latitudes 40° S. and 70° S. In spite of these extremes of land and sea distribution the average mean annual temperature along every circle of latitude, as determined by Meinardus, is practically the same in the two hemispheres, as will be seen from Table I.

Space does not allow of one examining this table in detail, but attention may be directed to latitude 70° as being representative of polar regions where one would expect any difference to be especially marked. Within the Arctic Circle there is a great sea; within the Antarctic Circle there is a great

TABLE I.—MEAN ANNUAL TEMPERATURES AT SEA-LEVEL.

Latitude.	Average Mean Annual Temperature.				Percentage of Land.		
	North.	South.	Difference.	Mean.	North.	South.	Difference.
1	2	3	4	5	6	7	8
	°C.	°C.	°C.	°C.	%	%	%
0	26·2	26·2	..	26·2	22	22	..
10	26·7	25·3	1·4	26·0	24	20	4
20	25·3	22·9	2·4	24·1	31	24	7
30	20·4	18·4	2·0	19·4	43	20	23
40	14·1	11·9	2·2	13·0	45	4	41
50	5·8	5·5	0·3	5·6	58	2	56
60	− 1·1	− 4·1	3·0	− 2·6	61	0	61
70	−10·7	−13·3	2·8	−12·0	53	71	− 18
80	−18·1	..	..	(−18·1)	20	100	− 80
90	−22·7	..	..	(−22·7)	0	100	−100
0–90	15·2	13·3	1·9	14·2	39	17	22

[1] Abridged from a paper read before the Royal Meteorological Society on June 15.

continent. Outside the Arctic Circle the continents of North America and Asia form together the largest mass of land in any part of the earth; outside the Antarctic Circle a continuous ocean extends completely around the earth for many degrees of latitude. The Gulf Stream Drift, the greatest heat-carrying ocean current which exists, conveys warm water right into the heart of the Arctic Ocean; in the south no current carries warm water within 40° of the pole. Yet there is only a difference of 2°·8 C. between the average temperature along latitude 70° in the north and in the south. In the face of the evidence of Table I. there can be little doubt that the distribution of land and sea plays little part in determining the average temperature along a circle of latitude and that no redistribution of land and water could possibly have raised the temperature in polar regions by the 25° C. required to give Spitsbergen the climate which exists to-day in the Mediterranean.

Although from the above discussion it would appear that the distribution of land and water plays a very small part in determining the average temperature of a zone, there is no doubt that it does play a very large part in determining the actual temperature in various parts of a zone.

Fig. 1 has been reproduced from Hann's "Lehrbuch der Meteorologie" to show the existing variations of mean annual temperature. We see at once that the temperature may be very different at different places along the same circle of latitude. The greatest differences occur along latitude 70° N., the mean temperature off the coast of Norway being more than 20° C. higher than the mean temperature in the west of Siberia.

In the zone between 40° N. and 60° N., the temperature is highest over the east of the oceans and lowest over the east of the continents. This is due almost entirely to the fact that over the east of the oceans the prevailing winds have a southerly component and over the east of the continents a northerly component. This means that the chief transport of warm air from equatorial regions is over the east of the oceans, and as the winds control the movements of the surface waters the effect of the ocean currents is simply an addition to the effect of the winds. On the other hand, the return flow of air from polar regions is mainly over the east of the continents, bringing with it low temperatures from higher latitudes. Whatever the distribution of land and sea within the zone we may expect the same effect, the transport of warm air will be over the east of the waters and the transport of cold air over the east of the land masses. The only question that arises is whether there are any limits to the difference of temperature that may be induced in this way. A glance at Fig. 1 will show that there appear to be such limits. The areas of the continents and of the oceans in the zone we are considering are very different, the extent of Asia being more than twice that of North America and the extent of the North Pacific Ocean being more than twice the extent of the North Atlantic. In spite of this difference of extent the lowest temperature

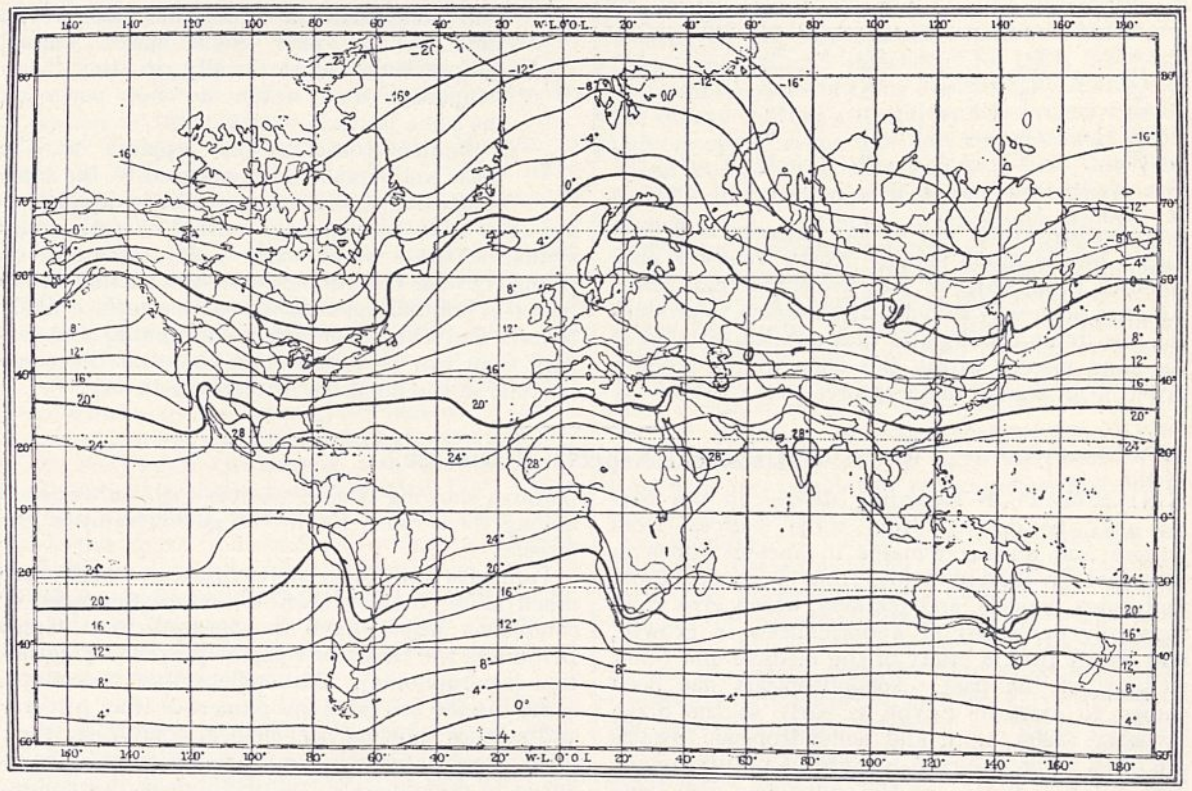

FIG. 1.—Yearly isotherms.

on any latitude over North America is practically the same as the lowest temperature on the same latitudes over Asia. In the same way, in spite of the Gulf Stream Drift the highest temperatures over the North Pacific are very similar to those over the North Atlantic.

The figures are the most striking in the case of the low temperatures in the east of the continents. From latitude 40° N. to 60° N. the great Asiatic land mass produces the same lowering of the temperature within one or two degrees as is produced by the much smaller North American continent. From this we may conclude that North America is already sufficiently extensive to produce the maximum cooling and that no readjustment of the land masses within this zone would produce lower mean annual temperatures than exist to-day in the east of North America and in the east of Asia.

TABLE II.

Latitude.	Lowest Mean Annual Temperature.			Highest Mean Annual Temperature.		
	America.	Asia.	Difference.	Atlantic.	Pacific.	Difference.
°N.	°C.	°C.	°C.	°C.	°C.	°C.
40	10	8	2	17	14	3
45	6	4	2	14	12	2
50	1	0	1	12	9	3
55	− 5	− 4	−1	9	7	2
60	− 8	− 8	0	8	5	3

Similarly over the sea; when we find that the highest temperatures over the broad North Pacific Ocean are within three degrees of the corresponding temperatures in the narrow North Atlantic with its active Gulf Stream Drift, we may legitimately draw the conclusion that no redistribution of land and water would materially raise the temperature over the sea.

We thus see that in the north temperate zone there are quite definite maximum variations from the mean temperature of the circles of latitude, and that these exist to-day over both North America and Asia. The conclusion is irresistible that at no time in the past could mean annual temperatures exist locally in the north temperate zone which do not occur on the same latitude to-day.

Similar considerations applied to the polar and equatorial zones lead to the same conclusion, and there seems little doubt that not only have there always existed climatic zones similar to those which exist to-day (assuming no change in solar radiation), but also at no time in the past is a limited region of the earth's surface likely to have had a higher or lower mean annual temperature than can be found somewhere on the same latitude in the northern hemisphere to-day.

Historical Aspects of Disease.[1]

INFORMATION regarding disease in the past may be derived from three sources—from human and animal remains in ancient times (a considerably limited field), from a study of old sculptures, models, and pictures, which give more especially evidences of abnormalities in growth, and finally from a study of the medical and other writings of the past. Achondroplasia has been shown to exist in Egypt so early as the Sixth Dynasty (2900 B.C.), and achondroplasic dwarfs are often to be observed in Egyptian mural paintings. Pott's disease of the spine has also been noted in a bronze statuette of ancient Egypt. In a bust of Alexander the Great in his fatal illness, Sir Berkley Moynihan recognised evidences of cerebro-spinal fever. Achondroplasia and rickets are portrayed in the mural paintings of Pompeii and Herculaneum. The portrait of Ferdinand I., Emperor of Germany, painted in 1521 by Lucas van Leyden, shows the adenoid facies, although it was only in 1868 that Wilhelm Meyer of Copenhagen made adenoids known to the medical profession. Hystero-epilepsy has been identified in Raphael's pictures, and Charcot and Richer identified hysteria major and hystero-epilepsy in the engravings of the famous epidemic dancing mania which was prevalent in the Rhine provinces from the fourteenth to the sixteenth centuries. Similarly, these authors figured a number of old pictures showing plague victims with buboes, and among them Saint Roch, the patron saint of the disease.

Paintings may also show diseases which were much more common than at present (leprosy), or conditions which have disappeared from Great Britain as the result of efficient preventive legislation (hydrophobia). Although written records of acute disease are far more numerous than pictures and statues showing pathological conditions, their satisfactory interpretation is much more difficult owing to differences in the methods of description and nomenclature and the possibility of the existence of more than one disease raging at the same time, as was probably the case during the Antonine plague in Rome.

Now disease is not in itself a fixed entity, but the reaction of a complex organism to varying degrees of injurious influences; therefore a change in the organism or a change in the injurious factor may lead to widely different pictures. Changes in the organisms responsible for infective disease occur with far greater rapidity than do changes in the higher mammals. Some authors consider that changes in the former are much more important than changes in the host. Wars and famine readily determine changes in the type of disease by setting up conditions favourable to the spread of disease and unfavourable to the victim of the epidemic spread. Such changes are most liable to occur in the acute diseases, but it is very difficult to decide whether a real change in type has occurred.

[1] Abstract of the opening paper in the discussion on "Clinical Variations in Disease from the Historical Point of View," delivered by Sir Humphry Rolleston to the History of Medicine Section of the British Medical Association at Edinburgh on July 22.

Another factor which may alter the clinical picture is the presence of secondary infection, as, for example, was the case in the influenzal epidemic of 1918–19, where the presence of an additional hæmolytic streptococcal infection of the respiratory tract made the condition widely fatal, and so altered the influenzal picture that it was actually hinted in the lay press to be plague. Again, it has been averred that the more severe type of smallpox was due to the same virus as present in mild smallpox complicated by a secondary streptococcal invasion favoured by insanitary conditions which so often prevailed in the past; but there have been very mild epidemics of smallpox in the past, and along with other evidence it would appear that the mild and severe form are variants of the same virus, as is also cowpox. The presence of one disease may sensitise the organism to another infection, as, for example, the influence of measles in leading to tuberculosis.

Other diseases have shown definite changes in type, as in the case of scarlet fever, which forty or fifty years ago was often malignant and now is mild. Other diseases appear to have altered, but in these cases this is often due to a separation out of the disease from a series of closely related conditions, as, for example, the separation out of typhoid, paratyphoid, and typhus from what was formerly known as continued fever. It was only in 1675 that smallpox was first clearly distinguished from measles by Sydenham, although an eruption like smallpox was identified in an Egyptian mummy (1100 B.C.), and chickenpox was not definitely recognised as a distinct disease until 1767. War and its attendant circumstances may also give rise to new types of disease, as, for example, trench nephritis and trench fever, which were seen in North America seventy years before and not during the intervening years. After wars the epidemics and aberrant forms of disease that may have arisen tend to disappear.

The question as to when a disease first appears is one of the greatest difficulties, and may go back before the written records. Tuberculosis has been identified in the Egyptian mummies, and from the written records the pulmonary form was very prominent in Greece. Mumps was also known in ancient Greece, and the orchitic complication described by Hippocrates. It may have been plague that attacked the Philistines after their capture of the Ark of the Covenant. Its history can, however, be most certainly traced in epidemic form from the great plague of Justinian which, arising in Egypt A.D. 542, spread all over Europe. There is good reason to believe that malaria was one of the factors bringing about the fall of ancient Greece and Rome, and the references in classical literature to this disease have been most carefully correlated by W. H. S. Jones. His work shows the value of medical history in explaining that of the world.

Although gout and rheumatism were only separated in the sixteenth century, chronic arthritis has been shown in neolithic skeletons and in ancient Egypt. Brettoneau separated diphtheria from other throat infections in 1821, although malignant sore throat was described by Aretæus in the second century A.D. and by subsequent writers. Cerebro-spinal fever was first recognised in 1805. When encephalitis lethargica was first described in 1917, it appeared as if it were an entirely new disease, but scattered descriptions appear of conditions closely similar even so far back as 1413, when in Tournai there was an outbreak of epidemic hiccup which appears to be a manifestation of the myoclonic form of the disease. Appendicitis existed before it was described by Fitz of Boston in 1886, but it would appear to have become much more common in recent times, while chlorosis has for all practical purposes disappeared. Other anæmias would appear to have increased, or at least are more commonly recognised as a result of improved diagnostic methods.

Environmental factors also determine the incidence of disease, as in the case of parasitic diseases carried by animals or insect carriers, and then in the case of industrial diseases, diseases may have developed, reached a maximum, and then declined as the dangerous features were appreciated and controlled, as happened in the case of trinitrotoluene and tetrachlorethane poisoning. Finally, popliteal aneurism, which was very prominent in persons of a syphilitic taint in the days of horse-riding, has become relatively infrequent with the decline in use of the horse.

Obituary.

PROF. J. L. GUSTAV TSCHERMAK.

PROF. J. L. GUSTAV TSCHERMAK—Seysenegg, Hofrat, one of the most distinguished of modern mineralogists and petrologists, whose death was recently announced, was born at Littau, near Olmütz in Moravia, on April 19, 1836. He studied at the University of Vienna, and in 1857, while still a student, he accompanied Julius Schmidt in his examination of the extinct volcanoes of Moravia, and was responsible for much of the field work as well as for the subsequent determination and description of the specimens obtained. In 1858 he published his first paper, which dealt with the trachytes in the neighbourhood of Banov in Moravia. This was the earliest of a long succession of important publications spread over more than sixty years. In 1861 he was received into the Faculty of Science of the University and acquired the right to give academical lectures. In 1862 he was appointed custodian to the Court collection of minerals.

From 1863 until 1866 Tschermak travelled in the Alps and Carpathians, and as a result published in 1869 a treatise on the porphyritic rocks of the "Middle Geological Epoch" (actually from the Carboniferous to the Cretaceous) in Austria. For this he received an award from the Vienna Academy of Sciences. In 1868 he was appointed Director of the Court collection of minerals, and at the same time was nominated professor of mineralogy and

petrology at the University. He retained this post until his retirement in 1906 as emeritus professor and emeritus director of the Mineralogical and Petrological Institute of the University. He was then ennobled as Tschermak von Seysenegg. In 1875 he was made a full member of the Vienna Academy of Sciences. He was also honorary member of the scientific academies of Berlin, Göttingen, Münich, Paris, Rome, Leningrad and Sweden. He was foreign member of the Mineralogical Society and of the Geological Society of London.

The first edition of Tschermak's treatise on mineralogy was published in 1881 and the sixth in 1905. In 1871 he established the *Mineralogische Mitteilungen*, which formed for a time a portion of the *Jahrbuch der Kaiserlich-Königlich geologischen Reichsanstalt*. In 1878 it became the *Mineralogische und petrographische Mitteilungen* (familiarly known as Tschermak's *Mitteilungen*), which still continues.

Tschermak's most important work was on the constitution of the silicates. So early as 1865 he published a paper on the felspar group, a synopsis of which appeared in the *Geological Magazine* for the same year. In this he showed that the plagioclase felspars are built up of varying proportions of albite and anorthite, minerals which closely resemble each other in their crystalline form and in their molecular volumes. This formed the starting-point of Becke's work on the same subject. Tschermak afterwards applied similar principles to the amphiboles, the pyroxenes, the micas, the scapolites, the chlorites, and the tourmalines, as well as to the rhombohedral carbonates. He also claimed that he could obtain definite silicic acids by treatment of silicates with acid solutions, but this contention has not been universally accepted. He gave considerable time to the study of meteorites, of which a fine collection is housed in the museum at Vienna.

Tschermak married Fräulein Hermine Fenzl, who survives him. His two sons hold professorships, at Vienna and Prague respectively.

WE regret to announce the following deaths:

Sir William Ashley, emeritus professor of commerce in the University of Birmingham and president in 1907 and 1924 of Section F (Economics) of the British Association, on July 23, aged sixty-seven years.

Sir Bryan Donkin, honorary member of the Royal Medico-Psychological Association, and author of many publications on criminology and related subjects, on July 26, aged eighty-two years.

Sir Harry Johnston, G.C.M.G., K.C.B.,—zoologist, ethnologist, and explorer—distinguished particularly by his scientific contribution to knowledge of tropical Africa, on July 31, aged sixty-nine years.

Dr. Paul Kessler, professor extraordinarius of geology at the University of Tübingen, and author of several interesting papers on the morphology of fossil Ammonoidea, on July 14.

Mr. E. Sanger-Shepherd, well known for his work on colour photography and the development of instruments for photographic sensitometry, on July 8, aged fifty-eight years.

News and Views.

ALL large passenger ships have a complete staff of radio operators and keep a continuous watch for radio signals. The great majority of ships, however, have only one radio operator, and so a continuous watch is impossible. Such a ship might be in close proximity to a ship needing assistance and hear nothing of its distress calls. Probably a much larger ship at a greater distance away would be diverted from its course to give the requisite assistance. This would lead to delay and greatly increase the cost. This difficulty has now been overcome by the apparatus designed by the Marconi International Marine Communication Co., Ltd. The object of this auto-alarm is to ensure that the call shall be received by the smaller ships even when the operator is off duty. The alarm signal consists of a series of three dashes, each of four seconds duration, separated by intervals of one second. The Post Office regulations insist that this signal, the forerunner of the distress (S.O.S.) call, shall operate the receiving apparatus, which rings a bell to recall the operator, even when it is sent by hand with the aid of an ordinary watch with a seconds hand. If the signal be wrongly sent, even although the apparatus is set in motion, it will instantly come back to zero and be ready to receive signals correctly sent. Allowances are made for want of skill of the operator by making it operate when the dashes have intervals between three and five seconds long and the blanks have intervals lying between one fifth and two seconds. The apparatus operates even when two ships are sending Morse messages at the same time and on the same wave-length. When a distress call is received, alarm bells are rung on the bridge, in the radio cabin, and in the operators' sleeping quarters.

SIR RONALD ROSS, director-in-chief of the Ross Institute and Hospital for Tropical Diseases, Putney Heath, S.W., has been awarded the gold medal of the African Society in recognition of his valuable work and its services to Africa. In the report of the Ross Institute and Hospital for 1926, recently received, reference is made to the need for extension of the hospital and especially to the importance of the extension of malaria control operations. In this connexion attention is directed to the British Mosquito Control Institute at Hayling Island, and it is suggested that when young men are engaged for service on plantations in the East, it might be advantageous if they could spend a few hours or days at Hayling Island to obtain an idea of the habits of mosquitoes and the methods of control. Sir Ronald Ross was invited by the Indian Tea Association to visit plantations in India and to inspect the work being done there to reduce malaria. He visited also Malaya and Burma, and has prepared a report on his observations. Comparing his experiences while on service in India from 1881–1899 with his recent observations in

Ceylon, Malaya, Assam, and Calcutta, he concludes there must be a marked reduction of culicine mosquitoes in the houses of Europeans, due principally to better knowledge of these insects and of their breeding habits, and also to the activities of public health departments. He advocates still further control of both culicines and anophelines by public action.

MALARIA control in Malaya has reached a high state of efficiency and will quite possibly succeed in practically banishing the disease or at least in reducing the pandemic to small local outbreaks. In Burma, Sir Ronald found that advance has not been nearly so rapid, apparently due chiefly to the fact that the planting community is not nearly so large and there is much more popular, and therefore less instructed, control of the administration. Assam presents a state of transition; the details of malaria control for a large number of estates have been worked out, but the whole movement should be unified in order to prevent expensive local failures due to recalcitrant neighbours and other causes. Calcutta has still much to learn from Singapore; it does not spend enough on mosquito control. Dengue is prevalent every year and malaria still haunts the outskirts of the city. The housing of the poorest classes is bad, and Sir Ronald makes an appeal for its improvement by legislation and action. He refers to the formation of anti-malaria and public health societies in Bengal, managed by the people themselves, with many branches in remote villages and rural areas. In conclusion, he remarks that what can be done in other countries against malaria can be done in all. "Is it not time to hope that malaria control by modern methods will soon be adopted everywhere?"

FURTHER information is now available relating to the remarkable find of a liquid in the canopic jar of Queen Hetepheres, mother of Khufu, which unquestionably has been preserved since the Pyramid age. An analysis has been made by Mr. Lucas, chemist to the Egyptian Antiquities Department, of which some particulars are given in the *Times* of July 26. It appears that the liquid is a 3 per cent. solution of natron, of which the water has been stained yellow by the organic contents of the canopic jar. It is suggested that the water has been preserved owing to the fact that it was enclosed in an alabaster box with a tight-fitting lid and buried in a chamber cut from the living rock at a depth of 100 ft. and in a niche which had been built up with plaster-covered limestone slabs.

SINCE the resumption of archæological excavation after the War few fields have advanced more rapidly in public interest than Mesopotamia, which at one time was regarded almost exclusively as the province of the specialist. This is to be attributed to a great extent to the broader treatment which has been given to the announcements in the press of the results obtained both by the Weld Blundell Oxford University and Field Museum expedition at Kish and the joint expedition of the British Museum and the Pennsylvania University Museum at Ur. A further and welcome indication of this trend is afforded by the publication of a guide to the antiquities of Mesopotamia by Mrs. MacKay. It deals with sites dating from the earliest period down to, but not including, the Islamic period. For the convenience of travellers the sites are grouped under the stations of the railway from which they are most accessible, and each is described briefly but in sufficient detail to enable the non-expert to grasp the essential significance of what has been revealed by excavation. Brief historical notes, a chronological table from the "Cambridge Ancient History," and a few useful hints on equipment are included. The guide is issued by K. Mackenzie, the Book Shop, Baghdad, Iraq.

FURTHER particulars are announced of the seventeenth International Congress of Orientalists to be held at Oxford from Aug. 27–Sept. 1, 1928. The president of the Congress will be the Right Hon. Lord Chalmers, and Prof. F. W. Thomas, Boden professor of Sanskrit, will act as chairman of the organising committee. The meetings will be held in the Indian Institute and adjoining College and University buildings. The work of the Congress will be distributed among nine sections, of which one will be general, including anthropology, ethnography, prehistoric archæology, comparative mythology, and folklore. Other sections will be: Assyriology and cognate subjects, Egypt and Africa, Central and Northern Asia, the Far East, India and Iran, including the Indo-European languages of Asia, the Old Testament, the language, literature, etc., of Islam, and oriental art. Each section will have its sectional president. The languages of the Congress will be French, German, and English; but other languages may be used with the permission of the sectional president. The fee for the Congress is £1. Applications for membership should be addressed to the treasurer of the Congress, Mr. G. R. Driver, Magdalen College, Oxford. Titles of papers offered should reach the secretary, Mr. C. N. Seddon, not later than Mar. 1, 1928.

AN active eruption of Vesuvius began towards the end of July, and on Aug. 1 there was a new flow of lava and an increase in the number and intensity of explosions inside the volcano. A large amount of material has been ejected in the form of volcanic bombs and ash.

A BRIEF report on the great Kansu earthquake of May 23 (May 22, G.M.T.) has come from Mgr. Buddenbrock, Vicar Apostolic in Kansu (*Times*, July 30). The writer, who was at Lanchow, the capital of the province, at the time, states that the city of Kulang has disappeared, and he estimates that 100,000 people were killed. Kulang is about 120 miles north-west of Lanchow, and between the positions assigned from seismographic evidence to the epicentre, and nearer to that given by Prof. Turner (see NATURE, vol. 119, pp. 826, 937). According to information received by

the China Inland Mission in London, the earthquake was strong enough to damage buildings so far as Liangchowfu, 150 miles north of Lanchow.

THE third meeting of the International Union of Geodesy and Geophysics will be held at Prague on September 3-10. Papers will be read and discussions will take place in the various sections of the Union, namely, geodesy, seismology, meteorology, terrestrial magnetism and electricity, oceanography, volcanology, and hydrology.

DR. EDWARD R. WEIDLEIN, director of Mellon Institute of Industrial Research of the University of Pittsburgh and president of the American Institute of Chemical Engineers, will spend the months of September and October in visits to European educational institutions, research laboratories, and chemical works. While abroad he will also confer with a number of educationists and laboratory directors regarding various problems in industrial research organisation and management. Dr. Weidlein expects to be in England during the period Sept. 14-24, where he may be addressed c/o The Old Colony Club, 79 Fore Street, London. His continental trip through Germany, Switzerland, Italy, and France will follow.

THE ninth International Congress of Zoology will meet at Budapest from Sept. 4-9, under the presidency of Dr. G. Horvath. The offices and the general meetings will be in the Hungarian National Museum, and the sectional meetings will be in the University Institutes of Natural Science and Medicine. A large number of communications have already been offered. In addition to the more serious business, opportunity will be given for excursions on the Danube, to mountains in the neighbourhood, to Lake Balaton, and to the Puszta Hortobágy, with its herds of horses, cattle, and sheep. Various facilities are given by the Government and railways of Hungary. Owing to an unfortunate statement in the preliminary announcement, notices appeared in German zoological publications which made one fear that the Congress would lose its international character; but we understand that any difficulties there may have been are now entirely smoothed away, and a successful gathering, the first since Monaco in 1913, seems assured.

THE fourth Conference of A.S.L.I.B. (the Association of Special Libraries and Information Bureaux) will be held at Trinity College, Cambridge, on Sept. 23-26. The proceedings will open with a reception by Sir J. J. Thomson in the Fellows' Garden of Trinity, and discussions will occupy the mornings and evenings of succeeding days. The subjects for discussion include the following: the Report of the Public Libraries Committee of the Board of Education (Mr. A. E. Twentyman and Lieut.-Colonel L. Newcombe); recent developments in connexion with the Science Library, South Kensington (Sir Henry Lyons); information, organisation, and statistics in industry (Major L. Urwick, Mr. S. J. Nightingale, Mr. Hugh Quigley, Mr. W. Wallace, Mr. A. E. Overton, Mr. F. W. Tattersall); patent classification (Mr. A. R. Wright, Mr. Allan Gomme); problems of the information bureau (Mr. A. F. Ridley, Mr. P. K. Turner, Dr. J. C. Withers); photographic reproduction of printed and MS. material (Mr. N. Parley, Sir William Schooling, Mr. R. H. New); standards of book selection in science and technology (Sir Richard Gregory). Further particulars of the Conference can be obtained from the Secretary, A.S.L.I.B., 38 Bloomsbury Square, London, W.C.1.

THE Pacific Hydrobiological Station at Vladivostok was established in 1925 with the view mainly of research on the conditions of the Russian fisheries in the Pacific, but it is working not only on the problems of immediate practical interest, but also on various hydrobiological questions (*Priroda*, 1927, No. 3). The station is situated at the Basargin Peninsula, about 6 kilometres from Vladivostok, where some old military buildings were converted into laboratories and houses for the staff. During the first year of the existence of the station a systematic study of the marine fauna was begun and regular hydrological observations organised. The fauna of this part of the Pacific proved to be extremely rich, including numerous species of fish not previously known from Russian waters, while the invertebrate fauna is also of unusual interest. Apart from this purely scientific work, a detailed investigation of fisheries in the Bay of Peter the Great and at the Kamtchatka shores was organised. This study revealed that Russian fishing in the Pacific waters is almost exclusively devoted to salmon, while a number of other valuable fish are not exploited only for lack of information as to their value and methods of fishing. Laboratory accommodation at the Station is calculated not only to permit scientific work of its own staff, but also to enable outside students to work there temporarily.

THE seventh annual report of the Industrial Fatigue Research Board gives an account of its constitution, investigations, and researches. Its work roughly falls into three main categories: (1) Investigations of particular problems of wide industrial importance, such as hours of labour, accident causation, design of machinery, ventilation, rate of improvement in industrial occupations, vocational guidance, the relation of school-leaving age to well-being and proficiency. (2) Studies of specific problems submitted by government departments and industrial associations, *e.g.* sickness in cotton-weaving sheds and in the printing industry, weight carrying by men and women, telegraphists' cramp, vision and lighting, vocational selection. (3) Experimental researches undertaken in university and other laboratories, *e.g.* principles governing muscular energy, acquisition of skill, psycho-galvanic reflex. The Board directs attention to the necessity for a more general realisation of the possibilities and necessity for such research which, while its immediate effects may be less striking than those resulting from technical and mechanical developments, yet has far-reaching effects valuable both to the worker and employer. For example, an alteration in some material condition may lead to an increased

output immediately: if, however, that alteration should put too much strain on the workers, then increased sick-leave or general dissatisfaction may result, the effects of which will only be gradually felt. The Board suggests that small committees representing employers and workmen should be set up in the more important industries for the purpose of discussing and submitting for investigation problems affecting the human factor in industry.

IN the May issue of the journal of the Allgemeine Elektrizitäts Gesellschaft an account is given of a lecture by Dr. Lubowsky on the transport and packing of engineering products for foreign markets. This subject is of the greatest importance to industry and deserves close study. At the beginning of the War, the Germans made many tests, using suitable machinery, to find out the stresses called into play by every conceivable method of packing, the amount of packing material required, and the space taken. It is sometimes specified that the apparatus ordered should be contained in a soldered sheet tin case without stipulating on the methods requisite for the adjustment between the external and internal atmosphere. These are essential on account of the variations of temperature and atmospheric pressure. A small accident to a soldered edge often leads to the collection of condensed water in the box. This may arise also from the hygroscopic nature of the goods. Drying chemicals will not prevent the bad effects produced by condensation. The A.E.G. have found that hard wood cases suitably dove-tailed and utilising pitch-paper and oil-cloth are cheaper and much more serviceable. When there is a risk of breakage the goods are suspended by spiral springs during transport. In order to ascertain their weakest points, cases and casks were periodically allowed to fall to the ground from given heights. Thus particulars have been obtained for nearly every class of wood as to the requisite thickness, best method of stiffening, number, strength, and distance apart of the bands, best length and finish of the nails, appropriate humidity, and many other useful data.

WE referred incidentally in a recent issue to the educational experiment being made at the Malting House School at Cambridge, which aims at stimulating and developing the 'finding-out' interest in children from the age of 4–5 years onwards. A film privately exhibited by the school a week or so ago in London illustrated the methods used. The children, mostly between four and seven years of age, were shown finding out for themselves the properties of things, the sequences of various processes, the relations between objects, and between their own activities and these objects. They were shown trying whether leaves would burn, whether metals would melt, or how much water would put the fire out; a see-saw led them to try to weigh one another, and then to weigh and compare various objects on a balance; the water-tap in their sandpit went out of order and one of them tried with a spanner to turn it; some of them modelled in clay or used a potter's wheel; others listened to a gramophone, managed by themselves; they were shown taking care of their live pet animals, and dissecting ("looking inside") dead ones; they handled well and truly hammer, nails, chisel, a large saw, a drilling machine, a lathe; they sewed and wove; and moving freely in and out of these and other interests, they enjoyed, not less but not more, imitation and phantasy games, running about and climbing, like any other lively children of their ages. As one watched the ease and independence with which the children went about their manifold activities, it could scarcely be doubted that whatever additional methods practical educational needs might impose, all that children learned by this method is so much clear and certain gain.

THE Bureau of Standards at Washington publish a directory of commercial testing and college research laboratories. Apparently there are 207 commercial testing laboratories throughout the United States and no less than 143 college research laboratories. These form a most useful adjunct to the National Bureau of Standards, the main object of which is to make tests and carry out investigations for other government departments. The other laboratories do the ordinary routine work, and so the Bureau has more time to devote to research and official work. In Great Britain, engineers have standard specifications which they are continually revising, but the number of institutions which are prepared to test whether the material or workmanship comes up to the standard is very small and is practically unknown to many purchasers, and hence they hesitate to buy on specifications and trust too much to a firm's reputation. The Bureau of Standards has inaugurated a 'certification plan.' On this plan, lists of manufacturers are compiled who are willing to supply material in accordance with certain specifications and to guarantee that they fulfil the required conditions. We know of certain clauses in several widely used specifications which are virtually a dead letter in England, because very few purchasers know where they can get the required tests made, and even when they do, the prices are found to be prohibitive. In the immediate future there will probably be a great increase in the demand for such tests both in connexion with our domestic and our export trade. In our opinion a directory similar to the one produced by the Bureau of Standards in America, giving a list of both commercial testing and college research laboratories, would be a boon to industry in Great Britain.

THE following awards for the year 1927–28 have been made by the Salters' Institute of Industrial Chemistry and approved by the Court of the Company: *Fellowships renewed*: Mr. R. M. Deanesly, University of Oxford, at the Ramsay Department of Chemical Engineering, University College, London (Fellow, 1926-27); Mr. H. B. Spalding, University of Oxford, at the Massachusetts Institute of Technology (Fellow, 1926–27). *Fellowships awarded*: Mr. C. G. Akhurst, Imperial College of Science and Technology, London; Mr. A. Caress, University of Cambridge; Mr. I. G. Nixon, University of Cambridge; Mr. D. R. Pryde,

University College, Bangor; Mr. J. Muir Smith, Armstrong College, Newcastle; Mr. F. Witt, Imperial College of Science and Technology, London. The Salters' Institute has also awarded fifty Grants-in-Aid to young men employed in chemical works to facilitate their further studies.

THE Japanese meteorological observatory at Zinsen, Tyosen (Korea), has just issued a very comprehensive report of its activities during the year 1923. Hourly values are given of air pressure and temperature, relative humidity, and wind speed and direction, at the central observatory, while four-hourly observations of various meteorological elements at the observatory and its branch stations, which are numerous, are summarised. Details of the seismic and (absolute) magnetic observations made at Husan and Zinsen are also included. The work appears to be well organised, and the report is detailed and satisfactorily produced. The letterpress is given in Japanese characters and also in English. The customary European symbols for cloud forms and other meteorological phenomena are replaced by picturesque Japanese symbols, which by no means convey their import to a European reader at a glance.

REFERRING to the review which appeared in NATURE of July 16, p. 76, of Gurwitsch's "The Scientific Principles of Petroleum Technology," Prof. B. N. Menschutkin, of the Polytechnic Institute, Leningrad, writes pointing out that Prof. Leo Gurwitsch died on May 30, 1926.

THE National Research Council, Washington, D.C., has issued through its Committee on Child Development a "Directory of Research in Child Development" (Reprint and Circular Series, No. 76, Price 50 cents). The entries, 425 in number, give the names of research workers in the United States and Canada, the subjects of their specialties, and the research problems upon which they are engaged.

WE have received from Mr. C. Baker, 244 High Holborn, W.C.1, and Messrs. Ogilvy and Co., 20 Mortimer St., W.1, their respective catalogues of second-hand and shop-soiled scientific apparatus for sale at reduced prices. Prospective purchasers would do well to consult these catalogues in the first place, for many bargains in microscopical and other apparatus, cameras, etc., are listed.

MESSRS. Flatters and Garnet, Ltd., 309 Oxford Road, Manchester, have sent us their catalogue of microscopical preparations (Catalogue A, 1927). They claim to be the largest actual mounters of microscopical preparations in England, and their normal stock of mounted slides numbers 25,000-30,000. The list is a very complete one and comprises preparations illustrating all the biological sciences as well as petrology and metallurgy.

THE Edinburgh Mathematical Society has begun to issue a new series of its Proceedings. An attractive opening part contains ten research papers, Profs. Baker and Turnbull and Mr. Richmond being among the contributors. A general reader will find most interest in Prof. Gibson's "Sketch of the History of Mathematics in Scotland to the End of the Eighteenth Century." This paper gives an account of the mathematics studied in Scottish universities in their early days, and refers especially to the work of Napier and of James and David Gregory. It is unfortunate that a standard size of page has not been adopted for the new venture, also that the pages are not numbered in the customary place.

THE British Museum (Natural History) has added four sets of picture post cards to the two issued last year illustrating native British orchids. The various species are beautifully and faithfully done in colours, and the price of each set (F 16 to F 21) is one shilling, each consisting of five cards with an explanatory leaflet. Thirty out of some fifty known British species are represented in the six sets so far published. Many of them are uncommon, and some very rare and in danger of extinction. One aim of the Natural History Museum postcards of British flowering plants is to protect rare species by indicating the fact of their rarity and by providing a ready means by which unknown plants may be identified without picking them.

THE *Proceedings of the South London Entomological and Natural History Society* for 1926–27 forms an attractive booklet of more than 150 pages with several half-tone plates. It contains a number of short papers which should appeal more especially to entomologists. Thus Mr. K. G. Blair discusses stridulation in various orders of insects, while Dr. E. A. Cockayne writes on intersexes in Lycænidæ, and Mr. R. Adkin has a suggestive article on the possibility of new species being in the making in the case of certain British moths. The reports of the meetings of the Society indicate that its members take a live interest in various branches of natural history and botany, and the exhibits recorded cover a wide range in those subjects.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time lecturer in mining science and allied subjects under the director of education, Merthyr Tydfil, for the instruction of students in the higher stages of the joint scheme of education adopted by the L.E.A.'s in the South Wales and Monmouthshire coalfields—The Director of Education, Town Hall, Merthyr Tydfil (Aug. 9). A secretary for education for the Borough of Widnes—The Town Clerk, Town Hall, Widnes (Aug. 15). A highly qualified assistant at the East Malling Research Station, to abstract reports of a scientific nature—The Secretary, East Malling Research Station, East Malling, Kent (Aug. 15). A bacteriologist for the Dairy Research Laboratories, New Zealand—The High Commissioner for New Zealand, 415 Strand, W.C.2 (Aug. 23). An assistant lecturer in zoology in the University of Birmingham—The Secretary, University, Birmingham (Aug. 24). A junior assistant in chemistry in the agricultural department of the Marischal College, Aberdeen—The

Secretary, North of Scotland College of Agriculture, 41½ Union Street, Aberdeen (Aug. 27). A professor of zoology in the University of Manitoba—The Registrar, University of Manitoba, Winnipeg, Manitoba, Canada (Sept. 1). An assistant lecturer in botany and zoology at the University College of Swansea—The Registrar, University College of Swansea, Singleton Park, Swansea (Sept. 5). An assistant lecturer in electrical engineering at the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (Sept. 19). Two lecturers, in biology and chemistry respectively, in the University of Western Australia—The Agent-General for Western Australia, 115 Strand, W.C.2 (Oct. 1). A head of the department of building of the Manchester Municipal College of Technology—The Registrar, College of Technology, Manchester (Oct. 3). A senior demonstrator in the department of physiology of the University of Otago, Dunedin, New Zealand—The Registrar, University of Otago, Dunedin, New Zealand (Oct. 20). An assistant in the department of physiology and biochemistry of University College, London—The Secretary, University College, Gower Street, W.C.1. A temporary assistant bacteriologist for research on fabrics in Admiralty Establishment—The Secretary of the Admiralty (C.E. Branch), Whitehall, S.W.1. An agricultural botanist at the Seale-Hayne Agricultural College—The Principal, Seale-Hayne Agricultural College, Newton Abbot, Devon. A laboratory assistant in the zoological laboratory of the University of St. Andrews—Prof. D'Arcy W. Thompson, The University, St. Andrews.

Our Astronomical Column.

NAKED-EYE SUNSPOTS.—A large circular or 'regular' spot has recently been in transit across the sun's disc. This is the second appearance of the spot which began its existence more than a month ago in the previous rotation. Its area measured on July 25 was a little more than 500 millionths of the sun's hemisphere, which is about the limit at which spots become naked-eye objects to keen eyesight. Owing probably to its regular outline, the spot was seen without difficulty by several observers. Particulars of its position are given in the table below, including another spot, No. 6, which was on the disc about a month ago. This spot was seen on one or two days only, partly on account of unfavourable weather, but as its area exceeded that of the more recent spot, it has also been tabulated. Spot No. 6 represents the third and last appearance of a naked-eye group whose earlier history is given in NATURE, May 21, p. 759, and June 18, p. 903.

No.	Date on Disc.	Central Meridian Passage.	Latitude.	Area.
6	June 29-July 11	July 5·4	15° N	1/1500
7	July 21-Aug. 3	July 27·8	8° S	1/1900

SPECTROSCOPIC PARALLAXES OF EARLY TYPE STARS.—The spectroscopic method of determining parallaxes was at first confined to stars of later type. It is considerably more difficult to apply it to types *A* and *B*, and it is necessary to use sharpness of spectral lines as a criterion, and further to employ different standards of sharpness for each subdivision of spectral type. Two papers describing researches on this subject made at the Norman Lockyer Observatory appeared in *Monthly Notices of Royal Astronomical Society* for March. The first, by D. L. Edwards, applies various tests to the method of Adams and Joy and gives curves connecting the line-character with absolute magnitude for types B_0 to B_9. These curves are then used to deduce parallaxes for 300 stars. The resulting parallaxes are compared with those by other authorities and found to be somewhat smaller, the mean difference being about 0·002″.

The stars of type A_0 to A_5 are dealt with in a paper by Dr. H. C. Woods. The classification is chiefly by the sharpness of the hydrogen lines, and is tested by trigonometrical and group-motion parallaxes. This list also contains 300 stars. The deviations in individual stars from the trigonometrical or group-motion values are considerable in stars with peculiar spectra, but generally small for the others.

The stars in both lists are naked-eye stars contained in Boss's P.G.C.

VARIABLE ROTATION OF THE EARTH.—Prof. W. de Sitter investigates the fluctuations in the motion of the sun, moon, Mercury, and Venus in *Bull. Ast. Int. Netherlands*, vol. 4, No. 124. He adopts from ancient observations the secular acceleration +1″·80 for the sun and +5″·22 for the moon, noting that the ratio of the former to the latter is too high according to the ordinary theory. He finds that the accelerations of the sun, Mercury, and Venus are proportional to their mean motions, as they should be if produced by tidal friction: the moon alone is discordant. He suggests that the secular acceleration of the moon may itself be variable. Taylor and Jeffreys found that the friction occurs almost entirely in shallow seas, where they would be liable to slow changes owing to silting up, etc. Accordingly, the acceleration in modern times (which is the one determined for the planets and partially for the sun) may be different from that determined for the moon, which depends on ancient observations. The changes in the earth's rotation are concluded to be of two kinds: one due to tidal friction, supposed to be variable, the other due to changes in the earth's moment of inertia.

Prof. de Sitter thinks it better to treat the great empirical term in the moon's motion in the same manner as the smaller terms. It is not safe to assume that either of them follows sine curves; they can be as well represented by a zigzag of straight lines. He notes that his results from Jupiter's satellites are not in harmony with those from the sun, Mercury, and Venus. He suggests that the Jovian system may have fluctuations of its own.

A METEOR TRANSITS THE SUN.—*Astr. Nach.* No. 5505 contains a note by A. Stentzel of Hamburg, describing an observation of the transit of a round black object, some 18″ in diameter, across the sun's disc from P.A. 120° (about) to 5° (about), on Mar. 15 at 15^h 25^m U.T. The time of passage was 6 seconds. The object was sufficiently distinct to make certain that it was not a distant bird. The observer notes that it is the first undoubted observation of the kind that he has made in twenty-seven years of observing. A very similar transit across the moon was noted by Dr. W. H. Steavenson, a few years ago, and described in the *B.A.A. Journal*. The rate of apparent motion was about the same in each case. The slowness of the motion makes it probable that the distance, and therefore the size, of the object were considerable. Most meteors cross the telescopic field in a small fraction of a second.

Research Items.

EDINBURGH FOLKLORE.—In the *Nineteenth Century and After* for July, Mr. Lewis Spence publishes the first instalment of a much needed study of the folklore of Edinburgh. He proposes to deal with his study under three heads: (i) Mythology, dealing with traditional material predominantly of a religious character; (ii) legendary tradition related to human personages or persons once actually existing; and (iii) folklore associated with ritual, popular customs, or superstition. In the first section he shows that the Chapel of St. Triduana in Restalrig was in all probability originally a structure erected over a holy well serving as a place of immersion. The shrine with its holy well was a resort of pilgrims for the cure of blindness. St. Triduana is not in the Roman calendar and was probably a Celtic goddess who, on account of the similarity of the legend accounting for her blindness, is to be equated with St. Brigit, the goddess Brigantia of the Brigantes, and Sulina (Gael. Suil, "eye of life"), worshipped at Bath. Brounger, associated with the fishing suburb of Newhaven in popular tradition, was an old fisherman who when he did not fish himself asked for a few fish or oysters from his returning neighbours. If they refused, ill luck followed. He is equated with the thunder god through a tradition connecting him with a flint or meteorite suggesting the holy or lucky stones representing that deity. It is possible that he may be Perunu, the thunder god, of Rügen, linking up through the connexion of the North German fishers with Scotland, and also the Slavonic Bóg. A demon, Shellycoat, finds an analogy in Japan only, and a piper who disappeared in a subterranean passage from the Castle to Holyrood recalls the legend of Orpheus and other stories of that class.

A NEW VIEW OF PILTDOWN MAN.—In *Man* for July, Prof. Frassetto of Bologna figures and describes his reconstruction of the jaw of Piltdown man, which he compares and contrasts with the jaws of the orang and the chimpanzee. In his view its resemblance lies in the direction of the orang rather than that of the chimpanzee. He gives in tabular form eight points in which the orang differs from the chimpanzee, and in which the jaw of Piltdown man, so far as its condition allows, is comparable with it. As a whole the jaw of the chimpanzee is relatively thin, slight, and light, while both orang and Piltdown are massive and heavy; the ascending ramus is oblique in relation to the horizontal portion, but in the orang and Piltdown almost vertical; the position of the semilunar notch coincides in the two jaws, but in both differs from its position in the chimpanzee jaw; the angle has a curvature of a large radius in orang and Eoanthropus, but it is small in the chimpanzee; the posterior margin of the chimpanzee ramus is narrow to the root of the condyle, where it widens rapidly, but in both the other jaws it widens gradually as it passes into the condyle. Again, the lower borders of the corpus of the mandible resemble one another in both orang and Piltdown but differ from the chimpanzee, which also has a relatively small genial fossa as opposed to the large fossa of the other jaws. The reconstruction was therefore made by grafting the symphysian region of the orang's mandible duly enlarged on to the corpus of Piltdown man's jaw, the conclusion being that the jaw is human, belongs to the same individual as the cranial fragments, and represents a primitive race belonging to a genus of the orang type. Not only is this because of the features of the mandible, but also because of the eyebrow ridges, which do not exhibit the prominent torus characteristic of the chimpanzee type to which Neanderthal man belongs.

INDUSTRIAL PSYCHOLOGY ON THE FARM.—The National Institute of Industrial Psychology, in Report No. 2, records the results of an investigation into certain processes and conditions on farms undertaken by Mr. W. R. Dunlop. The results would seem to show that farm management in Great Britain is by no means efficient. It is unfortunate that so many discussions on agricultural problems are complicated by political motives. The present investigation is the first systematic attempt in Great Britain to apply the point of view and methods of industrial psychology to agriculture. Two problems were studied: (*a*) the picking and packing of fruit, including bush fruit, hops, and glass-house produce, and (*b*) milking. It is shown that the best pickers at one kind of fruit are the best pickers at all other kinds, that there is no evidence to show that afternoon rates are lower than those of the morning, that there are considerable individual variations in efficiency. The milking problems include discussions of milking rates, differences of cows, manual skill of milkers. Some very important questions are raised in the third section dealing with future enquiries, not the least of which is the selection of the right worker for the right work, and the guidance of young people leaving school into occupations for which they are most fitted. Apparently there is a tendency for the children of a lower level of intelligence and ambition to take up agriculture, the town attracting the more intelligent. In so far as this is so, it is to be deplored, but obviously the problems connected with such a choice are very difficult to attack, involving as they do the attitude of mind of the community towards agricultural work, the lower standard of nominal wages and the ties with regard to hours.

THE SCIENCE OF ROWING.—Among the papers read at the July meeting of the Institution of Naval Architects at Cambridge was one on "The Propulsive Efficiency of Rowing," by Mr. F. H. Alexander. In welcoming the Institution to Cambridge the Vice-Chancellor, the Rev. G. A. Weekes, spoke of the subject of rowing as of particular interest to Cambridge men, especially as it is a matter of controversy at the present time. There are two schools of thought, the old orthodox school and a new school, which has proved very successful over short courses. Mr. Alexander's paper recorded the results of investigations as to the magnitude of the forces employed by oarsmen and the utilisation of those forces, a racing 'eight' and a ten-oared whaleboat being chosen for consideration. Various tables were given showing dimensions, ratios, properties of hull forms, weights of boats and crews, amplitude of the movements made by the crews, the oars and the boats, together with the speeds at different points of the stroke. It will come as a surprise to many to learn that the power developed amounts to so much as 1·09 H.P. for each man in the 'eight' and 0·90 H.P. for each man in the whaleboat. The efficiency of the total work in an 'eight,' *i.e.* the ratio of the work done per minute by resistance (91,800 feet-lb.) to the total work performed by the crew (288,680 feet-lb.) works out at 0·318. In the whaleboat the efficiency is only 0·221. The paper was accompanied by diagrams, and some of the points raised in the discussion will be dealt with by Mr. Alexander in a written contribution to the *Transactions*.

CANCER IN EUROPE.—Prof. Eugene Pittard of Geneva contributes an interesting article to the *World's Health* for June (vol. 8, No. 6) on the distribution of the incidence of cancer among the anthropological races of Europe. Surveying Italy, France, Holland, and Switzerland, the fact seems to emerge that the Nordic race is more prone to be attacked than the Celtic, Mediterranean, and Adriatic races. The last named, which includes the northern Albanians, the Bosnians, Montenegrins and others, seems almost immune from cancer.

THE PARASITOLOGY OF PLAGUE.—In regional studies in the parasitology of plague (*Ceylon Jour. Sci.*, vol. 1, Part 5, 1927) Dr. L. Fabian Hirst remarks that the gradual recession of plague from Europe at the end of the seventeenth century is one of the mysteries of epidemiology. Undoubtedly the substitution of the long sea route to the east round the Cape of Good Hope for the journey via the Mediterranean and the overland routes must have played an important part. But, he reminds us, bubonic plague is a disease of rats and the human epidemic is a mere offshoot of the epizootic, and therefore the fact which most requires explanation is the disappearance of the disease among the British rats and its failure to spread continuously when reintroduced among them. The generally accepted theory that the disappearance of plague from Britain is to be attributed to the replacement of the black rat (*Rattus rattus*) by the brown rat (*R. norvegicus*) is unsatisfactory, for the cessation of epidemic plague does not coincide with the appearance of *R. norvegicus* in England—it had been extinct for a generation when (in or about 1728) the brown rat reached England. The conditions prevailing in the wooden dwellings of old London with their large contents of grain, combined with defective scavenging and tolerance of large colonies of rats living in close association with man, amply suffice to explain the intensity of the historic human epidemics which devastated the city at fairly frequent intervals prior to the great fire. The former London plague season—June to December, with maximum prevalence in August and September—corresponds to the period of greatest prevalence of the flea *Xenopsylla cheopis* in Marseilles and Lisbon at the present day. The climatic conditions during plague years seem to have been especially suitable for the breeding of *X. cheopis*; during the great epidemics of 1636 and 1665 the summer was exceptionally hot and dry. That the disappearance of plague from Britain and Europe generally may possibly be due to a retraction of the area of *X. cheopis* prevalence is compatible with the known data.

ANTS OF THE CANARY ISLANDS.—In *Proc. Amer. Acad. Arts and Sci.*, vol. 62, April 1927, pp. 93–120, Prof. W. M. Wheeler contributes an interesting paper on this subject. He visited each of four of the larger islands during July and August 1925 and was able to collect and observe a considerable proportion of the ants known to occur in the Archipelago. He lists 56 species, subspecies and varieties now known, and by far the greater number have been taken in Teneriffe, the other islands having been little explored by entomologists. Nearly 70 per cent. of the total ant fauna is indigenous to the Canary Islands, while of the remaining forms, twelve are well-known south European and north African insects and five are tropicopolitan species. Among the latter the most important is the Argentine ant, *Iridomyrmex humilis*. Prof. Wheeler mentions that the banana plantations are suffering severely from this pest. Fear of closing the European markets to their produce has prevented the officials from announcing its presence, and Prof. Wheeler states that he encountered it in enormous numbers on three of the islands visited. This ant does not attack the banana directly, but owing to its fondness for honeydew excreted by coccids it not only cultivates these sap-sucking insects on the foliage but also transports their larvæ from plant to plant.

BUTTERFLIES OF SAMOA.—The Trustees of the British Museum have recently undertaken the publication of an account of the Insecta and other terrestrial Arthropoda collected in the Samoan Islands during 1923–24 by Dr. P. A. Buxton and Mr. G. H. E. Hopkins. The material collected was obtained during the expedition of the London School of Hygiene and Tropical Medicine to the South Pacific. The monograph will be divided into eight parts, which will be subdivided into fascicules. The latter will not appear in serial order, each one being published as soon as completed. On completion of the work it is intended to issue an introduction, summarising the whole monograph, and drawing from it whatever conclusions as may be warranted. The first study to be issued is Part 3, Fascicule 1 (London: British Museum (Natural History), 1927. 5*s*. Maps: No. 1, South-West Pacific; No. 2, Samoan Islands. 6*d*.), dealing with the butterflies of Samoa and of neighbouring island-groups, by Mr. G. H. E. Hopkins. It is noteworthy that with the exception of the comparatively recent American immigrant, *Danaida archippus*, the butterflies inhabiting Samoa and the neighbouring groups of Islands are all Indo-Malayan in origin. Most of them are widely spread through Polynesia and appear to have reached Samoa by way of Fiji.

LIVING CELLS UNDER DARK-GROUND ILLUMINATION.—The late Dr. T. S. P. Strangeways and Dr. R. G. Canti employed dark-ground illumination for the study of the living cell in culture and of the effects of fixing reagents upon the constituents of the cell. (*Quart. Jour. Micr. Sci.*, vol. 71, Part 1, 1927). Cultures of the choroid and sclerotic, heart, kidney, intestine, and skin of the embryonic fowl were employed. When growing on the surface of the coverslip the cell is flattened, has an irregular 'feather-like' shape, and shows no true cell-wall, the outline being apparently caused by reflection from the interface between the cytoplasm and the surrounding culture medium. This outline is unceasingly changing, if the culture is observed in the warm incubator, and the cell wanders over the surface of the coverslip by slow amœboid movement. Cells so observed show no nuclear membrane or Golgi apparatus. The centrosphere is seen as a cap over one side or end of the nucleus. The mitochondria appear to be formed in this region and to wander therefrom into the clear cytoplasm. Chromosomes can be distinguished in a dividing cell, but the most careful scrutiny failed to reveal a trace of spindle-fibres. The principal changes produced by fixing reagents were the formation of precipitate in nucleus and cytoplasm and shrinkage of these, distortion or destruction of the delicate cytoplasmic processes resulting in the cell assuming an artificially regular outline, the fusion of adjacent fat-globules, the modification or disappearance of the mitochondria, and the appearance of spindle-fibres in the dividing cell. Of all the reagents tested, 2 per cent. osmic acid produced the least change in the cell. The authors also describe the destructive effect of strong light (from the dark ground condenser) upon cells which had been fixed in a reagent containing chromic acid. The entire cell, with the exception of the fat-globules, was completely dissolved.

REDIA AND CERCARIA OF FASCIOLA.—W. Rees Wright records (*Ann. Trop. Med. and Parasit.* 21, 1927) observations on the redia, cercaria, and cyst of *Fasciola hepatica*. Thomas's statement that the sporocyst and daughter rediæ are not to be found during late summer and autumn is confirmed; at that time of the year, rediæ produce cercariæ only. The redia is cylindrical and about 2 mm. long and 0·4 mm. in diameter; its wall is very thin—for the greater part of its surface it is only one cell thick. Delicate muscle fibres, longitudinal and transverse, appear to be present in the wall external to the principal layer of cells. In addition to the simple digestive system there is an excretory system consisting of numerous flame-cells and their ducts, the main groups of flame-cells being near the oral end and near the two processes of the body wall, as Thomas pointed out. The redia, as Thomas indicated, is not a passive parasite; Wright states that in the case of very thin-shelled snails the rediæ may be seen devouring the liver tissue and moving through it. Wright describes and figures the position of the seven pairs of flame-cells of the cercaria. The cercariæ emerge from the parent redia through the birth pore, find little resistance to their movements in the eroded visceral mass, and escape from the snail through the respiratory aperture. Experiments with encysted cercariæ in artificial gastric and duodenal fluids suggest that complete digestion of the cyst walls takes place in the duodenum and not in the stomach. There is no definite evidence to show that *Limnæa truncatula* is the only intermediate host of *Fasciola hepatica* in Britain; observations are cited which suggest that *L. peregra* may also act as intermediate host.

NON-MARINE MOLLUSCA OF THE BELGIAN CONGO.—During the years 1909–15 the American Museum of Natural History maintained an exploring expedition in the Belgian Congo, under the leadership of Mr. H. Lang. The scientific results of that expedition, so far as the general invertebrate zoology was concerned, were published in the Museum's Bulletin, vol. 37, while a "Review of the Land Mollusks" by Dr. H. A. Pilsbry appeared in 1919 (*Bull. Amer. Mus. Nat. Hist.*, vol. 40, art. 1). Now, at long last, there comes to hand the companion volume on "The Aquatic Mollusks . . . With a geographical and ecological account of Congo Malacology" by Dr. H. A. Pilsbry and Dr. J. Bequaert (*Bull. Amer. Mus. Nat. Hist.*, vol. 53, art. 2). A bulky volume of 534 pages and 68 plates, with numerous text illustrations, it forms with its predecessor a complete monograph on the malacology of the vast territory of the Congo basin from the Atlantic coast to the great lakes of Central Africa, and will undoubtedly prove the standard book on the subject for many years to come. It is not to the malacologist alone, however, that the work will appeal, for the section on the zoogeography and ecology of the area will interest the general zoologist, and even the botanist and geologist. This topic seems to have been most thoroughly discussed and is well illustrated, text maps are furnished of the whole continent giving orographical details, rainfall, faunal areas based upon the distribution of birds, the hypothetical distribution of lake and river basins towards the close of the Pleistocene period, as well as other charts more immediately germane to the special subject. Twenty-two of the plates, moreover, are devoted to most excellent views of various habitats. The one defect of the whole work, and it is a big one, is the lack of any index. The Museum would do well if it would devote some future number of its Bulletin to an index to both volumes, and so crown what is a most important and valuable work.

NEW AMERICAN AND WEST INDIAN MOLLUSCA.—Dr. Paul Bartsch has described some new species of West American marine Gastropoda (*Proc. U. S. Nat. Mus.* vol. 70, art. 11), mostly small representatives of the Tænioglossa and Gymnoglossa. The thirty-one species believed to be new, with some previously described by the author but not figured at the time, are illustrated on six plates. Mr. W. B. Marshall contributes a short paper (*Proc. U. S. Nat. Mus.* vol. 71, art. 6) on "A New Genus and Two New Species of South American Freshwater Mussels." The new genus, Mycetopodella, has been created for the reception of the remarkable elongated form of Unio originally described under the name of *Mycetopus falcatus* Higgins, but since successively described to several other different genera. The new species are *Anodontites guanarensis* and *Mycetopoda pittieri*. Dr. H. A. Pilsbry (*Proc. Acad. Nat. Sci. Philad.* vol. 79) describes *Ceratodiscus portoricensis*, n.sp., a small land mollusc from Porto Rico. The genus has hitherto been known by one species in eastern Cuba and another in western Hayti, so that the new discovery extends the range of this peculiar group eastwards.

EARTHQUAKES IN NORWAY.—The earthquakes of Norway have been studied from the year 1887, and in a recent paper (*Bergens Museum Aarbok*, 1926) Prof. C. F. Kolderup has described those of the years 1924 and 1925. This was a period of unusual infrequency, the yearly numbers being 5 and 8, and also of slight intensity, for only one shock disturbed an area of more than about 1500 square miles. During the twenty-five years 1889–1913, 479 earthquakes were felt in Norway and 358 in Great Britain. Thus, taking the areas of the two countries into account, the frequency of earthquakes in them is almost identical, the ratio being 385 for Norway to 394 for Great Britain.

MICRODISSECTION.—The issue of *Watson's Microscope Record* for May (No. 11) contains matter of considerable interest. Dr. Eric Ponder contributes an article on 'microdissection,' in which by means of fine needles carried in mechanical holders minute structures, such as protozoa and cells, can be dissected while being viewed by the microscope, and any particular element, such as the nucleus, removed. The method is comparatively new and has many possibilities. Mr. G. T. Harris contributes Chapter III. of his studies of the Desmidiaceæ and Mr. W. G. Royal-Dawson details for mounting pollens for the microscope.

DISTANCE THERMOMETERS.—Messrs. Siemens Bros., Woolwich, have just issued a revised list of electrical distance thermometers. Amongst the instruments described are some designed to meet the special requirements of refrigeration, and they reflect the influence of the scientific workers studying problems of refrigeration on the design of technical apparatus for industrial use. One thermometer is intended for use in the refrigerated holds on board ship, and by means of flexible metallic connexion may be fixed in position or removed in a few moments. The object is to obtain an accurate measurement of the temperature of the cargo itself, which may differ considerably from that of the air near the refrigerating pipes. Another installation illustrated is a special outfit for a large precooling plant in South Africa. This is fitted with switch gear for connexion to 149 thermometers. In addition, five anemometers are fixed in the air ducts and five anemometer counters are fitted on the top of the board. Another installation which is illustrated was made for a grain elevator plant and was fitted with 900 thermometers.

Plankton of the Gulf of Maine.

THE great importance of the small and microscopic animals and plants that drift throughout the water layers in the sea and constitute the 'plankton' is now well established. On the plankton plants, chiefly consisting of diatoms, most of the animal life in the sea is ultimately dependent for its food supply. It is therefore natural that in fishery investigations, when seeking the basal causes of fluctuations in supply of fish, much time should have been spent in a study of this drifting life.

For the past twenty-five years the European countries attached to the International Council for the Exploration of the Sea have carried out extensive programmes in the regions of the great sea fisheries, no small part of which have been concerned with plankton research. The course of such investigations naturally follows an evolutionary path, and, while the earlier years were spent in classifying the various species and noting their comparative abundance and distribution in different localities, the work is now tending to a more detailed and minute study of those few forms that have been proved, on account of their numbers and prevalence, to be of the greatest importance in the economy of the sea.

Such is the position on the European side of the North Atlantic; but research is not so far advanced in the western Atlantic along the American seaboard. It is only in a recent publication [1] that full details of the preliminary survey necessary to depict the general characters of the plankton, and to point out those species worthy of a more detailed study, are forthcoming.

The area dealt with in this report is the Gulf of Maine, the oceanic bight from Nantucket on the west to Cape Sable in Nova Scotia on the east. The survey has been very thoroughly carried out and brings out clearly the major fact that the characteristics of the plankton community are essentially the same as those long known to be the case in other boreal waters of the North Atlantic.

The report, which has been written by that distinguished American oceanographer, Dr. Henry B. Bigelow, is divided into two main portions, the first dealing with the animals of the plankton and the second with the plants. The outstanding feature of the animal plankton is the predominance of the small crustacean copepod *Calanus finmarchicus*. This small creature is indeed deserving of a wider appreciation by the public, as it forms one of the main articles of food that constitute the links in the chain between plankton plants and fishes. Its abundance is overawing to the human mind; suffice it to say that in his largest catch Prof. Bigelow obtained upwards of 2,500,000 individuals by towing a net with a circular opening of one metre diameter through the sea for fifteen minutes. This huge catch shows that the region under observation can hold its own with the richest waters on the eastern side of the Atlantic, the largest catch the present writer is aware of being recorded by Hjort in "The Depths of the Ocean," p. 726, namely, at least 2,000,000 in a ten minutes' haul with a similar net to that mentioned above. Prof. Bigelow gives an instructive chart which emphasises clearly the predominance of this crustacean over other animals in the plankton.

In the catches also appear, in smaller and varying numbers, several species that characterise the collections, notably the copepods *Metridia lucens* and *Pseudocalanus elongatus*, the 'glass-worm' *Sagitta elegans*, the amphipod genus Euthemisto, the euphausiid genera Thysanoessa and Meganyctiphanes; the pteropod *Limacina retroversa*, the ctenophore *Pleurobrachia pileus*, and in deeper water the large copepod Euchæta. These organisms are here together designated the 'Calanus community.' Mention should be made of the euphausiid group; these shrimp-like animals are of considerable size compared with the other members of the plankton, Meganyctiphanes reaching a length of an inch or more, and their importance as food for fishes is being increasingly realised. There are few fish from northern waters, indeed, that have not been found feeding on them, and they form the chief food of the whalebone whales, the distribution of which in the Norwegian Sea has recently been shown by Hjort in a preliminary survey (Cons. Intern. pour l'Explor. de la Mer, *Rapp. et Proc. Verb.*, vol. 41, 1927, p. 115) to coincide at times with that of Meganyctiphanes. In this connexion Dr. Bigelow gives two interesting photographs of the fringe of whalebone plates, showing how the coarser fringe of the fin-back whale (*Balænoptera physalus*) allows the smaller animals of the plankton to pass through, the larger organisms, such as the euphausiids, alone being retained, while the fine fringe of the bone of the pollock whale (*Balænoptera borealis*) is able to retain in addition large quantities of the copepod Calanus.

Besides the species mentioned above, all animals present in the collections are dealt with in detail in the report as regards their seasonal and regional distribution. In the work of identification the author received the assistance of Prof. C. B. Wilson, but although relieved of this labour, Dr. Bigelow's report must represent the results of a vast amount of careful thought and study.

In dealing with the plants, or phytoplankton, for identification of which the author was indebted to Dr. Albert Mann, it is evident that far less information was available than in the case of the animals. Nevertheless, it is sufficient to show that in their general trend of behaviour the plants follow the same course in their seasonal distribution as they do in European waters. There is a very abundant plankton of diatoms in early spring which dies down and is succeeded in the summer months by a less abundant peridinian plankton.

At the end of this second portion of the report, Dr. Bigelow gives a valuable discussion on the problems connected with the cycle of events characteristic of phytoplankton throughout the seasons, in which a summary of much of the modern literature on the subject is included. The importance of those possible limiting factors in the environment, such as phosphates, nitrates, and silicates, is discussed, but the reader is left with the realisation that much work must be carried out before the various phenomena can be thoroughly understood. Unfortunately, no work on the phosphate and nitrate content of the sea-water comparable to that of Atkins and Harvey at Plymouth, and more recently Marshall and Orr at Millport, has yet been carried out in the region under survey.

Dr. Bigelow is to be congratulated on producing an addition to the literature that will prove invaluable to many plankton workers. The report is illustrated with many beautiful photographic plates reminiscent of those produced by the school of marine biologists at Port Erin, and contains an extremely useful bibliography of 365 titles. F. S. R.

[1] "Plankton of the Offshore Waters of the Gulf of Maine." By Henry B. Bigelow. Bulletin of the Bureau of Fisheries, vol. 40, 1924, part 2, Document No. 968, pp. 1-509. Washington, 1926.

Engineering and Technological History.[1]

THE desirability of preserving and making readily accessible accurate and authoritative information regarding the rise and decay of industries, the development of tools and machines, the evolution of handicrafts, and the lives of the principal actors therein, can scarcely be disputed. With the passage of time mines are abandoned, factories pulled down, machines and tools scrapped, papers are dispersed, and the pioneers often forgotten. Even when manuscripts and drawings are preserved, it is frequently difficult to learn of their whereabouts, and the student is often at a loss to know where to look for original material.

In its efforts to further the study of engineering and technological history by the preservation and publication of such information as that referred to, the Newcomen Society is doing valuable work and has gained for itself a recognised place among the technical societies of Great Britain. The fifth volume of its *Transactions* is evidence of the wide scope of its activities and the high standard of the matter presented. The present volume contains the papers read before the Society during the session 1924–25. Glass-making, the art of the gunsmith, the windmill in America, the evolution of the boring machine, the Eddystone lighthouses, are among the subjects dealt with. Two other papers on the iron industry of Coalbrookdale bring into proper perspective and correct date the epoch-making work of the Darby family, five generations of which engaged in iron smelting and founding. Both Mr. J. W. Hall and Mr. T. A. Ashton write on this subject, and the latter concludes his review of the work of the Darby family with the following pregnant paragraph: "The first Darby used coke in place of charcoal in the production of castings; his son converted this coke-smelted iron into malleable iron with charcoal; the Cranages and Henry Cort substituted coke for charcoal in the final process. By so doing they broke the last shackle binding the industry to the woodlands and enabled it to renew its youth on the coalfields of the Midlands, Yorkshire, and South Wales. The work begun by Abraham Darby in 1709 was completed by Henry Cort in 1794."

Among other contributors may be mentioned Mr. C. E. Greener, whose knowledge of guns and gun-making is unrivalled; Sir Flinders Petrie, who illustrates a discourse on ancient glass in Egypt by three plates giving specimens of Egyptian glass before 1200 B.C., between 1200 and 300 B.C., and between 300 B.C. and A.D. 300; Mr. D. Brownlie, who recalled a neglected worthy, John Patison of Airdrie (1828–1905), a pioneer in the shale oil industry; while Mr. R. Jenkins annotates some letters of the elder Brunel on boot-making by machinery.

A word should be said about the bibliographies that have appeared in the *Transactions*. Vols. 2 to 4 contained parts of a bibliography of engineering and applied science, compiled by Mr. E. W. Hulme. Most of the items given referred to articles published in periodicals and journals of the last few years. In the present volume is a subject list of books and pamphlets relating to the history of technology published during the period 1920–25. There are several hundred items in the list, which has been compiled by Mr. A. Gomme, of the Patent Office Library, and the value of the list is increased by the insertion of an asterisk against such of the books as are to be found in that library. We trust these bibliographies will be continued, and thus a body of information accumulated which will be of value not only to writers and students of engineering history, but also to others concerned with biography, economics, and commerce.

[1] The Newcomen Society for the Study of the History of Engineering and Technology. *Transactions*, Vol. 5, 1924–1925. Pp. xii+139+22 plates. (London: Newcomen Society, Science Museum, 1926.) 20*s*.

Appeal for the University of Sydney.

IN its comparatively brief existence of seventy-five years, the University of Sydney has been the recipient of numerous private benefactions. The princely Challis bequest (1880) of £276,000, and the even greater munificence of the late Sir S. McCaughey (1920), have rendered the University much less dependent than its neighbours upon State aid, particularly as the income in each of these instances is available for general purposes. Other noteworthy gifts, including one of £100,000 by Sir P. N. Russell, and another of £30,000 by Thomas Fisher, were allocated to specific purposes by the donors.

Such benefactions must doubtless be numbered among the chief factors which have brought about a development so rapid that the University "now finds itself in a more critical position than ever before, . . . its resources have not kept pace with its requirements." This quotation is taken from a pamphlet which has been issued recently by the University authorities under the title of a "75th Anniversary Appeal" for further funds. According to the facts set down therein, the University of Sydney, with an enrolment of 2490 in 1925, must be included among the major universities of the Empire. The teaching staff, however, numbers only 217; on the Liverpool scale it should be increased to 364, and on the Manchester scale to 452. A further handicap is discerned in an exhibition system which exempts 200 undergraduates per annum from fees, for a maximum period of 5 years, in return for a yearly Government grant of £20,000. Since, in addition, all teachers and intending teachers are entitled to a similar remission, there were 1084 students in 1926 who paid no tuition fees. The fees payable by other students average £25 per annum in the Faculty of Arts and nearly £40 in the Faculty of Medicine.

The Government of New South Wales has been liberal in granting a sum of about £50,000 per annum over a period of several years for the provision of new buildings, in strengthening existing departments, and in establishing new ones. The creation of new chairs, however, seems to have contributed considerably to the mounting expenditure. Owing to the adoption of the Workers' Compensation Act, the rise of wages, and the increased number of employees, the payments for attendants and laboratory assistants have risen by £7777 since 1922. Thus, although nominally wealthier, the University is relatively poorer, and in spite of a general services fee of a guinea a term which has been levied, not without protest, on every student, the present year will probably close with a deficit of some £8000.

Meanwhile, many claims press for fulfilment in connexion with (1) grounds, roads, and buildings, (2) sport, (3) the library, and (4) maintenance and research. The new chemistry building is still incomplete; pathology, pharmacy, and psychiatry are inadequately accommodated; the additions to the

library are unfinished; and "the University grounds give the impression of shabbiness and neglect." Further, the McCaughey Research Fund of £1000 per annum, from which grants were formerly made to teachers and graduates of the University, has been in abeyance since 1923. At the present time, apart from the question of future expansion, it is estimated that an additional revenue of more than £12,000 per annum is needed to enable the University to discharge all the functions that properly belong to it.

The University of Sydney, though young in years, is rich in achievement. Australia suffers from no lack of public-spirited citizens, and we hope that this appeal from one of the greatest centres of learning in the southern hemisphere will evoke an adequate response.

University and Educational Intelligence.

CAMBRIDGE.—Mr. L. E. S. Eastham has been appointed lecturer in advanced and economic entomology.

Mr. L. H. Wilson, Emmanuel College, has been elected to the E. G. Fearnsides research scholarship on the organic diseases of the nervous system.

Dr. E. H. Minns, fellow of Pembroke College, has been elected Disney professor of archæology.

LEEDS.—The Court of the University has decided to confer the following honorary degrees on the occasion of the meeting of the British Association in Leeds in September next,—*Doctor of Laws* (*LL.D.*): Sir Arthur Keith, president of the British Association; the Duchess of Atholl; and the Hon. Sir Charles Parsons. *Doctor of Science* (*D.Sc.*): Dr. J. S. Haldane, Dr. N. V. Sidgwick, Dr. F. O. Bower, and Dr. R. A. Millikan, of the California Institute of Technology, Pasadena. *Doctor of Philosophy* (*Ph.D.*): Mr. James Graham.

LONDON.—The following doctorates have been conferred: D.Sc. in botany on Major T. F. Chipp (Birkbeck College) for a thesis entitled "The Gold Coast Forest: a Study in Synecology"; D.Sc. in chemistry on Mr. P. B. Ganguli (University College) for a thesis entitled "Studies in Colloidal Chemistry," Mr. E. S. Hedges (Bedford College), for a thesis entitled "Periodic Electrochemical Phenomena," and Mr. S. J. Lewis (University College), for a thesis entitled "1. The Ultra-Violet Absorption Spectra of Blood Sera. 2. The Ultra-Violet absorption Spectra and the Optical Rotation of the Proteins of Blood Sera. 3. A New Sector Spectrophotometer"; D.Sc. in physiology on Dr. A. S. Parkes (University College), for a thesis entitled "On the Occurrence of the Oestrous Cycle after X-ray Sterilisation"; D.Sc. in zoology on Mr. C. A. Hoare (London School of Hygiene and Tropical Medicine), for a thesis entitled "Studies on Coprozoic Ciliates"; D.Sc. (Engineering) on Mr. A. C. Vivian (Imperial College (Royal School of Mines)) for a thesis entitled "The Preparation and Purification of Beryllium."

It has been resolved to institute an Academic Diploma in Biology.

The title of reader in philosophy in the University has been conferred, as from September, on Miss L. S. Stebbing, in respect of the post held by her at Bedford College. Miss Stebbing studied at Girton College, Cambridge, and at King's College, London. Since 1924 she has been lecturer in philosophy at Bedford College, London. Her published work includes "Pragmatism and French Voluntarism" (Camb. Univ. Press, 1914), and numerous articles in *Proc. Aristot. Soc.*, *Mind*, and other philosophical journals.

MR. GEORGE F. O'RIORDAN, Principal of the Leicester College of Technology since 1924, has been appointed Principal of the Battersea Polytechnic in succession to Dr. R. H. Pickard, who has accepted the post of Director of the British Cotton Industry Research Association.

A SENSIBLE Heat Distillation, Ltd., Coal Research Fellowship at the Imperial College of Science and Technology is being offered to candidates possessing a first-class university degree with chemistry as principal subject and intending undergoing two years' research training leading to industrial work in coal carbonisation. The value of the fellowship is from £175 to £200. Applications must reach the registrar of the College by Aug. 31.

FROM the National University of Ireland we have received its Calendar for 1927, a bulky volume of nearly a thousand pages. A summary of examinations at the constituent and recognised colleges in 1926 gives the following total numbers of students examined: at University College, Dublin, 1236; Cork, 525; Galway, 242; St. Patrick's, Maynooth, 166. Candidates admitted to the degree of B.A. were: Dublin, 92; Cork, 36; Galway, 7; Maynooth, 74. The other degrees granted were chiefly medical (146), commerce (63), and science (56). Four valuable travelling studentships (£200 a year for two years) were awarded in economics, experimental physics, modern languages, and agriculture, respectively.

A PAMPHLET on "Education in the United States," prepared under the direction of the Commissioner of Education for the Pan-Pacific Conference, 1927, has reached us. Its twenty-five pages provide a very useful summary, concise but comprehensive, of the organisations concerned with education in that country of all grades from kindergarten to university and the various types of adult education. The statistics are elucidated by interesting comments on recent developments. The traditional demarcation between the elementary and the secondary or high schools tends to give place to the 6-3-3 plan, consisting of six annual grades above the kindergarten followed by a three-years junior high school (for pupils of from 13 years to 15 years) which, in turn, leads to a three-years high school (ages 16 years to 18 years). This is designed to meet the special needs of the years of adolescence and to afford, especially for those who are not destined to complete the high school course, a better preparation for life than is possible under the old 8-4 scheme. About one secondary school in every six is now organised according to the newer plan. Among other recent developments noticed are: school consolidation, or the uniting of several small schools in one, which is proceeding at the rate of one thousand a year; consequential schemes for the transportation of pupils at public expense amounting now to more than thirty million dollars annually; the increase since 1920 in the proportion of men teachers in elementary and secondary schools; advancement of professional requirements for teaching; extended use of the 'project' method in teaching; co-operation of pupils' parents; increase in industrial and trade courses in secondary schools; municipally supported colleges and universities; adjustment of college entrance requirements with the aim of selecting the more gifted students; junior colleges offering the first two years of work of the ordinary four-years college; approximation of standards for all colleges and universities.

Calendar of Discovery and Invention.

August 7, 1807.—The famous Bell Rock Lighthouse, which was begun on Aug. 7, 1807, and completed in 1811, was the greatest work of Robert Stevenson. Modelled after Smeaton's Eddystone tower, it is 112 feet high and 42 feet in diameter.

August 8, 1793.—Founded by Colbert in 1666, the Paris Academy of Sciences with similar institutions on Aug. 8, 1793, was suppressed by the Committee of Public Safety. Two years later, however, saw the founding of the Institut National des Sciences et des Arts.

August 9, 1831.—The first locomotive that ever ran on commercial service in the United States was the *Stourbridge Lion*, built at Stourbridge, England. The most famous of early American passenger engines, however, was the *De Witt Clinton*, which on Aug. 9, 1831, ran from Albany to Schenectady, a distance of 17 miles, attaining a speed of 30 miles an hour.

August 10, 1675.—The founding of a Royal Observatory by Charles II. was due to the representations of Flamsteed, Sir Jonas Moore, Sir Christopher Wren, and others. Various sites were considered, but at Wren's suggestion Greenwich Hill was chosen. The warrant for the building was dated June 2, 1675, the first stone was laid on Aug. 10, and eleven months later Flamsteed took up his residence in the observatory. Towards the building the King gave £500, while some of the bricks came from Tilbury Fort.

August 10, 1846.—The famous Smithsonian Institution of Washington came into being by an Act of Congress approved on Aug. 10, 1846. James Smithson, the founder, an illegitimate son of the 1st Duke of Northumberland, died at Genoa in 1829, leaving a fortune of more than £100,000 to a nephew for life, and then to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an establishment "for the increase and diffusion of knowledge among men." The motives which actuated Smithson will probably never be known, for practically all his personal papers were destroyed in a fire in January 1865. Smithson was buried in the English cemetery at Genoa, but in 1904 his remains were removed from Genoa and now rest in a small chapel in the Smithsonian Institution.

August 11, 1716.—In the *London Gazette* for Aug. 11-14, 1716, an advertisement appeared to the effect: "Whereas the invention for raising water by the impellant force of fire, authorised by Parliament, so lately brought to the greatest perfection . . . as is demonstrated by diverse engines of this invention now at work in the several counties of Stafford, Warwick, Cornwall, and Flint . . . if any person shall be desirous to treat with the proprietors for such engines, attendance will be given for that purpose every Wednesday at the Sword Blade Coffee House in Birchin Lane, London. . . ." This is probably the earliest advertisement of the Newcomen beam engine, the oldest of all practical steam engines.

August 11, 1877.—It was on the night of Aug. 11, 1877, that Asaph Hall, with the large telescope at Washington, first caught a glimpse of one of the small satellites—Phobos and Deimos—of Mars. A few days later he was able to observe both satellites.

August 12, 1851.—Numerous as were the inventors of sewing-machines, it was Isaac Merritt Singer who made the first practical machine and also achieved commercial success. Singer's patent was dated Aug. 12, 1851, and the well-known firm bearing his name was founded in 1856. By 1863 the sales numbered 21,000 annually; by 1878, 350,000; by 1896, 800,000; while to-day the number has grown to between two and three million. E. C. S.

Societies and Academies.

DUBLIN.

Royal Dublin Society, June 28.—J. Reilly and G. Pyne: A modified micro-method for the determination of molecular weights. This depends on the alterations in the cooling curve of pure camphor produced by minute amounts of dissolved substances. The method is particularly useful for substances the low solubility of which in camphor, or their high molecular weight, precludes the use of the ordinary Rast method.—J. Wilson: Lord Morton's quagga-horse hybrid. Was it a hybrid?

EDINBURGH.

Royal Society, June 20.—T. J. Jehu and R. M. Craig: The geology of South Harris. In the Archæan complex are two well-marked bands of paragneisses which include crystalline limestones, quartz-schists, graphite-schists, garnetiferous sillimanite-gneisses, and garnetiferous kyanite-gneisses. With these are associated hornblende-schists and gneisses and hornblende-pyroxene rocks which are probably of igneous origin. These appear to be the oldest rocks in the district. Between the bands is an intrusive igneous complex ranging in character from an anorthosite-gneiss to a gabbro-diorite and eclogite. Belonging to the same period of intrusion are ultra-basic bands found in various parts of the island. The north-western part of the area is made up of a granite-gneiss which sends tongues and bands into the neighbouring rocks, and associated with this granite-gneiss are abundant pegmatites. Along the eastern margin of South Harris there is evidence of crushing and shearing with the formation of mylonites at places.—Robert Campbell and J. W. Lunn: Tholeiites and dolerites of the Dalmahoy syncline. An account of the petrology of a suite of cognate intrusions associated with the Cementstone group and the Lower Oil Shale group of the Scottish Carboniferous. The rock types represented are basalts, tholeiites, and dolerites all closely related to mugearites and essexites. They contain fayalite of late crystallisation associated with primary quartz, and are noteworthy also for their richness in chlorophæite. They are regarded as hypabyssal equivalents of the mugearitic and other alkali basalts of Lower Carboniferous age found at Corston Hill and elsewhere in the Edinburgh district.—Cyril Crossland: Marine ecology and coral formations in the Panama region, Galapagos, and Marquesas Islands, and the atoll of Napuka. The three regions described are sharply contrasted in climate, geology, flora, and fauna. Panama and the islands off its coast have a littoral fauna of great richness, but an extraordinary absence of algæ. In the Galapagos algæ abound, Sargassum in places giving the shores a temperate rather than tropical appearance. There are small coral flats in the Panama islands, but these are made of one species of Pocillopora, are unconsolidated, and would be thrown on to the beach in any sea of less continual calm. No coral deposits were found in the Galapagos (*pace* Agassiz), but considerable quantities are thrown upon certain beaches. The absence of reefs round the Marquesas has often been remarked. The coral fauna is greatly restricted, only five genera with twelve species being present, so that the problem is, after all, one for the biologist. These species belong to the Indo-Pacific fauna, not to that of the eastern side of this ocean. There are no true reefs in the group, the nearest approach to one being a structure which is probably unique. It consists apparently of one huge colony of a massive Porites, and therefore the whole reef has

grown from a single ovum. In the atoll of Napuka an ancient reef flat was found about two feet above the present sea-level, and the actual reef is an erosion flat, a foot or so above the present level of growth. It appears to be undergoing destruction by the sea.—W. G. **Thomson**: On the discharge of a condenser through a gas at low pressure. Observations were noted of the flash which frequently occurs in a discharge tube at low pressure when the electrodes are connected with the terminals of a charged condenser. Photographs of single flashes were shown. Spectrograms of the flash were obtained in air and in hydrogen. The former consisted mainly of lines of the spark spectrum of air, while in the latter, many lines of the second spectrum were identified.—E. L. **Ince**: Researches into the characteristic numbers of the Mathieu equation (iii).

IPSWICH.

Prehistoric Society of East Anglia (at the Royal Anthropological Institute), May 24.—J. E. **Sainty**: Acheulean flaking site at Whitlingham, Norfolk. Report on excavations on behalf of the Sladen Trust. Few palæolithic implements have been recorded from the Norwich district, but this site, discovered by the author and Mr. H. H. Halls, was exceptionally prolific. 550 artefacts were recovered in all, including 173 hand-axes. The implementiferous deposit was part of the 50-foot terrace of the River Yare. An upper clayey loam yielded sporadic specimens showing Le Moustier technique; one large end scraper of grey flint being of the well-known "High Lodge" character. Sterile ferruginous sand, stony gravel, and shelly sand underlay the Moustier horizon and separated it from a bed of gravel one to three feet thick, about eight feet below surface, which proved to be the main implement-bearing horizon. The implements show little if any sign of abrasion; several are of large size and range from 10½ inches in length downwards. Species of Chellean character, heavily abraded and striated, are also present and point to an ice advance between the period of that culture and the time of the Acheulean industry.—J. Reid **Moir**: Report on excavations at Hoxne made on behalf of the British Association and Sladen Trustees in 1924 and 1926. The results obtained confirmed the main facts observed in the British Association Committee researches conducted by Clement Reid in 1895–96, and produced important new evidence. The lacustrine beds of Hoxne rest in an ancient basin eroded in the surface of the Kimmeridgian Boulder Clay, and the implement-bearing horizon is later than the arctic plant-bed which overlies the 'temperate' clays filling the bottom of the basin. These lower deposits appear devoid of human artefacts, but St. Acheul hand-axes occur in thin gravel seams at the base of the brick-earth which covers the arctic plant-bed. The implements are slightly rolled and agree with those illustrated in Frere's classic paper of 1797, so that the gravel in question was probably the source of the implements which he reported upon. In the brick-earth itself, above the gravel, traces were found of a 'floor' of early Le Moustier date with hand-axes of black unrolled and unchanged flint. The early Le Moustier brick-earth is in turn sealed in by a contorted material of glacial origin containing 'erratics' and broken and striated implements of various ages down to that of Le Moustier; the deposit itself being correlated with the Upper Chalky Boulder Clay of East Anglia. The interglacial age of the lower palæolithic industries of St. Acheul and early Le Moustier times is thus taken to be established for this region and the second interglacial stage of East Anglia is indicated.—Miss **Layard**: A late palæolithic settlement in a river terrace of the Colne, Essex. Numerous small flake implements occur at depths varying from 1½ ft. to 2 ft. in water-laid gravels. They strongly resemble the more familiar continental cave industries of this period, and are fashioned out of pebbles rather than mined flints. The unrolled condition of the flints and the numerous cores found indicate a settlement. Small hearths have also been discovered. Characters belonging to both Aurignacian and Magdelenian work are noticeable. At the same time there are certain original characteristics which may be provincial. The occurrence of some more or less celt-like tools, in close connexion if not belonging to this industry, makes it probable that they should be placed at the very end of the Upper Palæolithic period, and it has been suggested that they approximate most nearly to the Maglemosean culture. A fine *feuille de laurier* of undoubted Solutrean workmanship was also discovered in a lower stratum of the same section.—H. F. **Dowie**: Further excavations in Kents Cavern. In the second season's excavations the removal of six feet of cave-earth underlying the stalagmite floor revealed flints and fauna similar to those from above it. Three human teeth discovered have been stated by Sir Arthur Keith to be Upper Palæolithic. The flint implements discovered last year have been variously regarded as Middle and Late Aurignacian. No palæolithic hearth or workshop, or any surface definable as a 'floor,' has been discovered. Re-sortment and mixture of deposits has probably occurred owing to flooding. The recent reclassification by the Abbé Breuil of harpoons of Magdalenian 6, results in placing the uniserial specimens with trapezoidal barbs found in the upper levels in 1866, at the very end of that period, and they are further stated to be Maglemose types. The brachycephalic skull found at Kents Cavern is similar to skulls found in Aveline's Hole, and possibly at Cresswell, which seem to appear first in Great Britain in a *milieu* of Late Magdalenian implements in bone and horn and a flint industry with survivals of Late Aurignacian types and a tendency to geometric forms.—S. **Turner**: Report on discovery of worked flints at Stone Cross Farm, Luton, Kent. A considerable number of white patinated flints apparently of palæolithic character, including one definite ovate hand-axe, were found. They were battered, and indicated much exposure. They occurred in a patch of gravelly material which had been covered by about six feet of clay-with-flints. The cultural affinities of the specimens are problematical and their characters peculiar.

PARIS.

Academy of Sciences, June 27.—Marcel **Brillouin**: The field of exterior gravitation and densities in the superficial layer of the globe. The question of isostasy.—H. **Douvillé**: Some episodes in the formation of the Pyrenees.—Gabriel **Bertrand** and D. J. **Perietzeanu**: The relative proportions of potassium and sodium in plants. The amounts of potassium in the fresh plant, in the dry material, and in the ash are given for 35 species of plants. The ratio potassium/sodium for the same plants is also given, this ratio varying from 1040 to 1·15.—A. **Blondel**: A method of synthetic discussion of the conditions of working of steam turbine governors.—Paul **Helbronner**: The common sides of the Avignon parallel and the southern chain of the French Alps. A discussion of the accuracy of the geodesic networks connecting the Lake of Geneva with the Mediterranean.—Leonardo Torres Quevedo was elected an *associé étranger* in succession to the late Kamerlingh Onnes.—E. **Cartan**: Certain remarkable Riemann forms

of geometries with a simple fundamental group.—L. Féraud: A generalisation of the point correspondences which establish projective applicability.—Maurice Gevrey: Problems at the limits of the elliptic type; the case of contours with angular points.—M. Lavrentieff: A problem of P. Montel.—D. S. de Lavaud: The fundamental critical velocities of a motor-car.—Robert Esnault-Pelterie: Methods and apparatus for the measurement of Hertzian hardness. The Hertz definition presupposes a transparent and brittle body: the author uses a modified definition which is applicable to opaque bodies, and especially to hard steels. The hardness is measured by the pressure p_m at the centre of circle of contact of two equal spheres of radius $r=1$ at the moment when the diameter of contact ceases to follow the law of Hertz $d=1{\cdot}761\sqrt[3]{Fr/E}$ (F in kilograms, r and d in cm., E in kilograms per sq. cm.). Two methods of carrying out the experiment are described and data given for quartz and for various steels.—Raoul Ferrier: The two magnetic moments of the atom. A discussion of the effects of the discordance between the Bohr moment (M) and Weiss moment (M').—Félix Michaud: Binary mixtures of volatile liquids. The case where the molecules of one of the components are partially associated.—Ny Tsi Ze: The electrical deformations of quartz.—C. Mihul: The structure of the second order spectrum of carbon (C II).—Maurice Auméras: The conductivity of hydrofluoric acid. A repetition of W. Ostwald's experiments on the electrical conductivity of hydrofluoric acid, with special care in the purification of the acid, gives values for the constant k lower than that of Pick ($7{\cdot}2\times10^{-4}$).—A. Sanfourche and B. Focet: The decomposition by water of monocalcium phosphate ($CaH_4(PO_4)_2\,.\,H_2O$).—Paul Bauret, Albert Portevin, and Pierre Chevenard: Alloys suitable for resisting the effects of an alternating temperature gradient and, in particular, alloys suitable for fine glass moulds.—Mlle. M. Quintin: A relation between the activity of the hydrogen ions H^+ and that of metallic cations in a solution of salts of the heavy metals. It is shown that in solutions of the sulphates and nitrates of zinc, cadmium, and copper, the activity of the metallic ion is, for all concentrations between $M/2$ and $M/2048$, proportional to that of the ion H^+.—P. Vaillant: The rôle of the intensity of the maximum absorption in the displacement of Kundt.—Jacques de Lapparent: The hydrated alumina of bauxites.—F. Dienert: The sources of the alluvial water of the Loire valley.—M. Lenoir: The observation of the pollen kinesis in living *Lilium candidum*. These observations on the living specimen show that the hetero-homeotypical scheme, established from the study of fixed and stained preparations, is perfectly exact.—M. Bridel and Th. Aagaard: The diastatic hydrolysis of turanose. Turanose is not hydrolysed by emulsin, rhamnodiastase, or the autolysate of high yeast, but low yeast causes the rapid hydrolysis of this glucoside. This is not due to the sucrase present but to an active α-glucosidase. Turanose is a glucoside of fructose.—Marcel François and Henri Piéron: Sensations of apparently internal heat are of cutaneous origin (experiments by the diathermal method).—Raymond-Hamet: The splenic vasomotors.—H. Hérissey: The extraction of asperuloside from *Galium verum*. The probable presence of this glucoside in numerous plants of the Rubiaceæ family.—E. Aubel and L. Genevois: The oxidation-reduction potential of yeast, of *Bacterium coli*, and of the media in which these micro-organisms increase.—J. Cantacuzène and O. Bonciu: Some peculiarities relating to filtered scarlatina products.—J. Giaja, X. Chahovitch, and A. Giaja: The absence of fever in the rat deprived of the suprarenal capsules. Rats after removal of the suprarenal capsules suffered no temperature rise when inoculated with a culture of the pyocyanic bacillus.

CAPE TOWN.

Royal Society of South Africa.—April 20: M. R. Levyns: A preliminary note on the Rhenoster bush (*Elytropappus Rhinocerotis*) and the germination of its seed. Under natural conditions the Rhenoster bush has no power of reproducing itself; its spread is largely due to man's influence, veld-burning being an important factor.—William Adam Jolly: On some defensive reflexes. The reflexes obtained in the hind limb of Xenopus on stimulation of one or both feet are discussed.—E. Newbery: Note on overvoltage problems. Modern improvements show that transfer resistance is a real quantity and therefore that the direct method of measuring overvoltage is incorrect. These improvements are mainly in the reduction of the time interval between the interruption of the main current through the cell and the measurement of the single potential of the experimental electrode. In the original work this time interval was 0·02 second; it has been reduced to 0·002 second (Glasstone), 0·0001 second (Sand), and finally the cathode ray oscillograph reduces it to 0·000001 second. The results are all explainable on the hydride theory of overvoltage. Transfer resistance is in itself a complex quantity, due chiefly to the resistance of a film of gas covering the electrode surface, but partly also to the presence of a partially exhausted layer of electrolyte surrounding the electrode.—K. H. Barnard: Some South African Crustacea. Three species of Crustacea are known to be injurious to pier-timbers immersed in the sea in South Africa. Two are cosmopolitan: *Limnoria lignorum* (the Gribble) and *Chelura terebrans*. These are not more than a quarter of an inch in length. The third species is *Sphæroma walkeri*, which is common in India and seems to be spreading down the east coast in to Natal. It reaches half an inch in length and is capable of rolling itself into a ball.

COPENHAGEN.

Royal Danish Academy of Sciences and Letters, Mar. 25.—Martin Knudsen: The hot wire manometer. A rational construction is given, and a series of measurements have shown that this method, for a certain interval of pressures, gives greater relative exactitude than any other method.

April 8.—C. Juel: Von Staudt's definition. After reviewing the different forms in which this definition for imaginary elements has been given, the definition for projectivity is considered, and imaginary elements are also discussed.

April 22.—Th. Mortensen: The postlarval development of some cidarids. The study of a series of young stages of *Eucidaris metularia* proves that the interradial plates on the peristome of cidarids are not homologous with the interambulacral plates of the test. The periproct is never covered by a single large anal plate. The embryonal spines do not develop into the adult type of spines, but are dropped in the course of growth of the animal. The young *Goniocidaris umbraculum* is unique in having a bundle of spines, instead of a single spine, attached to each tubercle.

May 6.—Martin Knudsen: The thermal molecular pressure. The condition of equilibrium in a gas enclosed in a circular cylindrical tube the ends of which are kept at different temperatures, will ordinarily be that the pressure in the gas has the same value at both ends. At low pressures deviations

from this law arise, and at very low pressures the law becomes completely altered. The author has investigated this phenomenon by a series of measurements and given a formula valid for all pressures.—J. Lindhard: The respiratory quotient during short-period muscular exercise. It has been maintained that the real respiratory quotient during short-period muscular exercise is 1, that is to say, the work is performed on the expenditure of carbohydrates exclusively. Experiments now in hand show that this contention is untenable.—J. Hjelmslev: Invariant theory of power series. An independent and complete invariant system for power series of any number is stated as a convergence problem. The corresponding invariant theory comprises and simplifies the well-known theory of the differential invariant. It has also wider applications where the usual conditions for constancy or differentiation are not valid.

GENEVA.

Physics and Natural History Society, May 19.—M. Gysin: On the chemical and mineralogical constitution of the limestones of Saint Bést (Pyrenees). A chemical and petrographical examination confirms the hypothesis of MM. Bertrand and Longchambon on the metamorphic origin of these rocks of Urgo-aptian age. The clay limestones have recrystallised with formation of silicates. The other minerals are due to fumerolles arising from the neighbouring granites.—E. Briner and A. Schidlof: The boiling-point paradox. As the result of their previous studies the authors arrive at the conclusion that it is the osmotic work of dilution of the vapour which provides the compensating work.—B. P. G. Hochreutiner: A new Australian species from Java. The author has collected in Java, at heights exceeding 2000 metres, a Cynoglossum which he connects with *Cynoglossum australe*, indicated by Bentham in the south of Australia, the province of Victoria, New South Wales, and Tasmania.

ROME.

Pontifical Academy of Sciences, April 24.—Wirtinger: Modern mathematics.—Hagen: Symmetry in the theory of surfaces. A problem, as yet unsolved, on a singular symmetry in the so-called Weingarten's identity.—Serini: Elastic co-actions. Various considerations of great importance to the technics of constructions are propounded.—Caronia: Di Cristina's new views on the processes of the defence of the organism against infections. According to these views, the infective process requires sensitiveness of the organism to the infective agent. Cure is associated with a process of de-sensitisation, which may be brought about artificially by special methods.—Teofilato: Investigations on the most suitable longitudinal profile of an aerodynamic tube.—Giorgi: Note on wave-filters.—Ernesta Porcu-Tortrini: Calculation of the powers of motors of the second order by reduction to the canonical form.—Neviani: *Cheiloporina circumcineta*. The history of this species, discovered by the author, is summarised and co-ordinated with observations of other investigators.—Bresadola: (1) Selecta mycologica; (2) Basidiomycetes Philippinenses.

SYDNEY.

Linnean Society of New South Wales, April 27.—A. S. Hitchcock: Two new species of Setaria from Western Australia.—R. Greig-Smith: The influence of certain colloids upon fermentation. (Part iv.) Agar fibre in the alcoholic fermentation. Agar fibre, when in sufficient amount, accelerates the fermentation of invert sugar and thus falls into line with the mineral colloids. (Part v.) Old or heated yeast cells are not stimulated by fuller's earth. (Part vi.) The non-adsorption of the invertase of heated yeast by fuller's earth. Heating the yeast to near the lethal point does not inhibit the production of an inverting substance, but this is indifferent to the presence of fuller's earth. Normal yeast under the same conditions secretes invertase, which is partly adsorbed by the mineral colloid.—I. M. Mackerras: Notes on Australian mosquitoes (Diptera, Culicidæ). (Part i.) The Anophelini of the mainland. New locality records and life histories are given, and the hitherto unknown male of *A. atratipe* Skuse is described.—Miss Lesley D. Hall: The physiographic and climatic factors controlling the flooding of the Hawkesbury River at Windsor. Two causes of recent decreases in height and frequency of floods suggested are (1) the building of dams on the Upper Nepean, and (2) a natural diminution in precipitation.

VIENNA.

Academy of Sciences, May 5.—B. Sander: Report on results of the analysis of strata undertaken in the institute of mineralogy and petrology at Innsbruck.—E. Philippi, R. Seka, and others: The oxidation of charcoal with sulphuric acid. Pyromellitic acid was obtained from various samples of charcoal, also carbon monoxide. The action passes from a phase of strong oxidation and abundant sulphur dioxide to one of decreased oxidation with increase of oxides of carbon.—L. Schmid: The sterines of coltsfoot (*Tussilago farfara*).—A. Duschek: The relative theory of surfaces.—B. Zekert: The coloration of rock-salt and of kunzite by Becquerel rays. The rate of change depends on temperature.—E. Kara-Michailova: Brightness of scintillations and possibility of counting with magnetically deflected H-rays of various velocities.—O. Dischendorfer and W. Danziger: The oxidation of β-naphthol.

May 12.—L. Kölbl: The tectonics of the boundary region between west and east Sudetes.—G. Ortner: The $K\beta$ lines of the elements of the iron series II. In the X-ray spectra of cobalt and nickel lines the $K\beta^1$ and $K\beta_1$ can be separated.—R. Weiss and S. Luft: Derivatives of 1, 3-diphenyl-hydrindene.

May 19.—F. Hernler: Substitution in the phenyl nucleus of phenyl-1-dimethyl-3, 5-triazole-1, 2, 4.—M. Kohn and F. Rabinowitsch: On 2, 4, 6-trichlor-3-bromophenol and 2-chlor-4, 6-dibromophenol.—M. Kohn and F. Rabinowitch: Dibromo-*o*-cresol formed by the action of aluminium chloride on tetra-bromo-*o*-cresol.—A. Duschek: Lines of curvature of Monge's surfaces.—F. Kerner-Marilaun: The climatic threshold value of the complete laterite profile.

Official Publications Received.

BRITISH.

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1926 May 19—1927 May 18. Pp. 3. (Cambridge.)

The British Mycological Society. Transactions. Edited by Carleton Rea and J. Ramsbottom. Vol. 12, Parts 2 and 3, 30 June. Pp. 79-230. (London: Cambridge University Press.) 15*s*. net.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 65, No. 367, July. Pp. 653-732+xxx. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

Loughborough College, Leicestershire. Calendar, Session 1927-28. Pp. xiv+228+67 plates. (Loughborough.) 2*s*. 6*d*. net.

Magnetical, Meteorological and Seismographic Observations made at the Government Observatories, Bombay and Alibag, in the Year 1922. Under the Direction of Dr. S. K. Banerji. Pp. iv+68+5 plates. (Calcutta: Government of India Central Publication Branch.) 7.6 rupees; 11*s*. 9*d*.

Durban Corporation. Art Gallery Report for the Municipal Year ended 31st July 1926. Pp. 3. Museum Report for the Municipal Year ended 31st July 1926. Pp. 6. (Durban.)

The Stone Age in India. Being the Sir S. Subrahmanya Ayyar Lecture delivered on December 10, 1925. By P. T. Srinivasa Ayyangar. Pp. ii.+55+4 plates+2 maps. (Madras: Government Press.) 1 rupee.

Aeronautical Research Committee: Reports and Memoranda. No. 1001 (Ae. 242): The Spinning of Aeroplanes. By S. B. Gates and L. W. Bryant. Pp. iv+128+67 plates. 6s. 6d. net. No. 1066 (Ae. 248): Wind Tunnel Experiments on a Symmetrical Aerofoil (Göttingen 429 Section). By C. N. H. Lock, H. C. H. Townend and A. G. Gadd. (A.3.t. Autogyros, Helicopters and Rotors, 3; A.3.a. Aerofoils-General, 169.—T. 2349.) Pp. 20+6 plates. 1s. net. (London: H.M. Stationery Office.)

Journal of the Royal Statistical Society. Vol. 90, Part 3. Pp. x+433-635. (London.) 7s. 6d.

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 2, No. 15: On the Feeding Mechanism of Nebalia Bipes. By Prof. H. Graham Cannon. Pp. 355-369. 2s. Vol. 55, Part 2, No. 17: The Geology of Gigha. By W. J. McCallien. Pp. 395-409+1 plate. 2s. 6d. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Cordwainers Technical College, Eagle Court, St. John's Lane, E.C.1. Prospectus of Classes in Boot and Shoe Manufacture and Making, and Leather Goods Manufacture. Day and Evening Classes, Session 1927-8. Pp. 42. (London.)

City of Norwich. The Report of the Castle Museum Committee to the Council, 1926. Pp. 26. (Norwich.)

British Museum (Natural History). Picture Postcards. Set C19: British Game-Birds, Series No. 1. 5 cards in colour. (London: British Museum (Natural History).) 1s.

Forestry: the Journal of the Society of Foresters of Great Britain. Edited by H. M. Steven. Vol. 1, No. 1. Pp. 130. (London: Oxford University Press.) 7s. 6d.

The Journal of the Textile Institute. Vol. 18, July, Special Issue. Official Record of the Annual Conference of the Textile Institute, held at Bolton, 7th, 8th and 9th June 1927, in association with the Samuel Crompton Centenary Celebrations. Pp. 156+xx. (Manchester.) To members, 2s. 6d.; to non-members, 5s.

The Scientific Proceedings of the Royal Dublin Society. Vol. 18 (N.S.), No. 39: Report of the Irish Radium Committee for the Year 1926. By Dr. Walter C. Stevenson and Maurice R. J. Hayes. Pp. 443-476. 3s. Vol. 18 (N.S.), No. 40: Inhibition of Pollen Growth by Living Tissue Extracts. By P. O'Connor. Pp. 477-484. 6d. Vol. 18 (N.S.), No. 41: Lord Morton's Quagga-Horse Hybrid; was it a Hybrid? By James Wilson. Pp. 485-487. 6d. Vol. 18 (N.S.), No. 42: A Modified Micro-Method for the Determination of Molecular Weights. By Dr. J. Reilly and G. T. Pyne. Pp. 489-493. 6d. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Union of South Africa: Department of Agriculture. Bulletin No. 14: The Sweet-Potato Weevil (*Cylas formicarius*, F.). By C. P. Van der Merwe. Pp. 10. Reprint No. 18: Farm-Yard Manure. By Dr. J. J. Theron. (Division of Chemistry Series No. 78.) Pp. 5. (Pretoria: Government Printing and Stationery Office.)

Transactions of the Royal Society of Edinburgh. Vol. 55, Part 2, No. 16: Air-Bladder and Lungs, a Contribution to the Morphology of the Air-Bladder of Fish. By Frances M. Ballantyne. Pp. 371-394. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 8s.

FOREIGN.

Department of the Interior: U.S. Geological Survey. Bulletin 786-B: Geology of the Cat Creek and Devils Basin Oil Fields and Adjacent Areas in Montana. By Frank Reeves. (Contributions to Economic Geology, 1926, Part 2.) Pp. iv+39-98. (Washington, D.C.: Government Printing Office.) 30 cents.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 557: Large Springs in the United States. By Oscar Edward Meinzer. Pp. vii+94+17 plates. 30 cents. Water-Supply Paper 584: Surface Water Supply of the United States, 1924. Part 4: St. Lawrence River Basin. Pp. v+147+3 plates. 20 cents. Water-Supply Paper 596-A: Methods of Exploring and Repairing Leaky Artesian Wells. Papers by John McCombs and Albert G. Fiedler. (Contributions to the Hydrology of the United States, 1927.) Pp. ii+32+5 plates. 15 cents. (Washington, D.C.: Government Printing Office.)

Smithsonian Institution: United States National Museum. Contributions from the United States National Herbarium. Vol. 24, Part 8: The Grasses of Ecuador, Peru and Bolivia. By A. S. Hitchcock. Pp. v+291-556+vii-xx. (Washington, D.C.: Government Printing Office.) 45 cents.

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 548: Wave-length Measurements in the Arc and Spark Spectra of Zirconium. By C. C. Kiess. Pp. 47-60. 5 cents. Scientific Papers of the Bureau of Standards, No. 549: Wave-length Measurements in the Arc Spectrum of Scandium. By William F. Meggers. Pp. 61-71. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the Imperial Academy. Vol. 3, No. 4, April. Pp. vii-x+195-246. (Tokyo.)

Schweizerische Meteorolog'sche Zentralanstalt. Rapport de la Réunion de la Commission Internationale de Radiation solaire tenue à Davos les 31 août, 1er et 2 septembre 1925. Pp. 12. (Zürich.)

Zentralanstalt für Meteorologie und Geodynamik. Publikation Nr. 130: Bericht über die 12 Versammlung des Internationalen Meteorologischen Komitees in Wien, September 1926. Pp. 54. (Wien.)

Smithsonian Miscellaneous Collections. Vol. 80, No. 1: Morphology and Mechanism of the Insect Thorax. By R. E. Snodgrass. (Publication 2915.) Pp. 108. (Washington, D.C.: Smithsonian Institution.)

Det Kgl. Danske Videnskabernes Selskab: Mathematisk-fysiske Meddelelser. Bind 7, Nr. 15: The Hot-Wire Manometer. By Martin Knudsen. Pp. 18. 0.80 kr. Bind 8, Nr. 3: Thermal Molecular Pressure in Tubes. By Martin Knudsen. Pp. 35. 1.50 kr. (København: Andr. Fred. Høst and Søn.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 79. On Arfvedsonite, Riebeckite and Crocidolite from Greenland, by Samuel G. Gordon; The Probable Identity of Gageite with Tephroite, by Samuel G. Gordon. Pp. 193-208. On some North American Vaginulidae. By Dr. Hans Hoffmann. Pp. 209-221. Minute Mexican Land Snails. By H. Burrington Baker. Pp. 223-246+plates 15-20. (Philadelphia, Pa.)

Mellon Institute of Industrial Research of the University of Pittsburgh. Bibliographic Series, Bulletin No. 2: A List of the Books, Bulletins, Journal Contributions, and Patents by Members of Mellon Institute of Industrial Research, 1911-1927. By Lois Heaton. Pp. v+80. (Pittsburgh, Pa.)

Report of the Danish Biological Station to the Board of Agriculture. 32, 1926: On the Renewal of the Stock of Plaice in the Baltic Region. By H. Blegvad. Edited by Dr. C. G. Joh. Petersen. Pp. 37. 33, 1927: On the Fluctuations in the Quantity of Young Fry among Plaice and certain other Species of Fish, and Causes of the Same, by A. C. Johansen; On a Spawning Place for Winter Spawning Herring in the Northern Part of the Baltic Sea, by A. C. Johansen; On the Annual Fluctuations in the Age-Composition of the Stock of Plaice—Investigations from the Danish Biological Station, 1923-26, by H. Blegvad; Studies on the Biology of the Oyster (*Ostrea edulis*), II-IV, by R. Spärck. Edited by Dr. A. C. Johansen. Pp. 65. (Copenhagen: G. E. C. Gad.)

Hamburger Sternwarte in Bergedorf. Präzessions-Tafeln 1925.0 berechnet mit Newcombs Wert der Präzessions-Konstante nebst Tafeln der Besselschen Sternkonstanten. Herausgegeben von Richard Storr. Pp. vii+196. (Bergedorf.)

CATALOGUES.

Bulletin No. 86: The New Radiological Department, Royal Infirmary, Edinburgh. Pp. 40. (London: Watson and Sons (Electro-Medical) Ltd.)

Leaflet 2051: Siemens Auto Alarm Device. Pp. 2. (London: Siemens Brothers & Co., Ltd.)

Diary of Societies.

CONGRESSES.

EMPIRE MINING AND METALLURGICAL CONGRESS.

Montreal Meetings, August 22 and 23.—Sir Thomas Holland: Proposed Review of the Mineral Resources of the Empire.—G. M. Carrie and C. S. Pascoe: Magnesia Refractories for Steel Furnaces.—A. Stansfield: Smelting Titaniferous Iron Ores.—W. A. Toohey: Portland Cement in Canada.—Mining and Metallurgical Practice in Australia.—Health Safety Problems.

Toronto Meetings, August 25 and 26.—C. Johnson: Winning and Refining of Precious Metals from Sudbury Ores.—R. C. Stanley: Nickel, Past and Present.—A. A. Cole: The Silver Mining Industry of Canada.—J. G. Morrow: The Cascade Method of Pouring Steel.—A. Mavrogordato and H. Pirow: Deep Level Mining and High Temperatures.

Winnipeg Meeting, September 3.—G. E. Cole: The Development of Gold Mining in Canada.—W. A. Quince: Methods of Eliminating Barren Rock from Ore at the Sub-Nigel Mine.—C. R. Davis, J. L. Willey, and S. E. T. Ewing: Notes on the Operation of the Reduction Plant at West Springs, Ltd.—E. J. Laschinger: A New Form of Air Meter and the Measurement of Compressed Air.

Vancouver Meeting, September 14.—C. P. Browning: Canadian Copper and its Production.—F. J. Alcock and T. W. Bingay: Lead and Zinc in Canada.—C. J. N. Jourdan: A Brief Review of the Principal Base Metal and Base Mineral Resources of the Union of South Africa.—R. Craib: Dewatering the Lower Levels of the Simmer and Jack Mines, Ltd.—W. S. Robinson: Manufacture of Sulphuric Acid by the Contact Process. From Zinc Blende Roaster Gases.

Edmonton Meeting, September 20.—R. Strachan, W. J. Dick, and R. J. Lee: The Coal Industry in Western Canada.—J. Ness: Petroleum in Canada.—A. Docquier, L. Bataille, and R. Beetlestone: A Combination of the Baum, the Draper, and the Froth Flotation Systems as applied to the Washing of Coal at the Linsi Mine of the Kailan Mining Administration, North China.—A. E. Cameron: Impact Resistance of Steel at Low Temperatures.

Quebec Meetings, September 5 and 26.—J. G. Ross: Asbestos Mining and Milling.—A. W. Nash: Possible Auxiliary Sources of Liquid Fuel.—A. Job: The Sinking and Equipment of the Ventilation Shaft of the Government Gold-Mining Areas.—G. W. Sharp: The Tipping and Guiding of Vertical Skips.—P. M. Newhall and L. Pryce: Improvements in Drilling Efficiency with Jack-Hammers.

Sydney Meetings, September 9 and 10.—F. W. Gray: Mining Coal Under the Sea in Nova Scotia.—Sir Robert Hadfield: The Metal Manganese and its Properties: also, the Production of Ferro-Manganese and its History.—Raw Materials for the Iron and Steel Industry in India.—B. Yaneske: The Manufacture of Steel in India, by the Duplex Process.

SEPTEMBER 1–4.

SCHWEIZERISCHE NATURFORSCHENDE GESELLSCHAFT (at Basel) (in 14 Sections).—Presidential Address by Dr. F. Sarasin.—Lectures on, respectively, The Causes and Factors of Morphogenesis, by Prof. A. Brachet; Recent Work and Views in Astronomy, by Prof. L. Courvoisier; The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof. L. Duparc; Paracelsus in Relation to Modern Thought, by Prof. H. E. Sigerist.

SEPTEMBER 3–10.

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS (at Prague).

SEPTEMBER 4–9.

INTERNATIONAL CONGRESS OF ZOOLOGY (at Budapest).

SEPTEMBER 11–17.

INTERNATIONAL CONGRESS OF PHYSICS IN COMMEMORATION OF THE CENTENARY OF VOLTA (at Como).

SEPTEMBER 11–18.

INTERNATIONAL CONGRESS OF GENETICS (at Berlin).

SEPTEMBER 18–OCTOBER 3.

INTERNATIONAL CONGRESS OF THEORETICAL AND APPLIED LIMNOLOGY (at Rome).