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The Science and Practice of Pure Milk Supply.

I.

THE history of our milk supply, especially when considered in relation to the corresponding history of the milk supply of the United States, illustrates more intimately, perhaps, than any other subject the necessity for the man of science to study the practical problems involved in the application of his discoveries, and for the administrator and the producer and trader to acquaint themselves with the added responsibilities and increased possibilities of improved trade bestowed by science.

We are chiefly concerned in NATURE with the scientific aspects of the milk problem; but at every stage these are interlocked with practical problems requiring the expenditure, or more correctly the investment, of much money to ensure the health of the community. A statement of some of the considerations involved will make these points clear.

The first point we make is frequently overlooked. An increase in the quantity of milk available for the general public, and particularly for children, is even more important than improved quality of the milk, though this also is a public health requirement of the first grade. In this country far too little milk is consumed. Biologists and chemists have demonstrated that no other food is so vital to the welfare and health of mankind as milk. McCollum, of Baltimore, has laid down the rule that every growing child should be allowed one quart of milk daily, and Lusk states that "no family of five should buy meat until they have bought at least three quarts of milk" daily. In Great Britain not half as much milk is consumed per head as in the United States, and it is to the lack of this element in the dietary of children that a large share of the common malnutrition and undergrowth, and the associated excessive proneness to disease is ascribable. There are abundant instances in which the daily giving of half a pint of milk to each child attending school in poor neighbourhoods has been followed by a marked raising of the general standard of health.

The above statement that an adequate quantity is even more important than an improved quality of milk, although it truthfully represents a neglected aspect of the milk problem, is obviously subject to the condition that milk of the present quality must be made safe either by pasteurisation on the large scale or by bringing it domestically near the boiling point.

Alongside of educational propaganda in favour of purer milk there is needed steady and persistent instruction through child welfare centres, in schools, and generally, to induce parents to spend on milk the greater part of

the money now devoted to beer. At the present time three times as much is spent by the British public on alcoholic drinks as on milk, and to this avoidable physiological impoverishment of the children, which is associated with the deficiency of milk, we can in large measure ascribe the proneness to catarrhs and the development of bronchitis, of rickets, and of tuberculosis.

Early, then, in any attempts at practical reform must be placed the need for educating the public into willingness to buy more milk—at least twice or three times as much as is now being bought, for daily dietetic use. It follows that any measures proposed for the purification of milk must be tempered by consideration of the degree of risk to health, the administrative practicability of the proposals, and the expenditure involved.

The necessity for milk sanitation, as for general sanitation, was first impressed on the public mind by the occurrence of epidemics attributed to contaminated milk. It was in 1857 that Dr. W. M. Taylor, of Penrith, traced an epidemic of typhoid fever to contaminated milk, and ten years later he traced an outbreak of scarlet fever to milk. In 1880 Mr. Ernest Hart collected accounts of fifty epidemics of typhoid, fifteen of scarlet fever, and four of diphtheria traced to infected milk supplies; and since then the number has become immensely greater, until, in recent years, commercial pasteurisation combined with a modicum of sanitary precautions on the farm and in the retailing of milk has been associated with a great decrease in the number of such outbreaks. In addition, septic sore throats have not infrequently been traced to milk derived from cows with udder inflammations; and, most important of all, a considerable proportion of human tuberculosis, especially in young children, has been attributed to milk.

The history of the relation of human to bovine tuberculosis is an interesting chapter in bacteriology. In 1896 Theobald Smith announced that the tubercle bacillus of cattle differed materially from that of human tuberculosis. In 1901 Koch made the sensational announcement in London that bovine tuberculosis did not infect human beings. Inasmuch as, prior to this statement, the stress of anti-tuberculosis agitation had been much more against bovine than against human sources of infection, Koch's dictum necessitated a re-investigation of the entire subject. A Royal Commission was appointed, and continued its inquiries for many years. The results of these and of many collateral investigations may be summed up in the statement that bovine tuberculosis undoubtedly does occur in the human being, but that it is a minor cause of human tuberculosis. Furthermore, that, unlike infection of human origin, bovine infection can be effectively prevented—as can also the infection of such occasionally milk-borne diseases as scarlet fever, typhoid fever, and diphtheria,—by pasteurisation of milk, or by bringing milk domestically "just to the boil."

It was tuberculosis in the young subject which was regarded as chiefly caused by milk infection, but experimental observation of the type of bacillus found in children's tuberculous lesions has shown that less than one-third of tuberculosis in children under five years of age is of bovine origin, the greater part being derived from infection of human source. The abdominal tuberculosis and tuberculosis of joints and bones and of glands, which may be due to infection of bovine source, are often not fatal; and it appears likely that, as Cobbett [1] has estimated, the mortality caused by infection with the bovine type of tubercle bacillus *at all ages* is not more than six per cent. of that caused by bovine and human types of bacillus combined. This estimate was made several years ago. The proportion of human mortality from tuberculosis due to bovine infection is probably less now, for one of the striking features of tuberculosis mortality is its recent reduction at ages under five. Thus the death-rate from tuberculosis per million living at ages under five was 1213 in 1920, as compared with an average rate of 1883 in 1912–14. Inasmuch as only a relatively small proportion of this mortality in the earlier period was caused by infected milk, the main credit for the decline, after making any needed allowance for changes in medical certification, must be given to the diminution of human infection; and the entire result can reasonably be regarded as the joint product of measures for diminishing bovine tuberculosis, which, speaking nationally, have been on an extremely small scale, of measures for rendering bovine infection impotent (pasteurisation of milk and domestic heating), and of measures directed chiefly against human adult sources of infection. We have mentioned the six per cent. as a possible limit of the proportion of total tuberculosis mortality at all ages which is due to bovine infection, without intention to minimise its importance, for the annihilation of tuberculosis of bovine origin would greatly reduce the mass of human suffering, and this end is within reach by easily practicable measures, which would serve the interest of dairymen as much as that of the consumers of milk.

The possibility of acquiring tuberculosis or an acute infectious disease like scarlet fever, although the chief, are by no means the sole risks of contaminated milk. Past experience has shown an intimate association between an impure milk supply and excessive infant mortality; and the remarkable reduction in

[1] L. Cobbett. "The Causes of Tuberculosis," Cambridge University Press, 1917.

infant mortality in the present century in this and in other countries has been associated with marked improvement in the cleanliness of milk, commercially and domestically. At each step scientific investigations have been important means to this end. The determination of the thermal death-point of pathogenic bacteria has shown the possibility of heating milk to a lower point than boiling, which, while removing the possibility of infection, leaves milk with its natural taste almost unimpared. The bacterial counting of milk, showing the close association between cleanly milking followed by immediate cooling of milk and a sparse bacterial count has given a great impetus to the supply of clean and cool milk, especially in America. The tuberculin test has been largely utilised as a means of discovering clinically undiagnosable tuberculosis in cattle, and of its elimination from herds. It is a condition of the official granting of a certificate of production of "Grade A (Tuberculin Tested)" Milk, in accordance with a recent Order of the Ministry of Health. The discovery in 1890 of Babcock's simple method of fat determination has had far-reaching consequences in securing high standards of food value in milk supplies, and in enabling the public when they desire to buy milk of known value. The list of items of indebtedness of the public and of milk purveyors to scientific laboratory workers might easily be extended.

In England there is a large excess of infant deaths in the three hottest months of the summer, and these are due in the main to diarrhœa. To discuss adequately the factors of heat, of impurity of food, of impurities apart from food (*e.g.* exceptionally in breast-fed babies) which are responsible for this devastating disease would require much space; but the following determined facts can be stated. Diarrhœa is rare in breast-fed infants; it is exceptional among the infants of the well-to-do, who can take adequate precautions in respect of food; but it is common in the infants of the poor, and has been found to be more common in infants fed on condensed milk than in infants fed on fresh cows' milk. This does not apply to dried or desiccated milk, infants consuming which appear to suffer much less from diarrhœa than infants artificially fed with other foods. The explanation of these facts is not far to seek. Domestic contaminations of milk are even more important than contaminations at the farm, in transport, or in the local shop, though these also are serious. Condensed milk is difficult to manipulate in a cleanly manner, dried milk is not so. Fresh milk can be more easily provided and, when domestically pasteurised, has been shown to be less liable to cause gastro-intestinal trouble in the summer months than diluted condensed milk. The details showing the need for aseptic precautions in milk preparation, all based on the science founded by Pasteur and applied by Lister, can easily be understood. In the last seventeen years active steps have been taken to instruct and guide mothers in the right feeding of their infants, and there can be little hesitation in ascribing the lowered infant mortality in large measure to this cause, and to the collateral general improvement in the milk as delivered at the home. This improvement has consisted largely in the increasing practice of commercial pasteurisation. Prior to 1900 the rate of infant mortality averaged 140 to 160; in the last quinquennium it was only 85 per 1000 births.

The above consideration of evils and of possible channels of improvements naturally leads to a consideration of the administrative aspect of the problem. This in the main consists in the application of scientific methods to the milk industry, which will be discussed in our next issue.

Progressive Meteorology.

Board of Education. Catalogue of the Collections in the Science Museum, South Kensington, with Descriptive and Historical Notes and Illustrations: Meteorology. Pp. 107+6 plates. (London: H.M. Stationery Office, 1922.) 1*s.* 6*d.* net.

Air Ministry: Meteorological Office, London. A Short Course in Elementary Meteorology. By W. H. Pick. (M.O. 247.) Pp. 118. 1*s.* 6*d.* net. *The Observer's Handbook.* Approved for the use of meteorological observers by the Meteorological Office, and the Royal Meteorological Society. 1921 edition. (M.O. 191.) Pp. xxx+140+18 plates+10+17 plates+5. 7*s.* 6*d.* net. *Cloud Forms according to the International Classification: The Definitions and Descriptions approved by the International Meteorological Committee in 1910.* With an atlas of photographs of Clouds selected from the Collection of Mr. G. A. Clarke of the Observatory, Aberdeen. (M.O. 233, 2nd edition.) Pp. 10+17 plates+5. 1*s.* 6*d.* net. *Notes on Meteorological Corrections for the use of Gunners.* By D. Brunt and J. Durward. Pp. 18. 3*d.* net. *Forecast Code for the Abbreviation of Weather Forecasts transmitted by Telegraphy or Radiography.* Pp. 18. 1*s.* net. *The New International Code for Meteorological Messages,* 1922. Pp. 20. 4*d.* net. *Weather Forecasting in the North Atlantic and Home Waters for Seamen.* By Com. L. A. Brooke-Smith. Pp. 24. 6*d.* net. *The Wireless Weather Manual.* Pp. 24. 9*d.* net. (London: H.M. Stationery Office, 1921–1922.)

ON turning over this packet of the latest official publications on meteorology I feel disposed to survey them in a contemplative rather than in a critical

attitude. They fall into two groups. The Catalogue of Meteorology in the Science Museum reviews the present in the light of the past, and the various publications of the Meteorological Office of the Air Ministry deal with the present in anticipation of a greater future.

Meteorology in a museum is something of a problem, for it is impossible to place samples of weather in a glass case, or at least to keep them there when the fog clears away, and the representation can be only by instruments, maps, diagrams, and models. The collection of instruments is intended to represent historical development and present-day adaptations, and the Catalogue gives a short description of the exhibits, following a brief historical introduction on each group of instruments. The number catalogued is considerable and achieves a fair historical continuity. Their ownership is left curiously vague; some are recorded as presented to the museum, but many are stated to be lent by well-known meteorologists, most of whom are now dead, so that it is scarcely likely that their return will be demanded. We note one misprint in the name of Prof. Mohn, who is consistently called Möhn, possibly under the influence of Föhn. A reference should be given to "British Rainfall," 1908, p. 25, for the principle of the Hyetograph (No. 206), from which the originator as well as the patentee of the instrument could be ascertained.

The exhibits other than instruments are scrappy and of little value as illustrations of the scientific developments of meteorology, but time and some fostering care should remedy this.

Turning to the side of present effort which faces the future, one looks on a new world. For thirty years, from 1882, I read every contribution to meteorology published accessibly in the English language and a good deal in other tongues. For the last ten years I have read practically nothing, and now find that a vast river of new research and discovery separates me from the old familiar country where Buchan ploughed his lonely furrow and sowed the seed of upper-air research on the inhospitable summit of Ben Nevis. How wide and deep that river is I recognise when in the preface to Mr. Pick's "Short Course in Elementary Meteorology" I find the Director of the Meteorological Office saying:

"The British Empire has produced some of the world's foremost meteorologists—Halley, Beaufort, Abercromby, Blanford, Eliot and Shaw, to mention only a few."

No Buchan and no Aitken among these immortals! An oversight of a too busy man, of course, but significant of the new horizons on which the great figures of the immediate past stand out in view of the men who are reaping the harvests now maturing. It is the natural fate of pioneers to be buried in the foundations they lay for others to build on, and the fundamental nature of their work may remain unrecognised until the historians of a later generation tunnel amid the ruins of successive superstructures to find material for some science museum. Anyhow, it is certain that the enterprise of the students of to-day is put to better purpose in pushing onwards rather than in looking back. The war is responsible for the abruptness of the overturn which has buried much of the past before it is dead, and now affords to the young men an unencumbered field.

In Mr. Pick's work and Dr. Simpson's preface it is good to find strong grasp of essential principles, a discriminating disregard of irrelevant detail, and an easy command of concise and vigorous English. It would serve no purpose to regret omissions from so short a treatise on so great a subject. There is a wise abstention from the use of long words when short words serve better, and indeed the only lapse into this besetting fault of youth I have noticed is the use of the terms "katabatic" and "anabatic" with reference to the valley winds by night and day; this just serves to quicken a sense of thankfulness that we are spared "katapelagic" and "anapelagic" attacks on the land and sea breezes or even on the monsoons.

Dr. Simpson's approval can scarcely extend to Mr. Pick's statement that "no great land masses are situated in the southern" hemisphere, for is there not the Antarctic continent, very potent in its influence on the air? The effect of oceanic circulation is passed by, and I am sorry that Mr. Pick has missed the interesting analogy between the upward gradient of temperature in the atmosphere and the downward gradient of temperature in the hydrosphere. The treatment of water vapour in the atmosphere is delightfully fresh and clear; the old confusion has passed away and the student who starts his study of meteorology with this little book is led straight into the heart of the subject.

To one who remembers the astonishment and incredulity with which Dr. John Aitken's discovery of nuclear condensation was greeted, it is quaint to see Mr. Pick's fresh mind jumping the event with "It was formerly thought that dust-particles formed the nuclei for condensation but——" and after all the new discovery is only that hygroscopic particles such as common salt are the efficient nuclei. Aitken classed salt-particles as "dust," and who can say that any particles in our atmosphere are not seasoned with salt?

To me the value of this short course is the proof it conveys that meteorology has attracted the rising men of science, not as a humdrum routine, but as a fascinating pursuit confidently expected to yield rich results. Already, as the admirable section on the upper air

and the brief but comprehensive account of weather forecasting show, the reward is being grasped.

Of the other publications before us, those dealing with the various codes for transmitting weather data are of interest only to the senders and receivers of telegraphic and radiographic reports, yet the mere fact that such elaborate systems of communication have become necessary shows the vastness of the recent strides in synoptic meteorology.

"The Observer's Handbook" is an old friend, inclining towards portliness now, and with an air of dignity consonant with its post-war price. The appendix of cloud-photographs by Mr. G. A. Clarke of Aberdeen, also issued separately, is helpful in defining the forms of cloud, and more so in showing how independent the clouds hold themselves of all hard and fast classifications. The prints of cirrus and allied forms showing the cloud in white on a blue ground are particularly effective.

The Handbook is ripening for complete revision and cannot yet be viewed as having reached a final form. It is still suggestive of the compiler's anxiety to justify the system of units recommended, and it remains rather over the head of the average observer, on whose faithful and patient routine the whole structure of weather study is based.

The new units which were suggested about 1908, and introduced by the Meteorological Office eight years ago, have had a less fair trial than the length of time they have been before the meteorological world suggests, as criticism on such matters was necessarily suspended during the war. I think that the substitution of the millimetre for the inch in rainfall measurement is well on its way; it is merely the substitution of one legal unit for another, and it makes for uniformity with other nations. The millibar, however, has not yet helped towards uniformity, although Commander Brooke-Smith, in his "Weather Forecasting . . . for Seamen," says that "it will help towards obtaining uniformity if new barometers are graduated with this scale." I suppose that its future will depend largely on propaganda, like a new sect inspired by the ambition of unifying all the churches. Some observers will continue to look on it as simply a new linear measure. Once a rainfall observer, wishing to be up-to-date, ordered a rain-measuring glass to be graduated in millibars so as to be directly comparable with the barometer! The idea of freeing the measurement of atmospheric pressure from the gravity correction by using a unit based on acceleration instead of weight appeals powerfully to some minds. I think, however, that it will be apt to share the fate of the kilowatt in its competition with the horse-power, *i.e.* to be limited in its use to special lines of work. Messrs. Brunt and Durward, in their "Notes on Meteorological Corrections for the use of Gunners," use the old units, apparently as a matter of course, without apology.

So far as I can see from these publications, there is now a tendency to relax the boycott of the handy old Fahrenheit degree, thereby going back to the "absolute zero" of the snow-and-salt epoch. I have sometimes yearned for a scale starting at the "absolute zero" of the mercurial thermometer, that captivating temperature at which Fahrenheit and Centigrade thermometers read alike and below which mercury refuses to work. Can we look on the "absolute zero" of the air thermometer as absolutely fixed? May a lower temperature not be reached some day and a new way of estimating it be discovered? Think of the absoluteness of the old Daltonian atom. As a mere matter of nomenclature "absolute temperature" sounds unhappy in our days, when absolute time and absolute space are on the verge of becoming unfashionable. Be that as it may, I am glad that there is now less probability than there was once of temperatures reckoned from -273° C. being harnessed to our English weather.

If I may conclude in a lighter vein I would refer to a misprint in one of the works under notice printed officially. Once on a time an official of a department, driven beyond discretion by the delays of another department, addressed a letter to the "Controller of H.M. Stationary Office," and was dealt with in a disciplinary manner. Times have changed, and now a waggish printer's imp has the audacity to speak disrespectfully of the isobars in these words—"anticyclones . . . often remaining more or less stationery for several days."

HUGH ROBERT MILL.

The Constitution of Matter.

Der Aufbau der Materie: Drei Aufsätze über moderne Atomistik und Electronentheorie. Von Max Born. Zweite, verbesserte Auflage. Pp. vi+86. (Berlin: J. Springer, 1922.) 3*s*.

La Constitution de la matière. Par Prof. Max Born. Traduit par H. Bellenot. (Collection de monographies scientifiques étrangères, II.) Pp. iii+84. (Paris: A. Blanchard, 1922.) 6 francs.

THE most important part of Prof. Max Born's work is contained in the second and third of his essays, where he shows that it is possible to obtain approximate values for the heat of chemical union of the halogen elements with the alkali metals and with hydrogen from purely physical data. In collaboration with Landé he has calculated the repulsive force between the Na+ and Cl− ions in rock salt, which, combined with the ordinary Coulomb attractions and repulsions between these ions, accounts

for the measured compressibility, and finds that this force may be written $F=b/\delta^n$, where b and n are constants and δ is the distance between neighbouring ions of the same kind. For sodium chloride and other halogen-alkali compounds $n=9$. The law of force thus obtained is used to calculate the energy produced by the union of the ions to form the salt, which for one "Mol" is $U=545^3\sqrt{\rho/(\mu_+ + \mu_-)}$ kg. cal., where μ_+ is the atomic weight of the metal and μ_- that of the halogen. For absolute zero $U_{NaI}=158$, $U_{KI}=144$, when the ions are at rest in the position of equilibrium.

Nernst has shown that, if U is known, the chemical affinity *at any temperature* can be determined from purely physical considerations. These results can be checked by measuring the heat of solution of the salts, in solutions so dilute that dissociation is complete, and calculating the heat produced in such reactions as NaCl + KI = NaI + KCl. The values obtained were of the same order as those calculated by the above theory, but depend only on the *differences* between the values of U.

Another method of attacking the problem is to use Bohr's theory of atomic structure and radiation to find the work required to form ions from neutral atoms. Franck and Hertz have deduced that the energy of ionisation $I=h\nu_\infty$, where h is Planck's constant and ν_∞ is the limit of the series of absorption spectrum lines of the quiescent vapour. These workers have confirmed this theory by measuring the ionising potential which must be applied to a stream of electrons to produce a velocity just capable of ionising the vapour. They have thus found the energy of ionisation of a number of substances. Combining these values with values of the affinity for electrons of electro-negative atoms obtained by Franck, who used a method also based on Bohr's theory of the spectrum, the values of U can be calculated independently, and are within 12 per cent. of those obtained from the compressibility data.

Habers has studied metal crystals, on the assumption that the negative atoms in the Bragg space lattice are replaced by electrons. He finds for the alkali metals $n=2{\cdot}5$ to $3{\cdot}4$, copper $n=8{\cdot}0$, silver $n=9{\cdot}0$, in the expression for the repulsion. The heats of vaporisation calculated from these figures agree remarkably well with the observed values. The value of n must depend upon the distribution of the electrons in the ion.

The author seems perfectly justified in concluding his work in the following words: "If we survey the road we have travelled we see that, although it has not yet penetrated very far into the mighty kingdom of chemistry, it has reached a point from which we can observe, in the distance, the passes over which we shall have to travel if we wish to subject this kingdom to physical law."

Bauxite in Ayrshire.

Memoirs of the Geological Survey, Scotland. The Ayrshire Bauxitic Clay. By G. V. Wilson. Pp. vi + 28. (Southampton: Ordnance Survey Office; London: E. Stanford, Ltd., 1922.) 1*s.* 6*d.* net.

WHILE deposits of bauxite, that is, of the aluminium hydroxides gibbsite and diaspore, are greatly in request as sources of aluminium, bauxitic clays are also of considerable value for the lining of high-temperature furnaces. It is well known that under tropical conditions of weathering, especially where the surface-waters are alkaline, rocks of very varied nature, containing aluminium silicates, yield bauxite rather than kaolin. Any ferruginous matter forms at the same time lateritic crusts. Laterite, indeed, as Sir Thomas Holland pointed out for India, is at times rich in aluminium hydroxide.

Bauxitic formations have thus come to be regarded as indications of climate in the past, and we now have the interesting discovery of bauxitic clays in strata of Millstone Grit age in Ayrshire. The lateritic nature of these Carboniferous beds was pointed out by Mr. John Smith in the Transactions of the Geological Society of Glasgow in 1893. The Geological Survey of Scotland, when recently remapping the area, collected samples for analysis and proved the presence of aluminium hydroxide. Mr. Wilson, in the memoir now published, defines a bauxitic clay (p. 6) as one that "contains more alumina than is necessary to supply the demands of the whole of the silica present for the formation of the kaolinite molecule." Silica present in the form of quartz sand is included in this definition, since such silica affects the value of a clay as a refractory material.

On p. 25 twelve analyses are given of the Ayrshire bauxitic clays. The most striking of these is that of the bed on the Saltcoats shore, which yields 47·57 per cent. of alumina and only 29·0 per cent. of silica. Titanium dioxide, a substance characteristically present, amounts, however, to 9·04 per cent., and the refractory quality of a kaolinite clay is said to be lowered by 5 per cent. and upwards. This effect is not so noticeable in clays with an excess of alumina. In the Ayrshire deposits, a large part of the material of inferior grade reaches a refractory quality of 30-31 on the Seger cone scale, while the Saltcoats shore material, despite its titanium-content, is recorded as over 35.

These bauxitic clays have been derived from basaltic lavas in the first instance, though in some cases the material has been transported. It is held that kaolinite was formed as the earliest product, and that a fairly pure aluminium hydroxide arose from this, sometimes with an oolitic structure. A recombination of the

silica set free occurred in some cases, a secondary kaolinite being formed. This association of kaolinite and bauxitic matter in the same series of deposits recalls observations made by the Geological Survey of Ireland on the Cainozoic beds of Co. Antrim (Mem. on the Interbasaltic Rocks, p. 51, 1912). In both areas, titanium dioxide is a prominent constituent of the clays; Mr. Wilson (p. 12) shows that it is present as rutile and anatase, less commonly as brookite, and sometimes in combination in sphene. He traces its origin to the augite of the basalts; in Ireland it has been attributed to the decay of ilmenite.

The new industry now developed in Ayrshire, in the manufacture both of refractory bricks and of alum, is a satisfactory result of the official researches here described. G. A. J. C.

Anderson Stuart: his Relation to Medicine and to the Empire.

Anderson Stuart, M.D., Physiologist, Teacher, Builder, Organiser, Citizen. By William Epps. Pp. xv+177. (Sydney, N.S.W.: Angus and Robertson, Ltd., 1922.)

THE career of Sir Thomas Peter Anderson Stuart has few parallels in medical or other annals. His student career in Edinburgh under Turner, Rutherford, and Lister was brilliant; his building and organisation of the Sydney school, and what they provoked, form a university romance of the first order. Dean for thirty-six years, he dominated medical history in Australia in a manner that few, if any, individuals will ever be able to imitate. During that period the number of students in medicine increased from four to nearly one thousand; and for this apotheosis of his department Anderson Stuart planned and built. Without any demerit to the brilliance of assistants in his faculty or to the capacity of men in other faculties of the University of Sydney, it is no exaggeration to state that that phenomenon was the offspring of Anderson Stuart's imagination and the fruition of his consummate scheming and effective individual manœuvre.

In this sphere his work was monumental. The standards set by Anderson Stuart in his school involved the emergence of such a university in Sydney as stands to-day—not merely a local inspiration, but the most prominent centre of Anglo-Saxon culture in the Southern Hemisphere. This achievement carries Stuart's work beyond the confines of institutional endeavour, and places it in the rank of empire-building.

For Australia, his work had a distinctive result in society-moulding, in that it was the initial step towards the quasi-aristocratic rank which the medical profession now enjoys in that country, and in that it foreshadowed and conditioned the elevated professional status which dentistry, veterinary medicine, nursing, midwifery, and massage are rapidly assuming in that continent.

Such are the more outstanding facts upon which Stuart's claims to remembrance will rest. As a physiologist and a man of science he was not distinguished, nor even as a teacher. Although he was a forceful lecturer, his words were selected for their rhetorical effect, and his lecture material was that of an earlier generation of physiologists. A claim to teaching ability must rest on more than rhetoric—it must rest upon the capacity to arouse the hearers to be *doers*; and doers in physiology as a result of Anderson Stuart's teaching are difficult to discover.

To present a man's autobiography with the force, frankness, and vividness that Mr. Epps has done, vindicates his claim that it was "a labour of love." He has carried out with nice selection a difficult piece of composition, which will always bring credit to himself and to the long list of subscribers. But Epps is not a Strachey. Although he has described many of Anderson Stuart's characteristics in the introduction, and although others crop out in the faithful narrative of events, the fearless character sketch is still unpenned. The achievement of a man is only explicable in terms of his character, and can be appreciated best when the record is frankest. Such incidents as the expectation of his name at the "top of the class list," and such self-appreciation as his own declaration that "I had the essentials of a good teacher born in me," reveal the character of Stuart more warmly and nakedly. A towering ambition and a Napoleonic will to tyrannic power, together with sufficient selfishness for the realisation of these twain—these very qualities are at one and the same time the key to his achievements, to the oppositions they evoked, and to the relentless manner of their crushing.

Anderson Stuart will always stand as a beacon-light and a landmark in the history of a university and a country which have a long future.

RAYMOND A. DART.

Our Bookshelf.

The Home of the Indo-Europeans. By Prof. H. H. Bender. Pp. 58. (Princeton: Princeton University Press; London: Oxford University Press, 1922.) 4*s.* 6*d.* net.

THE original home of the Indo-Europeans is a well-worn subject, and Prof. Bender has treated it generally on the lines of philology, familiar to readers of works like Schrader's "Prehistoric Antiquities of the Aryan Peoples." He suggests, but does not grapple with, the question whether there was an Indo-European

race, or merely an aggregate of tribes, possibly of varied physical characteristics, more or less closely united by a common tongue and a common culture. Anthropology and archæology may in time throw light, he suggests, on their habitat in the Stone Age, "although it will always be difficult to determine from the examination of a skull or a stone axe what language their owner spoke in life." Again, we have only grave furniture to guide us, and the consideration of broad or long skulls is of little help, because the cephalic index "is merely a ratio," and "among the living Chinese or in the Neolithic graves of Europe long skulls are nearly always found with short skulls, and *vice versa*."

Environment, again, affects the cephalic index, and the Scandinavians, supposed by some authorities to represent the primitive Indo-European type, "owe their long heads, not alone to race, but partially, at least, to hyperthyroidism and ultimately to the iodine of the seas near which they have lived, and from which they have obtained a considerable part of their food." The most novel point raised is that of the newly discovered Tocharian language in East Turkestan, a *centum* language, possibly introduced from the west, the home of languages of this type. Mainly on the evidence of philology the author reaches the conclusion, held by many scholars, that the primitive home of the Indo-Europeans was the great plain of Central and South-Eastern Europe, including the present Poland, Lithuania, Ukraine, and Russia south and west of the Volga. There is not much original matter in this little book, but the points are well put, and it will be useful as a guide to the study of a problem which has not yet been finally settled.

The Journal of the Institute of Metals. Vol. 27. Edited by G. Shaw Scott. Pp. viii+621. (London: The Institute of Metals, 1922.) 31*s.* 6*d.* net.

THE increase of research in non-ferrous metallurgy is so rapid that succeeding volumes of the Journal of the Institute of Metals show a rapid growth in size. Volume 27 contains some interesting papers on recrystallisation and grain growth. The paper by Mr. Adcock, containing a beautiful series of photographs illustrating recrystallisation in cupro-nickel, an alloy which proves very suitable for the purpose of this study, will be of material assistance in advancing the subject, which has been studied with such good results by Carpenter and Elam. Major Smithells' paper on grain growth in tungsten filaments makes use of the hypothesis of varying vapour pressure. Condenser tubes are considered from two points of view, the experience of the Corrosion Committee being utilised as a basis for recommendations as to their care in practice, while a second paper from the Research Department at Woolwich deals with the prevention of season cracking by the simple process of removing stress by low temperature annealing. The revision of the alloys of aluminium and zinc clears up some difficult points in the behaviour of this curious system, one of the most interesting in respect of its changes in concentration of solid solution with temperature. Several other papers deal with questions of practical importance, and the volume contains a very large number of abstracts of work published elsewhere.

Arab Medicine and Surgery: A Study of the Healing Art in Algeria. By M. W. Hilton-Simpson. Pp. viii+96+8 plates. (London: Oxford University Press, 1922.) 10*s.* 6*d.* net.

IN this volume Mr. Hilton-Simpson describes the medical and surgical methods of the Shawía of the Aurès Massif of Algeria. His record is the result of careful inquiry pursued in the course of a number of visits to the country, and possesses a peculiar value in that it deals with practices which must inevitably disappear before the advance of civilisation. Although some of the treatment prescribed by Shawía medicine is derived "from the sorcerer's defensive armour against Jenun," the demons or spirits which cause disease, medical practice is not here synonymous with magic, as among most primitive peoples. The medical practitioner is regularly apprenticed, usually to a member of his own family. The medical treatment would appear to be derived from the medicine of the medieval Arabs. The origin of their surgery is more obscure, and it has been suggested, on account of the primitive character of their instruments and the prevalence of the operation for trepanning, in which they take much pride and show much skill, that it may possibly go back so far as the Neolithic age. The trepanning operation is usually successful, a fact which is due perhaps as much to the remarkable vitality of the people as to the skill of the surgeon.

A Naturalist's Calendar, kept at Swaffham Bulbeck, Cambridgeshire. By L. Blomefield. Second edition, edited by Sir Francis Darwin. Pp. xviii+84. (Cambridge: At the University Press, 1922.) 3*s.* 6*d.* net.

THE Cambridge University Press was well advised in adopting Sir Francis Darwin's suggestion to republish this Calendar. Lists such as those compiled by Blomefield not only assist the amateur naturalist, but are of real value as contributions to the science of phenology. A collection of such Calendars embodying the notes of some of the scores of observers scattered over the British Isles, and based on a consecutive series of years, would probably add not a little, in the hands of a central receiver, to our knowledge of the movements of birds, the awakening of vegetation, and other phenomena dependent upon the seasons.

Woodland Creatures: Being some Wild Life Studies. By Frances Pitt. Pp. 255. (London: G. Allen and Unwin, Ltd., 1922.) 12*s.* 6*d.* net.

"STUDY any animal, even the most common, carefully, and you will find out something that has hitherto escaped notice." Repeatedly did this sentence spring to mind as we read the pages of this charmingly written and beautifully illustrated book. The author, whether writing of the furred or the feathered creatures of our woodlands—of badgers, foxes, dormice, rabbits and squirrels, or of woodpecker, bullfinch, kestrel, sparrowhawk, owl, magpie and jay,—tells us something of habits or of adaptation of structure to habit that we have not met elsewhere; and not infrequently has shrewd criticism to offer on plausible theories of armchair origin. Her photographic illustrations bear comparison with the very best.

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.*]

Palæontology and Archaic Fishes.

IT is now a good many years since I first decided to devote myself to the study of vertebrate morphology. I was attracted to this study through feeling in the old days at Cambridge that the position of comparative neglect into which this science had fallen was the fault, not of the subject itself, but rather of that band of enthusiasts who, carried away by the inspiration of Darwin, and setting to work at the building of the new morphology, took in their haste but little heed that the foundations upon which they built were adequate either in extent or in sound workmanship. As regards the former, an important gap in the foundations was glaringly visible in the region occupied by these two exceedingly archaic subdivisions of the Vertebrata—the Crossopterygii and the Dipnoi. In particular, nothing whatever was known regarding the early developmental stages of any crossopterygian or of either of the two lung-fish which seemed nearest to the evolutionary stem of the terrestrial vertebrates. It was the recognition of the importance of this gap in the foundations of vertebrate morphology that, above all, influenced me in taking the decision to do what I could towards making the gap less extensive. Seeing that so much of my research work has been concerned with the two groups I have indicated, I may perhaps be regarded as justified in having a special interest in them and their relation to the general problems of vertebrate morphology.

I am in consequence particularly interested to find in the newly published Proceedings of the Linnean Society the presidential address of Dr. Smith Woodward entitled "Observations on Crossopterygian and Arthrodiran Fishes." In view of the president's position as the official head of British palæontology, and still more in view of his pre-eminent position as an investigator of the palæontology of the lower vertebrates, his words will carry great weight where he is dealing with palæontological fact. In the course of his address, however, he comes into touch with some of the broader questions of vertebrate morphology, the answers to which, if they are to be trustworthy, must necessarily be based upon the judicial consideration of all the evidence available, and not merely of that which is constituted by the data regarding skeletal structure afforded by palæontology. It is, I think, particularly necessary to remind the younger generation of workers, to whom will fall the task of restoring morphology to its proper position in biological science, that as regards several of the questions dealt with by Dr. Smith Woodward, due heed must be given to witnesses other than palæontological.

It would not, for example, be gathered from the address in question that we do not all accept Dollo's view that the modern lung-fish have "abandoned the fusiform shape which is adapted for free-swimming life, and have become (secondarily) more or less eel-shaped in adaptation to a wriggling and grovelling existence."

There is no general characteristic of the Vertebrata more fundamental than the fact that during early stages in their development their muscular system consists of segmentally arranged blocks of longitudinally-running fibres along each side of the body. There is no escape from the physiological implication that this peculiar arrangement of the muscular system has for its function the production of movements of lateral flexure. To some of us, the further conclusion appears to be equally inevitable that the vertebrates in general were in early stages of their evolution "more or less eel-shaped in adaptation to a wriggling and grovelling existence."

The view may of course be held that, even admitting that the primitive vertebrates were elongated in form, yet the ancestors of existing Dipnoi were, for a time during their evolutionary history, fusiform—just as was undoubtedly the case with the ancestors of the eel-shaped teleostean fishes.

Whichever view is taken as to the fusiform ancestral stage of the Dipnoi—whether primitive or merely intercalated—I regard the evidence in the way of known facts as quite inadequate to form the basis of any such idea. This evidence is palæontological in its nature. Stated shortly and crudely, it is constituted by the fact that the palæozoic dipnoans with which we are acquainted up to the present are on the whole fusiform, while the modern dipnoans are elongated in form.

Personally, I take the view that the vertebrates, during the prolonged early phases of their evolutionary history before they evolved into creatures highly specialised, on one hand, for a purely swimming habit—like the modern fish—or, on the other, for a terrestrial existence as are the modern tetrapods, were actually, in all probability, creatures of elongated form of body which "wriggled and grovelled" in a swampy environment. Further, I believe that such conditions are highly unfavourable (1) to existence in crowds or shoals, and (2) to that rapid enclosure in preservative silt or other deposit which is essential to their persistence as fossils. Consequently I should attach very little weight to the fact that the specimens known to us as fossils of the palæozoic dipnoans happen to have fusiform bodies. As a matter of fact, I regard the fusiform body just as I regard the divided-up median fin and the heterocercal tail (or its further development the homocercal tail), as marks of the efficient swimmer. They are characteristics which I should expect to find in the majority of species in any group of fish during its period of maximum prosperity, when it reached the highest degree of adaptation to a purely swimming existence.

Dr. Smith Woodward mentions the failure up to the present to discover fossil links between the paired fin of the crossopterygian and the leg of the terrestrial vertebrate. I suppose I am still in the position of being the only investigator of the evolutionary history of the vertebrate limb who has had at his disposal embryological material of Polypterus and of all the three genera of lung-fish in addition to that of elasmobranchs and amphibians. It may be well, then, to state that my own work, together with a careful consideration of the work of others, palæontologists, anatomists, and embryologists, leaves no doubt in my mind that the reasonable view to take is that which regards the paired fin (of whatever type—archipterygial, crossopterygial, or actinopterygial) on one hand, and the pentadactyle leg on the other, as being limbs specialised for different types of movement, neither of which has evolved out of the other, but each of which has evolved out of an ancestral, more or less styliform, type of limb.

There is another point to which it seems desirable to refer, namely, the use of group names based on our knowledge of existing animals in discussions on palæontology. The natural classification of animals is of course a concise method of summing up their

morphology, *i.e.* their genetic relationships as expressed by their structure. In working out these relationships, as every morphologist knows, it is essential to have due regard to structure as a whole, collecting and weighing the evidence afforded by all the various organ systems of the body. The group name Dipnoi, or Amphibia, or Reptilia, or Aves, or Mammalia, connotes in each case a particular assemblage of structural characteristics relating to the entire structure of the body.

Now it is particularly desirable to bear in mind that when an extinct animal is allocated to one of the larger classificatory groups, this is done as a rule on no more sure basis than a knowledge—often a very imperfect knowledge—of the inorganic portions of its skeletal system, and consequently such allocation is, as regards the probability of its being correct, on a totally different footing from the assignment of a modern animal to its taxonomic group after full consideration of its whole structure. It is quite impossible for any one to say whether a palæozoic creature now included in the group Dipnoi or Crossopterygii would, or would not, have this inclusion justified were we acquainted with its general structure apart from the skeleton. The same consideration indicates to us how vain were the old controversies as to whether the ancestor of the group Mammalia was an amphibian or a reptile. Even had we before us the undoubted skeleton of that ancestor in perfect condition, we should still require to know about its soft parts—its skin, its heart, its main blood vessels, its brain, its urino-genital organs, its embryonic membranes, and so on—before we should be justified in concluding definitely in which, if either, of the two groups named it should really be included.

J. GRAHAM KERR.

The University, Glasgow, December 19.

Some Interesting Tracks of Alpha Particles in Gases.

SELECTED photographs taken from about ten thousand exposures show a number of types of alpha ray tracks, some of which have been described before and some have not. Fig. 1 gives a track in which

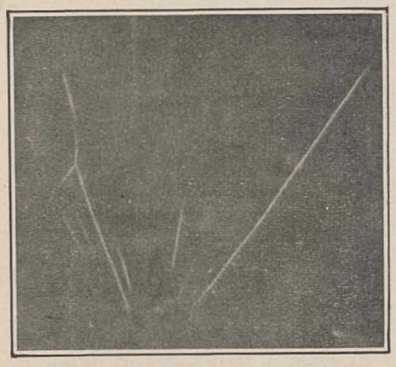

FIG. 1.

it is apparent that the alpha particle hits the nucleus of an oxygen or nitrogen atom. The nucleus is projected forward at a very high speed, while the alpha particle is reflected backward at a sharp angle. In Fig. 2 the track is an almost straight line with a branch which goes off at an angle of about 8°. In some instances the branch is at an angle as great as 50° with the straight track. An example of this is given in Fig. 3, though in the plane of the photograph the angle is only 40°. In some instances another type of track is given, in which one of the

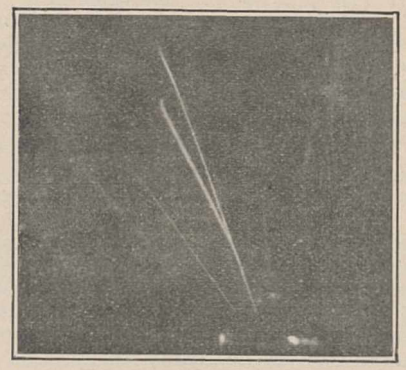

FIG. 2.

branches is very short, the other very long. It is not unlikely that some of the longest tracks are due to hydrogen nuclei. A discussion of the tracks will be published very soon in one of the physical journals. All the photographs were taken by the Shimizu-

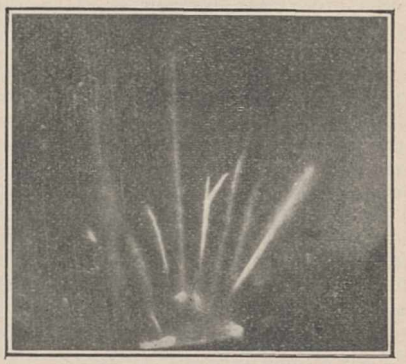

FIG. 3.

Wilson method, by means of which many more photographs showing views at right angles will soon be taken.

R. W. RYAN.
W. D. HARKINS.

University of Chicago,
December 23.

The Age and Area Hypothesis.

IN a paper by the late Prof. D. P. Penhallow, of McGill University, Montreal, entitled "A Review of Canadian Botany from the First Settlement of New France to the Nineteenth Century, Part I." (Proceedings and Transactions of the Royal Society of Canada for 1887, volume 5, section 4, pp. 45-61, 1888), the following passage occurs:

"But Michaux appears to have attached a much wider importance to his prospective work, and to have regarded it more from a scientific point of view, since he had already conceived the idea that the distribution of the trees of America should be studied, and that it would be possible to ascertain their original centres of distribution through careful observation of their dimensions and predominance in different parts of the country. It was the elaboration of this idea that largely led him in so many directions, and over so wide a range of territory" (D. P. Penhallow, Proc. and Trans. Roy. Soc. Can., 1887, 5, sect. 4, pp. 55-56, 1888).

Apparently Michaux was of the same way of thinking in reference to the Origin of Species as Dr. Willis. J. ADAMS.

Central Experimental Farm,
Ottawa, December 18.

THIS reference is of great interest. As I have shown in the Introduction to my recent book upon "Age and Area," both Lyell and Hooker had conceived the ideas which I have elaborated. The incoming of the Darwinian theory of evolution, however, with its novel conception of universal gradual change, diverted effort from the lines that it was beginning to follow, and to which it shows signs of returning, with the increasing recognition of the fact that gradual change is not possible in the case of most characters. JOHN C. WILLIS.

Zoological Nomenclature : Musca and Calliphora.

IN accordance with the rules of the International Zoological Congress, the attention of the zoological profession is invited to the fact that Dr. L. O. Howard, W. Dwight Pierce, and twenty-one other professional zoologists have requested the International Commission on Zoological Nomenclature to exercise its plenary power in the case of the Linnæan genus Musca, 1758, and, under suspension of the rules, to declare *M. domestica* as type of this genus; also, under suspension of the rules, to validate Calliphora, Desvoidy, 1830, with *C. vomitoria* as type.

The request is based on the grounds of practical utility, and an almost unbroken history of consistent usage since 1758 in the case of Musca, and since 1830 in the case of Calliphora. It is claimed that a strict application of the rules will produce greater confusion than uniformity.

According to the premises at present before the Commission, if the rules are strictly applied, the generic name of Musca would take either *M. cæsar* or *M. vomitoria* as type, and the species *M. domestica* would be cited either in Conostoma, 1801 [?] (type *Ascaris conostoma* = larva of *M. domestica*), or in Conosoma, 1802 (type *Ascaris conosoma* = larva of *M. domestica*), or in Promusca, 1915 (type *M. domestica*), thus resulting in a very regrettable change in the nomenclature of the species in question as almost universally used in entomological, zoological, medical, epidemiological, and veterinary literature.

The secretary of the Commission invites any person interested in these cases of nomenclature to communicate his opinion on the subject as soon as possible. On account of delay caused by the war, the final vote of the Commission will not be taken until about January 1, 1924. C. W. STILES
(Secretary to Commission).

25th and E Streets, N.W.
Washington, D.C.

Tesla Spectra and the Fraunhofer Effect in Complex Compounds.

IN conjunction with Mr. W. H. McVicker, we have begun an investigation of the spectra emitted by the vapours of compounds when subjected to waves from a Tesla transformer passing between two glass-coated electrodes. For the sake of clarity, these spectra may be termed electro-luminescence spectra.

Among the substances examined by us was benzene. At ordinary pressure and at the boiling-point, the vapour of benzene emits only a fragmentary spectrum which seems to be built up from portions of the carbon spectrum, only the strongest bands making their appearance. On reducing the pressure of the vapour, an extremely regular spectrum is emitted by benzene; a very regular set of band-groups, each of which has the same general internal structure as the others. Six of these band-groups lie between $\nu = 3194$ and $\nu = 3752$; while traces of yet another band-group were observed in the region beyond 3194. Beyond 3765, the absorptive power of the vapour itself cuts off part of what is evidently another set of band-groups.

Each of the band-groups has the following structure: four strong bands, each accompanied by a weaker band; then two broader and weaker bands, which may possibly be produced by the fusion of the strong and weak companions of a doublet.

The whole spectrum shows an extraordinary regularity. There are no air-lines or spark spectra traceable throughout its extent; nor are there any lines visible on the parts of the plate unaffected by the luminescence spectrum. The following figures represent the wave-numbers of the four strong bands in each group:

Group	A.	B.	C.	D.	E.*	F*.
	3752	3652	3554	3454	3357	3257
	3736	3636	3537	3438	3339	3242
	3717	3618	3521	3422	3322	3229
	3703	3602	3504	3405	3308	3211

For the band-groups marked with an asterisk, the readings on the plate were difficult—the bands being diffuse—and the figures are probably not exact.

The whole of the bands in the electro-luminescence spectrum appear to be directly related to each other; their wave-numbers are calculable from the following formula:

$$\nu = 98{\cdot}712n - \frac{98{\cdot}712m}{6},$$

where n is successively equal to 33, 34, 35 . . . and m is successively 0, 1, 2. . . .

The electro-luminescence spectrum presents especial interest when it is compared with the fluorescence and absorption spectra of benzene. Hartley (Phil. Trans., 1908, 208, 519) and Grebe (*Zeit. wiss. Phot.*, 1905, 3, 363) found that the change from benzene vapour to a solution of benzene in alcohol produced a shift of 10-20 units in the position of the absorption bands towards the less refrangible rays. If the same shift be assumed to occur in the case of fluorescence, then it appears that the full fluorescence spectrum of benzene corresponds, band for band, with a part of the luminescence spectrum, as the following figures show:

Electro-luminescence bands . .	ν=3454	3554	3652	3752
Fluorescence bands . . .	ν+19=3454	3556	3650	3752

An even more surprising result is obtained by comparing the electro-luminescence and absorption spectra of benzene vapour. Hartley (*loc. cit.* 484) divides the absorption bands into four series. When his least refrangible bands are compared with our most refrangible set, the coincidence between the two is most remarkable. For the sake of brevity, only the first strong series is given here:

Absorption bands .	=3650	3683	3700	3716	3734	3749-52	3761
Luminescence bands .	=3652	3686	3703	3717	3736	3752	3765

Thus, if an obvious constant difference of 2 units between our scale-readings and those of Hartley be assumed, all these bands coincide within our experimental error.

This appears to establish that parts at least of the benzene absorption spectrum are replaced by luminous bands in the electro-luminescence emission spectrum, just as the dark Fraunhofer sodium line in the solar spectrum corresponds to the D-line in the emission spectrum of sodium. In other words,

the Fraunhofer effect has now been established in the case of the spectrum of an organic compound of complex structure.

A more detailed account of this work will be published almost immediately. We wish to reserve this particular group of spectra for our own investigation, as we have already planned and in part carried out a connected series of investigations upon it, which we wish to complete before venturing upon the theory of the matter. We hope also to investigate the behaviour of solutions under the influence of the Tesla discharge.

J. K. MARSH.
A. W. STEWART.
The Sir Donald Currie Laboratories,
The Queen's University of Belfast,
January 8.

Distribution of the Organ-Pipe Diatom (*Bacillaria paradoxa*).

IN connexion with the interesting question raised by Mr. F. Chapman in NATURE of January 6, p. 15, as to the peculiar movements of *Bacillaria paradoxa* being due to osmotic pressure, I am writing to say that all the specimens observed by Mr. H. Weaver and myself that were gathered from the Staffordshire and Worcestershire Canal at Stourport and from ponds at Wilden and Hartlebury (see NATURE, vol. 108, p. 163) were very active and so continued during the period we kept them under observation (about a week in each case). The water in this canal and in these ponds is some eighty miles removed from the sea. It is quite fresh and not at all brackish.

J. W. WILLIAMS.
67 Load Street, Bewdley, Worcs.

Experiments on Hardness and Penetration.

As a student of colloidal chemistry I was much interested in the results of the experiments on the clay-water systems by Mr. A. S. E. Ackermann (NATURE, January 6, p. 17), showing that there was a continuous penetration of the systems by a heavy object when its pressure exceeded a certain critical value referred to as the "pressure of fluidity."

The phenomenon has been observed in many colloidal systems and also with the coarser systems such as paints, thick oils, etc. Bingham found zero fluidity or infinite viscosity with 4 per cent. china clay or 5·5 per cent. of graphite. E. Hatschek, investigating aqueous solutions of gelatine, showed that the viscosity varied with the rate of shear, and a similar conclusion was reached by Hatschek and Humphrey, working with systems of sifted rice particles in toluene-carbon tetrachloride. In general, at the lower rates of shear the viscosity is abnormally high and even infinite if the system be coarse-textured.

With the Stormer type of viscometer the curve relating the number of revolutions per minute of the cylinder rotating in a coarse system such as a paint or grease, with the load rotating it, is curvilinear and does not pass through the origin.

The minimum load required to start rotation, apart from that to overcome the friction of the apparatus, would correspond to the "yield point" obtained by the use of Bingham and Green's plastometer, or the "pressure of fluidity" by Mr. Ackermann.

It is evident that the viscosity of these systems has lost its usual significance since it is a variable function and any value obtained by any one method is empirical. This would apply to the value given by Mr. Ackermann for the viscosity of lead in the solid state.

Another interesting phenomenon in this connexion is that the rate of penetration by the object gradually decreases and eventually ceases; thus a steel ball remains suspended in a well-mixed paint after a fall of some distance. With some oils, a falling sphere cuts a path through the liquid, so that the apparent viscosity decreases with each determination by the falling sphere method.

E. MARDLES.
2 Hillfield Villas, Union Street,
Farnborough, January 9.

IT is with great interest that I read Mr. Ackermann's letter in NATURE of January 6, p. 17, with regard to the penetration of clay and lead by a loaded disc. The manuscript of a paper intended for the next meeting of the Iron and Steel Institute is now complete. The work deals with several of the deductions to be made from my formula for Brinell hardness (NATURE, December 9, vol. 110, p. 773).

While clay has not been examined, tests have been carried out on pitch and plasticine. Meyer's formula appears to be true for these two materials.

HUGH O'NEILL.
The Victoria University of Manchester,
January 9.

A New Gregarine Parasite of Leptoplana.

MR. SAM SETNA, who is working under my supervision on the Polycystid Gregarines, has just found specimens of a Cephaline Gregarine infesting a specimen of *Leptoplana sp.* recently obtained from the Marine Biological Laboratory at Plymouth. This Gregarine seems to be rather a rare parasite of Leptoplana, as no Gregarine has been described before from Leptoplana, according to lists given by Minchin (1903) and Watson (1916), or in literature published since. Indeed, extraordinarily few Sporozoa have been found from the Platyhelminthes as a whole. The find is all the more remarkable as Leptoplana is so commonly used as a type animal. Only a single specimen was found to be infected, and other specimens in the same tube that have been examined do not show the infection.

In the sections of the infected worm, a number of individuals of the Gregarine have been found in the parenchyma of its body. The trophozoite is solitary and quite large in size, measuring from 103 μ to 168 μ in length. The protomerite is quite distinctly marked off from the deutomerite. Only one young individual has been found showing the epimerite. The latter is large, hemispherical, and simple. The nucleus is large and rounded and measures 19 μ to 23 μ in diameter, and exhibits the characteristic Gregarine structure, with a slightly eccentrically placed karyosome and a number of chromatin particles disposed round it.

Unfortunately, no other stages of the life-history have been encountered, and it is consequently impossible to refer the parasite to any particular genus.

B. L. BHATIA.
Zoological Laboratory.
Government College, Lahore,
November 23.

Discovery of the Use of Phosphates as Fertilisers.

IN view of the interest attaching to the so-called artificial fertilisers, it may be worth recording that the idea of the possibility of utilising raw mineral phosphates as phosphatic fertiliser is to be found in the current agricultural publications some years before 1840, the date usually regarded as that of the first serious record.

In 1842 Lawes took out his patent for the manufacture of superphosphate. In a question of infringe-

ment that arose later he showed that his application for a patent was the result of work at Rothamsted with bones and mineral phosphates from 1839, and with bone dust from 1843. Liebig had suggested phosphatic manure in a report to the British Association in 1840.

But in May 1837 an unnamed correspondent of the *Farmers' Magazine* (2nd series), writing on the difficulty and expense of obtaining bone dust in the required quantities, proposed the making of a "fictitious bone dust by impregnating lime with phosphoric acid." Another correspondent in answer asserted (May 1837) that there was no cheaper way of getting phosphorus than by burning bones, adding, however, "phosphate of lime if it could be found so as to be available to the farmer, would be invaluable. Whether it exists in England I know not, but in Spain there are entire mountains of it; it is compounded of phosphoric acid 41 parts, lime 59"; showing an earlier appreciation in England of the fertilising possibilities of Spanish phosphorites than is generally realised.

Whether or not Lawes had read these letters we do not know, but they form an interesting foreshadowing of the great work he began two years later.

E. J. RUSSELL.
A. HENDERSON SMITH.

Rothamsted Expt. Station,
Harpenden.

Soil Reaction, Water Snails, and Liver Flukes.

MAY I be allowed to add a few words to the discussion on *Limnæa peregra* and the liver rot of sheep, etc. First with regard to outbreaks of the disease following the application of lime. During a considerable experience of Mid and North Wales I have had a number of such cases brought to my notice by farmers (in one case basic slag had been used). In all cases the dressings had been applied to rough wet pastures of the "sour" type, which are not grazed closely by stock. In parts of these fields *L. truncatula* was present, but, owing to light grazing of the abundant herbage, the encysted cercariæ had presumably not been ingested. Following an application of lime, a "sweetening" or improvement of the pasturage leads to closer grazing and a more or less intense infection of the stock. This, at any rate, is my opinion following the investigation of actual cases.

Secondly, as to the distribution of the two species of Limnæa (in the same regions). Both are abundant, and although they may occur together now and again, it is usual for *L. peregra* to frequent the softer muds and *L. truncatula* the firmer substrata. For example, if a small streamlet be followed, *truncatula* will often be found in its upper and *peregra* in its lower (and more muddy) portions. In a wide ditch, *truncatula* may occupy the margins and *peregra* the soft central portion. These habitat differences are probably due to the relative size and expanse of foot. While working on the bionomics of *truncatula* I made some notes on *peregra* also; these were incorporated in a paper published in *Parasitology*, x., No. 2, December 1917.

With regard to *peregra* acting as an intermediate host for *Fasciola hepatica*, I have on several occasions obtained cercariæ from that species which I cannot distinguish from that of *F. hepatica* (*Cercaria fasciolæ hepaticæ*, Thomas). This, however, is not a common occurrence in my experience, although I have examined numerous samples of *peregra*. The last two cases were (*a*) from ill-drained fields, near Llanwnda, Carnarvonshire, elevation about 100 feet; (*b*) on the mountains near Bethesda, elevation more than 1000 feet. In both instances liver rot had occurred. In the first *truncatula* was present also; in the second only *peregra* could be found.

C. L. WALTON.

Department of Agriculture,
University College of North Wales,
Bangor, January 15.

The Silent Zone in Explosion Sound-Areas.

IN the recent interesting article on the Oldebroek explosion, it is stated (NATURE, January 6, p. 33) that in no case has it been found that the nearer margin of the outer sound-area lies at so short a distance as 114 km. from the source. When the minute-guns were fired at Spithead during Queen Victoria's funeral procession on February 1, 1901, there was a clearly marked silent zone, and the nearest point of the outer sound-area was 80 km. from the flagship. In this case the sounds were easily recognised, as they recurred at regular intervals (*Knowledge*, vol. 24, 1901, pp. 124-25; *Science Progress*, vol. 14, 1920, pp. 625-26). In the sound-area of one of the Asama-yama explosions (December 25, 1910) the corresponding distance was about 87 km. (Bull. Imp. Earthq. Inves. Com., vol. 6, 1912, pp. 61-63 and plate 18). These figures have an important bearing on the origin of the silent zone.

C. DAVISON

70 Cavendish Avenue, Cambridge,
January 12.

Time Relations in a Dream.

IT is commonly believed that a dream which appears to be of long duration lasts in reality for a short time only. Since precise knowledge on the point is difficult to get, the following observations may be of interest. Having fallen asleep again, after being called a few mornings ago, I dreamt I was visiting a strange laboratory. On entering I was aware of a deafening hammering noise which rendered conversation impossible. My host took me to another room, where the noise was inaudible, but on returning to the first room it continued, the blows being at about the same interval. I then noticed, what I had not seen before, some one striking a pipe in a shaft in the wall, but I reflected that the force used seemed quite insufficient to produce the sound heard.

On awaking suddenly I connected the sound with the chipping of a stone-mason at work on the war memorial across the road. Remembering Mr. J. Barcroft's letter to NATURE (1919, vol. 104, p. 154), I timed the chipping blows. They were from 26-34 per 10 seconds, averaging 3 per second. Going over the dream it seemed that the loud sounding blows, which produced a continuous reverberation, were about 15 or 16 per 10 seconds; thus the time in the dream proceeded at about—or possibly slightly less than—twice the normal rate.

Both before and after the cessation in the dream —corresponding probably to one of the mason's pauses —the rate was the same. In this respect the experience differs from Dr. Barcroft's, for his clock ticking four to the second appeared to give a five-second interval, namely a twentyfold exaggeration; this, later in the dream, was reduced to a fourfold exaggeration. The noise of which I was conscious in the dream appeared to go on before the interval for about a minute and after it for two or three, with about a minute between. The duration of the dream appears accordingly to have been about two minutes or slightly longer. The loudness of the noise, as it was experienced in the dream, is remarkable in view of the actual loudness. The note was also far more metallic.

W. R. G. ATKINS.

Marine Biological Laboratory, Plymouth,
January 10.

The Disappearing Gap in the Spectrum.[1]

By Prof. O. W. RICHARDSON, F.R.S.

I.

THE Royal Institution seems a peculiarly fit place to deliver lectures on this subject, because it was while he was professor here 120 years ago that Thomas Young, the great advocate of the wave theory of light, showed how to estimate the wave-lengths of the different parts of the spectrum, and by so doing laid the foundations of spectroscopy as a quantitative science. His determinations of the wave-lengths in the visible spectrum were based on Newton's observations of the colours of thin plates. He also explained the principle of the diffraction grating, and by experiments based on the method of Newton's rings he showed that the actinic or ultra-violet rays had shorter wave-lengths than those in the visible. The wave-lengths of the visible spectrum extend from a little below 4000 to a little above 7000 Ångström [2] units, or, roughly, over about an octave. On the infra-red side we have, first, the invisible rays, often referred to as radiant heat, which contain the major part of the energy in the solar spectrum and a greater proportion still of the energy radiated from bodies at a lower temperature. Beyond these we have the long electromagnetic waves of the type we are familiar with in wireless telegraphy. This side of the spectrum extends to waves of infinite length or of zero frequency.

The gap in which we are interested is on the other side of the visible spectrum in the region of waves of shorter length or higher frequency. In 1801 Ritter showed that there was something beyond the violet end of the visible spectrum which blackened chloride of silver. In other words, there are ultra-violet rays which, as we should now say, are capable of photochemical and photographic action. They also have other properties—they excite fluorescence in substances such as uranium glass, and they liberate electrons from the surface of a metal plate. They are, however, not very freely transmitted by glass; or, to put the matter more precisely, the ultra-violet spectrum which is transmitted by a glass prism spectroscope, does not extend very far beyond the visible limit. By substituting quartz for glass in the spectroscope, and by other improvements, Stokes was able to make a very notable extension and to carry the limit to beyond 2000 Å. This made the ultra-violet extend over more than an octave, and measured in that way its extent had become greater than the whole of the visible spectrum.

The limit to further extension was now found to be set by two things—(1) the absorption of quartz, which becomes fatal about 1850 Å, and (2) the absorption of air, which also becomes prohibitive in the same neighbourhood. These difficulties were faced and overcome up to a certain point by Schumann, who constructed a fluorite spectroscope which he could operate, with all its adjustments, in an evacuated chamber. In this way he succeeded in pushing to the limit of transparency of fluorite, which is in the neighbourhood of 1250 Å with good specimens.

The limit to further development was set, and the possible lines of advance narrowed down, by a very remarkable and important property of the radiation in this part of the spectrum, to wit, that every known material substance is practically completely opaque to it. I believe this high absorbability of the radiation to be due to the combined influence of two facts—(1) that the quantum of this radiation exceeds the ionisation or radiation quantum of every atom, and (2) it does not exceed it by so much that there is any considerable chance of the radiation getting past the atom which, as it were, is set to trap it. We have precise evidence that absorption sets in as soon as, but not earlier than, the frequency at which the quantum of the impinging radiation exceeds the ionisation or radiation quantum of the atom. We also have considerable evidence, both theoretical and experimental, that the chance of absorption is greater when the two frequencies are comparable than when they are widely divergent in magnitude. These considerations exclude completely any apparatus of the type of the prism spectroscope, in which the radiation passes through considerable portions of matter such as the materials of the prisms and lenses.

There is one spectroscopic apparatus which is free from this difficulty, namely, the concave grating invented by Rowland. In this device, if the slit, the grating, and the screen or photographic plate are all arranged to lie on a circle perpendicular to the rulings having a diameter equal to the radius of curvature of the grating, the spectrum is sharply focussed without using any lenses. The adaptation of the concave grating for use in this part of the spectrum is due to Lyman, whose vacuum grating spectroscope has only begun to bear the fruit which we may reasonably hope ultimately to gather from it. With this instrument, which I shall refer to more fully later, by 1913 Lyman had measured the wave-lengths of a large number of lines between the limits reached by Stokes (quartz) and Schumann (fluorite), and had also extended the known spectrum to the neighbourhood of 900 Å, which is the short wave limit of the most fundamental hydrogen atom spectrum series, now known as the Lyman series.

At that time, then, the spectrum was known to be continuous from wave-length infinity to wave-length 900 Å, or in terms of frequency from zero to $3{\cdot}333 \times 10^{15}$ vibrations per second. It was also known that we had in the X-rays and the γ-rays from radioactive substances rays of still higher frequency and shorter wave-length. Prior to the discovery of the crystal diffraction phenomena the wave-lengths of X-rays had been ascertained roughly by photoelectric methods—a fact which seems generally to have been forgotten—but by 1913 they had been measured accurately by the Braggs and Moseley with the crystal spectrometer. Moseley's measurements include such rays as the K-rays of aluminium, which are in the neighbourhood of 8 Å, and this was the longest X-ray wave then known. There was thus a gap from 8 Å to 900 Å, or about seven octaves. This is the gap with which I propose to deal.

I do not know that any systematic or very thorough attempt has been made to push the measurements of

[1] Substance of lectures delivered at the Royal Institution on May 13 and 20 1922.

[2] 1 Ångström unit (Å) = 10^{-8} cm.

X-ray wave-lengths so far as possible in the long wave direction by crystal methods, but it is evident that there must be a limit, and it is possible that this limit has almost been attained, for in spite of the great improvement in technique and the extraordinary

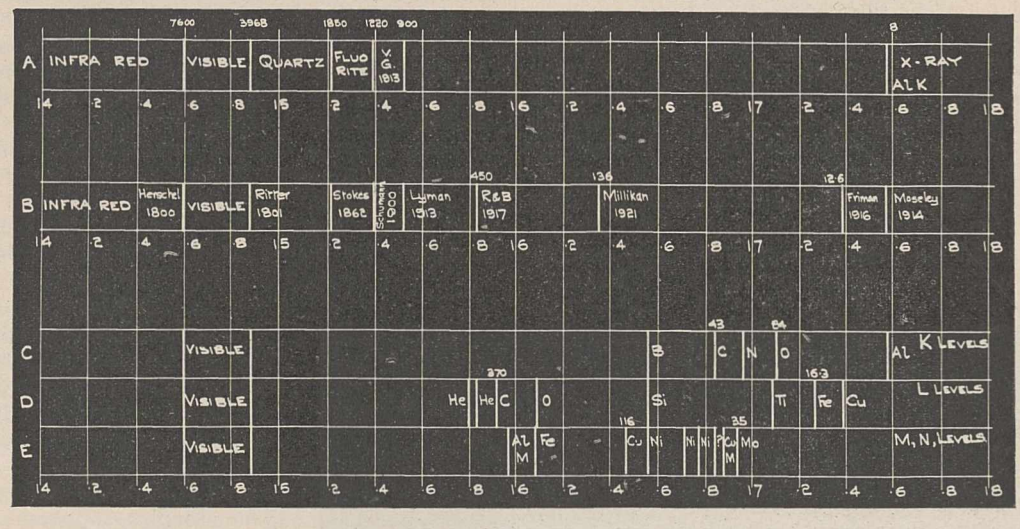

FIG. 1.

activity in this line of work since Moseley's measurements in 1913, the longest wave-length I have been able to find recorded as measured is the zinc L_{α_1} line given by Friman as 12·346 Å. This represents but half an octave out of the seven octaves between the limits left by Lyman and by Moseley.

The failure of crystal methods is due to two causes. The distance between the centres of the atoms in solids is of the order of an Ångström unit, so that at 12 Å the waves are already much longer than the distance between the reflecting planes which form the grating elements. (For the crystals rock-salt and calcite, with which most of the accurate measurements have been carried out, these distances are $2{\cdot}184 \times 10^{-8}$ and $3{\cdot}028 \times 10^{-8}$ cm. respectively.) The other difficulty arises from the intense absorbability of these soft X-rays by practically everything, a phenomenon that we have already witnessed in the radiation on the other side of the gap. Sir William Bragg has recently been investigating some organic crystals which have grating spaces very much farther apart than rock-salt and calcite, and it may be that in employing such crystals in an evacuated system we have a way of making considerable advances into the gap from the high-frequency end by the X-ray crystal diffraction methods. It would seem that in Moseley's original apparatus we have an arrangement which could be rather easily developed for this purpose. Another advantage of these crystals is the possibility that they may not absorb the rays so very intensely, as the only known substances which have appreciable transparency in this region are organic compounds or mixtures of them, such as celluloid.

Returning to the position about 1913, this is conveniently exhibited by diagram A of Fig. 1, in which the various spectral limits are marked against an even scale proportional to the logarithms of the corresponding frequencies. These are shown by the numbers on the base line, the numbers given at the top being corresponding wave-lengths in Ångström units. It will be seen that this representation is similar to that of the keyboard of a piano, equal horizontal spacings corresponding everywhere to an equal number of octaves. The great width of the gap between the X-ray and ultra-violet limits is very apparent.

A very considerable advance into this gap was made by Dr. Bazzoni and myself in 1917 using a method which was novel in spectroscopy. Our experiments were directed towards the measurement of the short wave limit of the arc spectra of various gases, and

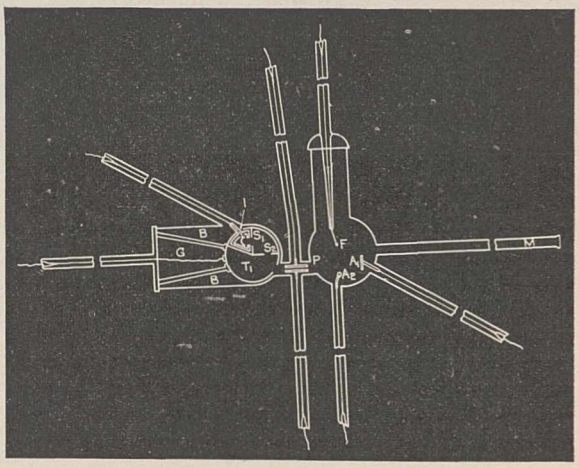

FIG. 2.—Horizontal section of apparatus used for the measurement of the short wave-length limit of arc spectra, drawn to scale.

more particularly of helium, which are generated when such gases are bombarded by considerable electron currents under moderate voltages (Fig. 2). The radiation from the gas generated under impact of the electrons passing from the incandescent tungsten cathode F to the cold anode A_1, falls on the metal strip T, after passing through the gap between the metal plates P, across which an electric field is maintained of sufficient strength to remove any ions present in the radiation stream. This radiation liberates electrons

from the surface of T by photoelectric action, and the energy of the swiftest of these electrons is given by the relation $\frac{1}{2}mv^2 = h(\nu - \nu_0)$, where ν is the frequency of the radiation and ν_0 the threshold frequency of the metal T, h being Planck's constant. The velocity v can be measured by applying a magnetic field perpendicular to the plane of the figure, when the electrons will be constrained to move in spiral paths, the axes of which are parallel to the magnetic field. Only those spiral paths the radii of which lie within certain narrow limits will pass through the gaps S_1, S_2. Consequently, since this radius depends on the velocity of the electrons and on the magnetic field, those electrons which reach the box I in a given magnetic field will have velocities lying between corresponding narrow limits. As the magnetic field is increased it will ultimately curl up the fastest electrons, so that their paths projected on to the plane of the figure lie along the circle $TS_2\ S_1$. Any magnetic field greater than this will give rise to spirals which are too narrow to get into the box I, so that the magnetic field, which is just sufficient to stop the electron current into the box, will determine the velocity of the fastest electrons, and from this datum the equation quoted above enables the greatest frequency present in the radiation to be estimated. In this way we determined the end of the helium spectrum to lie close to the position 15·83 on diagram B of Fig. 1. The corresponding wave-length is about 450 Å.

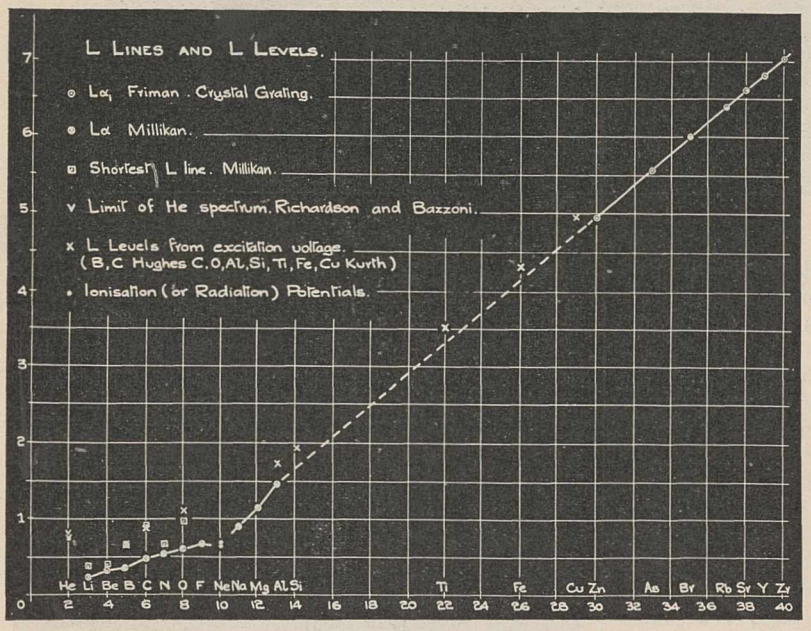

FIG. 3.

By 1916 Lyman had succeeded in measuring the wave-lengths of various lines extending to about 600 Å by means of his vacuum grating spectroscope. This instrument of course measures the wave-lengths of the lines with precision, and is the most valuable weapon we have for research in this region. Notable advances have recently been made with it by Millikan, who has made several improvements in technique which have contributed to the success he has attained. These improvements include—(1) the production of special gratings which are ruled with a light touch, so as to have about half the grating surface uncut, and thus throw nearly all the energy into the first-order spectrum; (2) the employment of very high-tension sparks (some hundreds of thousands of volts supplied by Leyden jars and a powerful induction coil) between metal terminals very close together (0·1-2 mms.) in a high vacuum maintained by diffusion pumps. With this apparatus he has succeeded in measuring a large number of lines in the extreme ultra-violet spectra of the light elements lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine, sodium, magnesium, and aluminium, extending in the case of aluminium to 136·6 Å. This limit is shown at 16·35 on Fig. 1, B.

All these elements exhibit, under these conditions, characteristic line spectra which extend into the ultra-violet, and, roughly speaking, the spectra go further into the ultra-violet with increasing atomic weight of the elements. The spectra differ very much in character as between the different elements; thus boron has but seven strong lines extending between the limits 676·8 Å and 2497·8 Å, whereas carbon has a very complex spectrum extending from 360·5 Å to 1335·0 Å. In fact the spectra of the elements of odd atomic number such as boron tend to be simpler than those of even atomic number such as carbon. The spectra of these elements in this region resemble the X-ray spectra of the heavier elements in this particular, that they consist of groups of lines separated by very wide intervals. Thus with aluminium there is nothing between 144·3 Å (L_α) and 1200 Å, where a new spectrum starts which extends into the visible.

There are good grounds for attributing the shorter wave-length groups of the lines of those elements in this region to the L characteristic X-rays of the elements. This will become clear by reference to Fig. 3, which represents the square roots of the various frequencies plotted against the atomic numbers of the corresponding elements. The points encircled between atomic numbers 30-40 (Zn-Zr) belong to the L_{α_1} lines of the elements, the wave-lengths of which have been accurately measured by Friman by the crystal diffraction methods. These points are all practically on a straight line, which, if prolonged in the manner shown by the broken line, reaches the abscissa for atomic number 13 (aluminium) at a value of the ordinate which corresponds almost exactly to the line of wave-length 144·3 Å, which Millikan found to be the longest in his group of aluminium lines in the far ultra-violet. This point is marked thus ⊗ on the diagram. It is of course a long shot from zinc to aluminium, but we shall see later that we have other evidence of the legitimacy of the extrapolation. The other points marked ⊗ refer to the longest lines, and those marked ⊡ to the shortest lines, of the spectra of the various

elements of low atomic weight observed by Millikan. It will be seen that the linear relation between the square root of the frequency of corresponding lines and the atomic number which holds for the higher atomic numbers breaks down in this region. In fact, while there is a general tendency for the corresponding frequencies to increase with increasing atomic numbers, one is no longer an approximately continuous function of the other. The vertical spacing between the points ⊗ and ⊡ for any one element is an indication of the extension of the relevant spectrum. It will be seen that this extension varies in an irregular manner in the sequence of elements from lithium to oxygen. The points shown for lithium are those for the well-known red line 6708 Å and the end, 2299 Å, of the series to which it belongs. No lithium lines were found in the ultra-violet beyond 2299 Å in the region in which the vacuum grating is effective; so that if the allocation of these spectra, for the intervening elements up to aluminium, to the L X-ray series of the respective elements is correct, this series is the L series of lithium. This forms very convincing evidence of the essential similarity of X-ray and visible spectra.

(*To be continued.*)

The Natives of Australia.[1]

By SIDNEY H. RAY.

IN the National Museum of Victoria at Melbourne a special gallery has been devoted to a fairly representative collection of objects connected with the daily life of the Australian aborigines. A very instructive and well illustrated account of the exhibits has been written by Sir Baldwin Spencer, and this gives, in a wonderfully succinct form, what are practically short comparative essays on the arts and crafts of the natives.

There seems to be very little doubt that the first inhabitants of Australia were frizzly-haired people of the old Stone Age, using unground axes, chipped stone knives, and scrapers without handles. They had no knowledge of boats or house-building. Part of this population, cut off by a subsidence which now forms Bass Straits, survived in Tasmania until modern times, but on contact with Europeans became exterminated. In the Museum these people are represented by masks of two males and one female and by a cast from the skeleton of Truganini, the last of the Tasmanians. There is also a collection of their stone implements.

On the mainland the primitive population was supplanted by people in a higher grade of development whose origin is still a matter for discussion. These people are remarkably uniform throughout the continent. The average height is about 5 ft. 6 in.; the skin a dark chocolate colour and never really black; the head long, the hair wavy, not woolly or frizzly like that of the Tasmanian, Papuan, or Negro. The people are nomadic, living in tribes which have distinctive names, and roam within certain clearly defined limits. They have no villages but only camps or clusters of rude shelters. One of the Museum cases contains a representation of a native camp, Fig. 1. This shows the *mia-mia* or shelter made of bark from gum trees resting on the windward side of a rough framework and forming a sort of lean-to. The man and woman are supposed to be returning from a hunting expedition. The woman carries in her hand her digging stick, and on her back a young child secured in its position by the skin cloak. The latter is usually of opossum skins, sewn together with sinews often taken from a kangaroo's tail. The head of the clothed man is decorated with a string forehead band in which are stuck feathers of the black cockatoo. But generally the men wear no clothing. The man in the foreground is making fire with a drill. In connexion with the camp, the *toas* or posts set up by South Australian tribes on departure as a guide to new-comers (see NATURE, February 12, 1920, p. 643) do not appear to be represented in the Victorian collection.

FIG. 1.—Native camp scene.

The languages used differ so much that natives of one tribe cannot understand the speech of their neighbours, and though in some regions, owing to the absence of mountains and rivers, tribes may be closely associated and a few words understood, there is even between these very little community in actual speech. In the Northern Territory the languages appear entirely different in grammatical structure from those in South, West, or East Australia, and approach in character

[1] "Guide to the Australian Ethnological Collection" exhibited in the National Museum of Victoria. By Sir Baldwin Spencer. 142 pp. Third Edition. Illustrated by 33 Plates. Melbourne: Albert J. Mullett, Government Printer, 1922.

the Papuan tongues of New Guinea. Throughout the Australian continent gesture language is very highly developed and forms a ready means of communication when words fail.

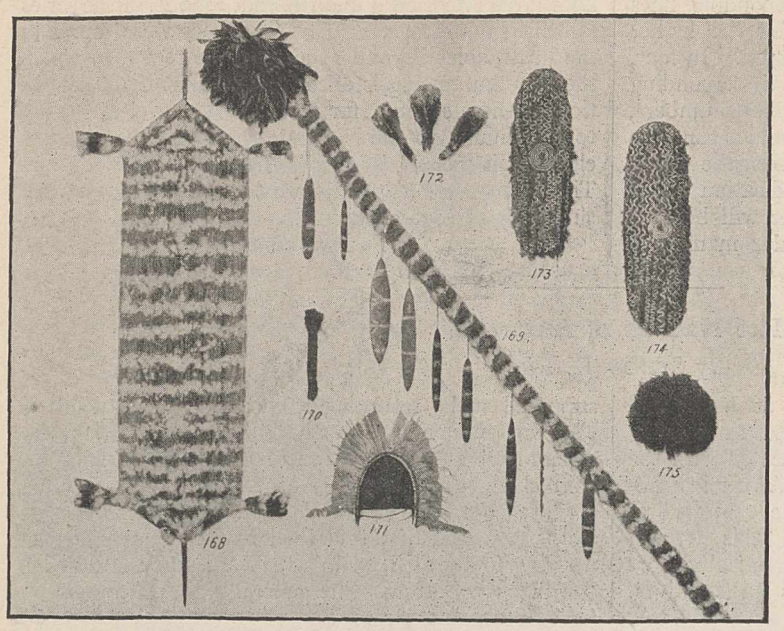

FIG. 2.—Ceremonial objects.

Much has been written about Australian tribes. Most of them have a very definite organisation and are divided into at least two main divisions (sometimes four or eight). Men of one group must marry women of the other, the children belonging sometimes to the father's division, sometimes to the mother's. Relationship names refer to the members of the group. Thus a man uses the term "father" not only for his real father but for all his father's brothers. His "mother" is any of the women whom his father might have lawfully married, and his "brothers" are not only his blood brothers but also his father's brother's sons.

Another social system which is greatly developed among the Australian aborigines is based on the *totems*. As defined by Sir J. G. Frazer, a totem is "a class of material objects which a savage regards with superstitious respect, believing that there exists between him and every member of the class an intimate and altogether special relation." In Australia the totem is an animal or plant, and the native describes himself as a kangaroo, snake, or gum-tree man as the case may be. Some tribes perform ceremonies to increase the totem animal or plant, while in others men may not eat or injure their totem. Sometimes the tribal organisation is based on the totems, sometimes it is sexual, and the women have different totems from the men. Often the totem regulates marriage.

Social organisations and ceremonies are controlled by men whose age, fighting power, or skill in magic make them prominent; but there are no chiefs. The passage from youth to manhood is marked by submission to painful rites of initiation. The knowledge of the sacred or secret ceremonies connected with initiation is forbidden to women and children under severe penalties. Many of the sacred objects connected with these ceremonies, and with the totems, are prominent in the Victorian collection (Fig. 2). They comprise *churinga* (sacred stones and sticks associated with the totems), wands, slabs, and decorations used at initiation.

No Australian weapons are made of metal. Bows and arrows are unknown. Spears are sharpened wooden sticks with barbs attached or cut near the point. Sir Baldwin Spencer describes twelve main types. In some places they are tipped with bone, flaked stone, or spines from the echidna or the sting-ray. The spear is launched by a spear-thrower. This is a stick with a point at one end which fits into a hole in the spear-shaft and gives leverage and accuracy of aim. Spear thrusts are warded off by shields, which are often highly decorated. Clubs of various forms are also used. The most distinctive Australian weapon is the boomerang. This was apparently not used by the Tasmanians. It is a curved throwing weapon varying in size and use, and most of the eastern and southern coastal tribes make a "return" boomerang which when thrown comes back to the thrower.

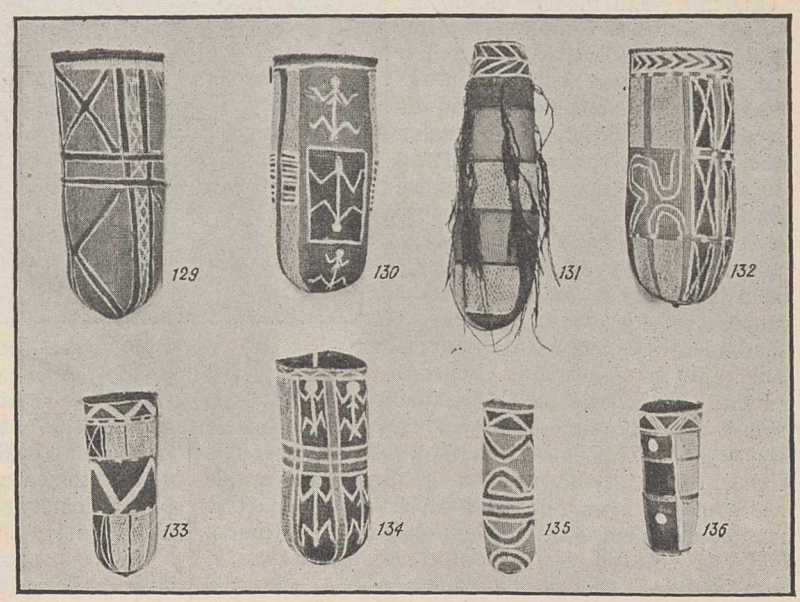

FIG. 3.—Baskets.

The weapons and implements exhibited have been arranged so as to show their development in various parts of Australia. Thus one of the cases shows transition from an ordinary throwing-stick to a boomerang

and thence to a large double-handed sword-like weapon. Another case shows a transition from a stick to various shapes of knobbed clubs. Two of the latter from Queensland with teeth in the swollen part are suggestive of the "pine-apple" clubs of New Guinea.

The stone implements in the Museum are of special interest. Sir Baldwin Spencer points out that there is no essential difference in type throughout Australia, neither is there any evidence of distinct stages of culture which might be called eolithic, palæolithic, or neolithic. Stone implements which, if discovered in Europe, would be assigned to these stages are found in use in the same camp and district at the present time. The cutting edges of knives and other implements are produced by flaking or chipping, or by grinding and polishing suitably shaped pebbles or cut lumps of stone. Spear-heads and knives are hafted with resin. Spear-heads made of glass, used since the advent of the white man instead of quartzite, are shown in one of the cases. The finely serrated edges are produced by pressure of a kangaroo bone broken and ground into a gouge-like form.

Fire is produced by drill or saw. A piece of hard wood is either rapidly rotated or worked up and down in a groove upon a softer piece, the powder worn away being ignited by the heat of the friction.

Bowls are hollowed from blocks of wood, partly by gouging, partly by burning. Baskets are plaited from grass-stalks, rushes, thin pliant twigs, or split cane. Sometimes they are open, sometimes close enough to contain honey or water. The close baskets are often decorated, as in those from Northern Territory shown in Fig. 3.

String in some places is made of human hair, but in others the possession of the hair of a person gives its possessor power to work harm upon the man from whom it has been cut. String is also made of vegetable fibre, sinew, and fur. Personal ornaments are made of fur, feathers, wood, bone, or shell.

Native art is well represented in the Museum collection. It consists of rude drawings of animals and plants and geometric designs drawn with yellow or red ochre, white pipeclay, and charcoal, or incised drawings with the sharp-edged tooth of an opossum or a flake of flint.

Among the descriptions of the exhibits Sir Baldwin Spencer has given many notes on their use. He has provided a most instructive and useful guide, which cannot fail to interest the student and stimulate the study of Australian ethnography.

Long-Distance Radio Telephony.

THE successful transmission of speech from New York to London, which took place in the early hours of the morning of January 15, shows that the difficulties of long-distance radio telephony are being overcome. The main difficulties are due to absorption of the radio-waves and the muffling of the sounds produced by extraneous noises due to atmospheric disturbances. By carrying out the experiment at night, when the absorptive effects are a minimum, and during the winter months, when the atmospheric disturbances are least, the chances were all in favour of a successful issue. During the first half-hour of the two hours' test, however, the cracklings due to the atmospheric disturbances were plainly audible. Since January 1 measurements have been made daily at the New Southgate Works of the Western Electric Co., Ltd., of the intensity of the signals and of the atmospherics respectively. The results for the first fortnight show that the amplitude of the disturbance due to the atmospherics was less than ten per cent. of the average amplitude of the signals for fourteen hours out of the twenty-four. At this period of the year it is only from 1 P.M. to 11 P.M. Greenwich time that transatlantic telephony is unsatisfactory. When the measurements have been carried out systematically for a year, it will be possible to estimate with fair accuracy the cost of a radio transmission system of satisfactory quality.

It has been found that although the Austin formula gives the daylight strength of radio signals with high accuracy for hundreds of miles over the sea, yet when the distances are measured by thousands of miles it cannot be used. The night values of the signals when the circumstances are favourable can be accurately calculated, as the damping effects are then negligibly small. In the recent test a small frame aerial was used, for the constants of such an aerial can be readily calculated. As there were sixty listeners, each with a head set, considerable amplification had to be employed, and so the test was a specially severe one. Amateurs in this country have occasionally picked up both speech and music sent out by the American broadcasting stations. These, however, are "freak" receptions due to several favourable conditions occurring simultaneously. For commercial radio telephony, communication must be possible at definite times of the day under practically all atmospheric conditions.

In the test the total distance traversed by the speech was first 70 miles by telephone cable from New York to Long Island, where there is a radio station with an antenna $1\frac{1}{4}$ miles long, supported by towers 450 feet high. About sixty kilowatts had to be supplied to this aerial. A notable economy of power was effected by suppressing the carrier wave between the radio-transmitting and the radio-receiving station, a distance of about 3000 miles. It has to be remembered that the speech could have been sent out with practically equal clearness from any point on the vast long-distance telephone network of the United States.

There can now be no reasonable doubt that trans-atlantic telephony is possible during a large fraction of the year, and it is quite probable that the result of the tests now being made at New Southgate will demonstrate that radio telephony between Europe and America will be feasible on a commercial basis. This will doubtless have important results on the world's future. It is to be hoped that rapid communication will prevent many of those misunderstandings which too frequently arise between nations.

Obituary.

PROF. J. B. HAYCRAFT.

PROF. JOHN BERRY HAYCRAFT, who died suddenly on December 30, was a figure better known to the older than to the younger generation of British physiologists. A serious illness, which fell upon him (as it fell upon Pasteur) in middle age, affected his scientific work; and the promise and fulfilment of his earlier period have to a certain extent been dimmed.

Haycraft devoted his life to physiology. Throughout it—in spite of ill-health—he held before him the ideal of scientific research. After graduation at Edinburgh he studied abroad in Leipzig. Then, while demonstrator in the physiology laboratory at Edinburgh with Rutherford, professor at the Mason College in Birmingham, interim professor during Rutherford's illness at Edinburgh, and finally professor of physiology at Cardiff, he steadfastly pursued his scientific investigations.

Haycraft's best-known works to-day are perhaps his contributions on animal mechanics and on the senses of taste and of smell in Sir Edward Sharpey Schafer's "Text-book of Physiology"; and his best-known original contribution to physiology is probably his paper on the cross-striation of skeletal muscle (1891). In this latter work he used the ingenious method of taking casts of muscle fibre upon collodion. The impression of the fibre upon the collodion showed the same cross-striated appearance as the original muscle fibre, and Haycraft inferred that the cross-striation is an optical phenomenon due to the varicose shape of the muscle fibrils, which gives different refraction effects in the globular and in the restricted portions of the fibril.

But Haycraft's range of investigation was a wide one: the results of temperature variation (1879); the chemistry of the blood, its coagulation, etc. (1879, 1882, 1884, 1888, 1891); special sense physiology—vision, taste, smell (1883, 1884, 1885, 1887, 1893, 1897, 1910); various contributions to chemical physiology (1889, 1891, 1894); contributions to histology (1879, 1880, 1889, 1890), and to development (1891, 1893, 1895); a theory of amœboid movement (1880); the "muscle sound" (1890); voluntary movements (1890, 1898); the scratch-reflex (1890); elasticity of animal tissues (1904).

Haycraft's chief interest was, however, the physiology of the heart. He published a series of papers in this field: the cause of the first sound (1890); the movements of the heart within the chest (1891); the time of contraction of the papillary muscles (1896); and the changes in shape of the heart during the cardiac cycle (1896)—the two latter papers in collaboration with Paterson. When he resigned his chair in 1920 it was with the intention of continuing his researches on the circulation, and up to the time of his death he applied himself to problems of the pulse-wave in the physiological laboratory at Cambridge.

Haycraft's illness left behind it an impairment of speech which made the expression of his thoughts sometimes a matter of difficulty. This defect in the mechanism of expression was a severe handicap, but did not dim the clearness of his vision and ideals. So far from this being the case, it was in the later part of his life that his vision was crystallised in the development of the Welsh National School of Medicine, and in the Physiology Institute at Cardiff, which will be his chief monument.

In his long tenure of the chair at Cardiff—from 1894 to 1920—Haycraft saw and guided the development of the medical school there until it became the Welsh National School just after his retirement. The modern organisation of that school on the basis of a compulsory degree in science for all its medical graduates, a six years' course of study, and whole-time professors in the clinical subjects, owes to Haycraft more than is commonly realised.

Haycraft insisted that physiology must be the basis of medical education, and fought long for the establishment of a modern laboratory in Cardiff. He was exceptionally fortunate in finding a munificent patron in Sir William James Thomas, Bt., and an enthusiastic architect in the late Col. Bruce Vaughan. The result of this collaboration was the building of the magnificent Physiology Institute in spite of endless discouragement and delay. That Institute, even in its incomplete form one of the largest in the country, carries evidence of his foresight in its detail and arrangement; it is one of the most modern and best planned of physiology laboratories.

His friends will remember Haycraft for his determination in face of opposition, for his vision, and for his high ideal of science; but most perhaps for this, that in spite of all the difficulties which he had to face, he did no mean thing. He was a gentleman, and the magnificent institute which was his vision is his fitting memorial. T. G. B.

SIR JOHN GAVEY.

SIR JOHN GAVEY, who died on January 1, at the age of eighty, was one of the most notable telegraphic and telephonic engineers in this country. He was born at St. Helier in Jersey and began his career in the Post Office in 1870. In 1902 he became Engineer-in-Chief and Electrician to the General Post Office. He was made a Companion of the Bath in 1902, and on his retirement in 1907 a knighthood was conferred upon him.

In his early days at the Post Office, Gavey originated many improvements which greatly increased the speed of automatic telegraphy, and in 1881 he opened the first telephone trunk line connecting two British towns, namely, Newport and Cardiff. In 1894 he succeeded in establishing communication between the opposite sides of Loch Ness, a distance of four miles, by means of the electromagnetic induction between two parallel wires stretched along the banks. This method was subsequently used for establishing communication between lighthouses and the mainland. Gavey was responsible for the organisation of the complete telephone trunk system for Great Britain, and he organised the Post Office telephone exchange system for London. He joined the Institution of Electrical Engineers in 1872, the year after it was founded, and communicated several valuable papers to it. In 1905

he gave in his presidential address to the Institution a masterly summary of telegraphic and telephonic progress, and a list of unsolved problems which proved very useful in directing the ingenuity of inventors along promising lines.

Sir John Gavey served on many international committees, including some of the earliest on radio-communication. He was one of the first to appreciate the importance of Oliver Heaviside's theoretical investigations, and to use Duddell's oscillograph in everyday experimental work. He was very highly esteemed by every one who came in contact with him, and the work he did at the Post Office has proved of the greatest value.

Mr. A. H. Curtis.

By the death of Alfred Harper Curtis on January 10, after a few days' illness, the Imperial Mineral Resources Bureau loses a very able and highly-esteemed member of its staff. Mr. Curtis was the second surviving son of the late Alfred Curtis, Town Clerk of Neath, Glamorganshire, and was born on July 12, 1863. Having chosen the profession of engineering, he early gave a practical bent to his studies. As a youth he spent three years with an engineering firm in the Swansea district, and during that time acquired a good knowledge of mining and metallurgical processes. He then proceeded to Owens College, Manchester, where he studied civil engineering and geology, after which he took up the study of mining, mine surveying, and other subjects at the Royal School of Mines, London, and graduated as B.A. at the University of London.

On leaving the Royal School of Mines, Mr. Curtis travelled widely in many parts of the British Dominions and foreign countries, spending long periods in New Zealand and Japan, investigating and developing mineral deposits. His paper on "Gold Quartz Reduction," read at the Institution of Civil Engineers in 1891–1892, gained for him the Telford premium. While in New Zealand, during the period 1896–1902, he was a member of the council and one of the honorary secretaries of the New Zealand Institute of Mining Engineers, to which, in 1898, he contributed a paper on "The Examination and Valuation of Mines."

During the war Mr. Curtis gave much time to the preparation of reports dealing with the mineral resources of the British Empire and foreign countries. In this capacity he worked for a short time at the Imperial Institute, and compiled the publication on "Manganese Ores" issued by the Institute. He later joined the staff of the Imperial Mineral Resources Bureau, and took a prominent part in the compilation of the statistical and descriptive reports issued by the Bureau.

Mr. Curtis was an untiring and conscientious worker, and his death leaves a gap that it will be difficult to fill.

Current Topics and Events.

At the meeting of the Chemical Society held on Thursday, January 18, it was announced that the council had nominated Prof. W. P. Wynne to fill the office of president, which will be vacated by Sir James Walker on March 22.

The gold medal of the Royal Astronomical Society has been awarded by the council to Prof. A. A. Michelson, for his application of the interferometer to astronomical measurements. It will be presented at the annual general meeting to be held on Friday, February 9.

Prof. R. A. Sampson, Astronomer Royal for Scotland, has been appointed General Secretary of the Royal Society of Edinburgh for the remainder of the current session, in succession to the late Dr. C. G. Knott.

Sir Edward Sharpey Schafer has accepted an invitation to deliver in London next autumn the first Victor Horsley memorial lecture. The lecture, which will be given triennially, is the outcome of the work of a committee formed in 1920 to commemorate the services of Sir Victor Horsley to science and the British Empire. The subscriptions received by the committee amounted to more than 1000*l.*

At the meeting of the Institution of Electrical Engineers to be held on Thursday, February 1, the president will present to Mr. J. W. Meares, late local honorary secretary of the Institution in India, and Electrical Adviser to the Indian Government, a salver and cigarette box subscribed for by his friends in India on the occasion of his retirement from the Indian Government Service, and as a token of his valuable services to the profession in India.

The Air Conference, to be held at the Guild Hall on February 6 and 7, will be opened by the Lord Mayor of London. During the Conference the following papers will be presented and discussed: "The Position of Air Transport To-day," by Maj.-General Sir W. S. Brancker; "A Self-supporting Airship Service," by Commdr. C. D. Burney; "The Progress of Research and Experiment," by Air Vice-Marshal Sir W. G. H. Salmond; "Gliders and their Value to Aeronautical Progress," by Col. A. Ogilvie; "Seaplanes," by Mr. C. R. Fairey.

On Tuesday next, January 30, at 3 o'clock, Mr. R. D. Oldham will begin a course of two lectures at the Royal Institution on the character and cause of earthquakes; and on Thursday, February 1, Prof. I. M. Heilbron will deliver the first of two lectures on the photosynthesis of plant products. The Friday evening discourse on February 2 will be delivered by Mr. C. F. Cross on fact and phantasy in industrial science, and on February 9, by Sir John Russell, on Rothamsted and agricultural science.

The Grocers' Company is offering a scholarship (one of three), of the yearly value of 300*l.*, with an allowance for necessary expenses, the object being to encourage original research in sanitary science. The appointment will be for one year, but it may be

renewed for a further second or third year. The election will take place in May next. All applications must be sent before April 1 to the Clerk of the Grocers' Company, Grocers' Hall, E.C.2, upon a special form obtainable upon application.

THE Riverbank Laboratories for research in Acoustics, Geneva, Ill., U.S.A., are establishing one or two research fellowships in acoustics, and invite applications for the same from college graduates who have taken advanced courses in physics and mathematics, and shown in their work qualities essential for success in independent investigation. The terms of appointment will be determined by the qualifications of the person or persons appointed. Applications should be sent to Mr. B. Cumming, Secretary, The Riverbank Laboratories, Geneva, Illinois, U.S.A.

THE Minister of Health has appointed the following representatives of the British Waterworks Association and the Institution of Water Engineers as a standing advisory committee to confer with representatives of the Ministry on questions of water supply: Mr. C. S. Musgrave, Mr. A. R. Atkey, Mr. A. B. E. Blackburn, Lieut.-Col. J. R. Davidson, Mr. F. W. Macaulay, and Mr. W. Terrey. The subjects discussed at the committee's first meeting included (1) the steps to be taken for formulating the outlines of a national water policy; (2) the survey of the water resources of England and Wales; and (3) the standardisation and testing of water fittings.

MR. R. I. POCOCK is retiring next March from the post of superintendent of the Zoological Gardens, Regent's Park, to which he has been attached since 1904, and the council has appointed Dr. Geoffrey Marr Vevers to succeed him. Dr. Vevers is at present a Beit Memorial Research fellow and an assistant at the London School of Tropical Medicine. He will have as his staff Mr. D. Seth-Smith as curator of mammals and birds, Mr. E. G. Boulenger as curator of the aquarium and of reptiles, and Miss L. E. Cheesman as curator of insects. Dr. R. W. A. Salmond has been appointed honorary radiologist and Prof. G. H. Wooldridge as honorary consulting veterinary surgeon to the society.

PROF. ALFRED LACROIX, president of the Geological Society of France, has been selected as the recipient of the Hayden memorial geological award for 1923 of the Academy of Natural Sciences of Philadelphia. The award, which is made every three years, and consists of a gold medal, was founded in 1888 in memory of Dr. Ferdinand V. Hayden, at one time director of the United States Geological Survey, "as a reward for the best publication, exploration, discovery or research in the sciences of geology and paleontology." Prof. Lacroix is well known among geologists; he was made professor of mineralogy at the Paris Museum of Natural History in 1893, and in 1901 he was elected a foreign member of the Geological Society, from which he received the Wollaston medal in 1917; in 1904 he was elected a member of the Paris Academy of Sciences, and for the past eight years has been permanent secretary for the physical sciences. His work includes studies of contact and endomorphic metamorphism and a detailed investigation of Mont Pelée. Among previous well-known recipients of the award are Suess, Huxley, Sir Archibald Geikie, Dr. Charles D. Walcott, Prof. H. F. Osborn, and Prof. T. C. Chamberlin.

MR. E. D. SIMON, late Lord Mayor of Manchester, has arranged with the Rothamsted Experimental Station to devote the whole of his farm and dairy herd at Leadon Court, Herefordshire, to a thorough test of the soiling system designed by Mr. J. C. Brown, formerly of the Harper Adams Agricultural College, in which a dairy herd is maintained largely on the produce of the arable land. Mr. Simon has obtained Mr. Brown's services as resident manager, and has authorised the Rothamsted authorities to publish all or any records and accounts that may be deemed helpful to farmers. It is believed that Mr. Brown's system will prove of great value; but in these difficult times the ordinary farmer could not afford to experiment on his own account, and the trial requires more land and dairy cows than could be provided at a college or an experimental farm. The experiment will serve a valuable purpose in showing how far the various modifications introduced will be financially advantageous to the dairy farmer, and agriculturists generally will greatly appreciate Mr. Simon's generous action.

ATTENTION was recently directed in these columns (November 11, p. 642) to the probable use of the cinema in England and France as a means of agricultural education among farmers. It is interesting to note that the United States Department of Agriculture has employed this method for the last nine years. At the present time they have 150 films available dealing with many branches of farming activity, and with rural life generally. Special attention is paid to the control of disease, both of animals and plants, and the best methods of crop production. The American parks and game preserves, which are in the charge of the Department of Agriculture, also receive attention, and their value to the nation is illustrated from many points of view. It is probable, however, that the films dealing with Extension Service activities of the Department are the most important. Of recent years the development of co-operation, both for the business interests and the amenities of rural life, has proceeded at an ever-increasing rate. There is no doubt that the progress of this movement has been, and will be, greatly stimulated by the use of films; they cannot, of course, replace in any way the valuable personal contact with the farmer, which is the corollary of an adequate research and advisory service, but they can help greatly in disseminating a general idea of the expert assistance that is available.

ON two previous occasions last month (December 2, p. 743, and December 30, p. 884) we referred to film displays in connexion with the Mount Everest Expedition of 1922. Another effort to place before the public a record of the results obtained, is the exhibition of

pictures at the Alpine Club Hall, Mill Street, Conduit Street, W.1. These pictures, which will be on view until February 6, include some 152 photographs and 52 paintings in oil and water colour. The photographs are chiefly by Capt. Noel, showing the personnel of the expedition, the camps and ground traversed, and the Tibetan people. Among the last-named group are several of the Rongbuk monastery and its inmates, including two telephotographs of the Chief Lama, who, as the supposed incarnation of the god Chongraysay, could not be approached sufficiently for an ordinary photograph. There are several fine photographs of the East Rongbuk glacier by Capt. Finch, some of them showing the tremendous ice-pyramids which had to be traversed, varying in height from 30 to some 300 feet. At nearly 23,000 feet the Chang La camp was pitched in very curious surroundings; the peculiar snow formation shown behind the camp in the picture was only met with at this place. The photographs follow the climbing to a height of some 26,000 feet, and one shows the party a few minutes before the disastrous avalanche. The view of Changtse and Gyachung Kang from Mount Everest, taken at an altitude of 26,985 feet by Mr. Somervell, creates a record in photography. Among the more striking scenic effects are the wind-blown snows on the east slopes of Everest, and the sunset on the north face. Copies of the latter photograph and several others of the collection may be purchased. The impressive scenes in water colour and oil by Mr. T. Howard Somervell are also for sale. The proceeds will be spent on a third expedition.

THE weather over England in 1922 had no outstanding feature like the drought in 1921, and it will go down to posterity as a fairly normal year meteorologically. Heavy gales were somewhat more frequent than in late years, especially over the southern portion of the Kingdom. Observations at the Royal Observatory, Greenwich, show that the mean temperature for the year was 49·4° F., which is 0·7° less than the normal, using the period of 35 years, in agreement with the system adopted by the Meteorological Office. The warmest month was June with a mean temperature of 60·3°; this was the only month with the mean temperature above 60° and the only month with the mean of the maximum readings above 70°. January, February, May, June, and December were the only months with an excess of temperature. The coldest month was January, with the mean temperature 40·3°, which is 1·7° above the normal. There were two days in May with the shade temperature above 90°, and there was one day in January, April, October, and December with the shade temperature less than 25°. Rainfall for the year, using the results for the civil day, measured 23·24 inches, which is 0·26 in. less than the normal. July was the wettest month with 3·20 in., which is 0·96 in. above the normal; the next wettest month was December with 2·92 in., which is 0·66 in. more than the normal. October was the driest month, with the total rainfall 0·93 in., which is 1·60 in. less than the normal. Rain fell in all on 178 days, which is 15 days more than the normal, and in both January and July rain fell on more than 20 days. November had only 8 days with rain. Sunshine was registered at Greenwich for 1469 hours, which is 9 less than the normal: the sunniest month was May with 284 hours, the least sunny, November with 26 hours.

THE January number of the *Museums Journal* prints the report of a committee appointed by the National Society of Art Masters, the Incorporated Association of Headmasters of Secondary Schools, the Association of Headmistresses of Girls' Secondary Schools, and the Museums Association, to inquire how far the system of circulating objects from the Victoria and Albert Museum meets the needs of the provinces. Besides recommending that the circulation collections should be systematically completed and brought up-to-date, the committee suggests that the local museum might become a local sub-circulation department of the Victoria and Albert Museum. It ends by pointing out that, "whilst the total vote for Education has grown enormously, the sum allocated for the museum side of Art Education in the Provinces has been practically stationary for generations, and bears no proper relation to the sum available for education as a whole." And yet on its museum side Art Education is treated generously as compared with other branches of education.

AUTHORS and readers will be interested in the authoritative statistics of the cost of book production published in the excellent new Catalogue of the publications issued by Mr. Milford for the Oxford University Press. In the year ending March 31, 1914 the Press issued 157 new books at the average price of 7*s.* 11*d.*, or 0·37*d.* per page. The corresponding figures for the year ending March 31, 1922 were 115 books at the average price of 11*s.* 10*d.*, or 0·64*d.* per page. These figures concern only those books, in their nature unremunerative, which the Press produces as a service to education and learning. "It will be readily understood that the cost of the present output is higher than that of the pre-war output (though the rise in the price to the public does not show an equivalent increase); and the moral is easily drawn, that the output can be restored to the old level only by the activity of the Press in the production of remunerative books and by increased support from the public." It may be also noted that the concluding volume of the Oxford Dictionary will, when completed, have cost not less than 50,000*l.*

IN the article on the last report of the Development Commissioners, which appeared in NATURE of December 30 (vol. 110, p. 865), the statement was made "that the report does not contain, as in the past, an account of the present finances of the Fund." The Secretary to the Commissioners writes to point out that this statement, which we regret, is incorrect; for such an account does, in fact, appear in the body of the report, and it shows that the balance at the credit of the Fund on March 31 last was 1,337,336*l.*, including 850,000*l.* received under the provisions of the Corn Production Acts (Repeal) Act 1921. The advances made during the year 1921–22 were, in the aggregate, 385,185*l.* The *net* balance available for annual

advances to meet the cost of existing schemes is stated to be 128,000*l.* only, against an estimated requirement of 200,000*l.* There may be some ground, therefore, for the apprehension expressed in the article as to the future adequacy of the Fund.

REFERRING to a remark made in the notice of his book "The Supremacy of Spirit" in NATURE of January 13, p. 45, Mr. C. A. Richardson writes to say that his purpose was not to attempt to deal at all adequately with scientific objections, but to show that (1) the evidence for the alleged facts is now of such a kind as to merit serious consideration and investigation by a scientific committee; (2) the alleged facts are in terms of his philosophical theory.

THE January list of new books and new editions added to Lewis's Medical and Scientific Circulating Library during October–December has just reached us. Although intended primarily for subscribers to the library, it should be of service to many others, being a general guide to medical and scientific works published in the past three months. The list, which is classified according to subjects, is to be obtained free of charge from Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1.

THE spring announcement list of the Cambridge University Press contains particulars of many forthcoming books of science. Among them we notice "The Air and its Ways," by Sir Napier Shaw, being the Rede Lecture for 1921, and other papers dealing with the physical explanation of the atmospheric circulation and with the application of meteorology to agriculture; "Relativity," forming the second of the supplementary chapters to Dr. Norman R. Campbell's "Modern Electrical Theory"; a newly arranged and enlarged edition of "The Mathematical Theory of Relativity," by Prof. A. S. Eddington; the "Collected Scientific Papers" of the late Dr. J. Aitken, containing some thirty-seven papers on atmospheric dust, fogs and clouds, air temperatures, and other scientific subjects, added to which is a sketch of the life and work of the author; and "Glass-Making in England," by the late H. J. Powell of the Whitefriars Glass Works, in which an account of glass-making in all its branches is given from the Roman period to the Great War.

Our Astronomical Column.

OCCULTATIONS OF STARS BY THE MOON.—On the night of January 27, the moon will pass over a number of the stars forming the well-known group in Taurus called the Hyades. The bright star Aldebaran is among those which will be hidden. The times of occurrence for four of the brighter stars will be as under:—

	Mag.	Disappears. h.	m.	Reappears. h.	m.
γ Tauri	3·9	2	57	3	57
θ' Tauri	4·2	8	31	8	56
+15° 637	4·8	9	26	10	39
Aldebaran	1·1	12	35	13	30

The moon will be about 10½ days old at the time and the stars will disappear at the unillumined side, and reappear at the bright edge of the disc.

The event may be witnessed with a small telescope, and it is possible that Aldebaran may be seen by acute, unaided vision nearly up to the time of its disappearance, which will occur 35 minutes after midnight. The moon will be due south at 8h and will be 55 degrees above the horizon at the time. There will be four other occultations of Aldebaran during the next 12 months, on March 23, October 27, November 24, and January 17, 1924.

OBSERVATIONS AT WALLAL OF THE ECLIPSE OF SEPTEMBER 1922.—The winter number of the *Chaldaean* (vol. v., No. 17) contains an interesting account of the observation of the eclipse at Wallal on the west Australian coast by Messrs. J. Hargreaves and G. S. Clark-Maxwell. Their principal instrument was the 19-ft. camera with lens of 4-in. aperture lent by Father Cortie, and the 8-in. coelostat lent by the Royal Irish Academy; these were the same instruments as were used at Sobral, Brazil, in 1919, when they gave a result in close accord with Einstein's predictions. But in 1922 the stars were too faint to be photographed with a ratio of aperture to focal length 1/57, and the instrument was simply used as a coronagraph. A large number of successful exposures were secured with a range of 1 to 80 seconds, so that they should give good details both in the inner and outer regions. Successful plates were also secured with the smaller cameras; a declinometer, to record magnetic variations during totality, failed owing to a smoky lamp. The darkness during totality is stated to have been considerable, necessitating the use of lamps for plate-changing, etc. The extension of the corona on some of the plates is 4 solar diameters, which is quite satisfactory.

A gale rendered re-embarkation very difficult, one boat sinking in the surf. None of the important pieces of apparatus were in it, and the articles were recovered. This experience shows that it would have been quite impossible to land the very heavy packages of the Christmas Island party at Wallal; it is a slight mitigation of the disappointment that they suffered to realise that they chose the only station that was reasonably possible in the circumstances.

SPECTROSCOPIC PARALLAXES OF A-TYPE STARS.—The earlier spectroscopic parallaxes were restricted to types F, G, K, M; but, as was recently noticed in this column, Messrs. Adams and Joy have found that the state of sharpness or nebulosity of certain metallic lines in the spectra of stars of type A forms a trustworthy guide to absolute magnitude. The calibration of the correlation curves is effected both by trigonometrical parallaxes and by the group parallaxes of stars in moving clusters. The average differences of the spectroscopic and trigonometric parallaxes (without regard to sign) are +0·0131″ (104 stars), spectroscopic and group parallaxes +0·0077″ (82 stars). The systematic differences are 0·0000″ and −0·0014″ respectively. A list is given (*Astrophys. Journ.*, November 1922) of 544 spectroscopic parallaxes of stars in Boss P.G.C., including a number of members of the Taurus, Perseus, and Praesepe streams. The parallax of Praesepe is given as 0·013″.

A test of the values found is afforded by plotting parallax against proper motion. The resulting graph is nearly straight, showing an increase of proper motion from 0·000″ to 0·400″ as the parallax rises from 0·009″ to 0·058″. It is found advisable to omit Sirius, the large parallax of which unduly affects the mean of its group.

Data are still wanting for finding the parallaxes of stars showing the *c* characteristic, α Cygni being the leading example. Its absolute magnitude is estimated as −4 or −5.

Research Items.

WEAVING IN ANCIENT EGYPT.—Mr. Winlock's discovery of a model weaving shop in the XIth dynasty tomb of Mehenkwetre at Thebes has caused a fresh revival of interest in the subject of ancient Egyptian looms. Two articles in *Ancient Egypt* (Part iii., 1922) are devoted to branches of this subject. Mr. Winlock deals with heddle-jacks and Mr. A. C. Mace with loom weights in Egypt. Some interesting pictures from other tombs dealing with processes of weaving render it easy to follow the lucid descriptions in the text.

BRASS-CASTING IN THE CENTRAL CAMEROON.—The methods of the artists who produced the remarkable series of brass-casting at Benin are illustrated in a paper by Mr. L. W. G. Malcolm, published in the January issue of *Man*. Mr. Malcolm found the art confined to the area in south-west Adamawa, the principal towns being Bamum and Bagam. As a rule the material now used is of European origin. In the north it appears that tin was formerly brought from northern Nigeria, and it has been suggested that copper may have come from the Katanga area of the Congo. In all cases the casting is done by the *circ perdue* process. The articles produced by the Eghāp tribe are generally pipe-bowls, personal ornaments, grotesque animal and bird forms, perfume flasks and bells. Several interesting examples of tobacco pipes used by the Eghāp head-men are illustrated by Mr. Malcolm.

TRIASSIC REPTILES AND STEGOCEPHALIANS FROM TEXAS.—Publication No. 321 of the Carnegie Institution of Washington is devoted to "New Reptiles and Stegocephalians from the Upper-Triassic of Western Texas," by E. C. Case. After sketching the geology of the borders of the Staked Plains in Texas and New Mexico, where these fossils occur, the author proceeds to the description of *Buettneria perfecta*, a new genus and species of Stegocephalia, that has its nearest relations in Metoposaurus. There follows a full description of *Desmatosuchus spurensis* and the sub-order Desmatosuchia, which were originally described by Case in 1920, accompanied by a restoration of *D. spurensis*. Of new parasuchians there are *Promystriosuchus ehlersi*, a fully mature phytosaur of the Mystriosuchid group, of small size and distinct in its characters from any previously described, and *Leptosuchus crosbiensis* and *L. imperfecta*. Descriptions of isolated bones of parasuchians and the remains of a small dinosaur, with notice of some coprolites and a small fragment of a jaw containing a singularly shaped tooth reminiscent of the teeth of Diadectes, terminate this important monograph, which is well got up, as all the publications of the Institution are, and most excellently and abundantly illustrated.

PHENOLOGICAL OBSERVATIONS ON PLANTS.—Dr. E. Vanderlinden has published (Recueil de l'Institut botanique Léo Errera, t. x.) further results of his observations on the relation between the time of flowering and various climatic conditions. He has now observed a series of woody plants during the years 1896–1920, and of herbaceous plants from 1910 to 1920. The results are tabulated and also plotted in relation to external factors, such as maximum and minimum temperature, soil temperature, and hours of sunlight. Dr. Vanderlinden finds that advancement or retardation of the flowering period in favourable or unfavourable seasons is much less in the case of herbaceous than in those of woody plants. This difference he attributes to the fact that in the latter the reserve materials accumulated to supply the new flowers occur in the aerial parts of the plant and are more exposed to the influence of atmospheric variations. Both woody and herbaceous plants show a periodicity in the distance between the two extreme dates of flowering. These are considerable in April but decrease onwards, reaching a minimum towards the end of June, and then show a progressive increase. That is to say, the flowering periods of the last half of May and the whole of June are less affected by climatic variations. The chief factor in inducing this periodicity is the less prevalence of inhibiting temperatures during the summer months as compared with the spring. The observations were made at Uccle in Belgium.

THE CONDITION OF THE EARTH'S INTERIOR.—The criticism by Mr. W. F. Jones of Prof. T. C. Chamberlin's views as to the planetesimal origin of the earth has been mentioned in a letter published in NATURE (August 19, 1922, p. 249), and it is only fair to state that Prof. Chamberlin has published a reasoned reply to Mr. Jones in the *American Journal of Science*, vol. 204, p. 253, October 1922). He maintains that the evidence as to the propagation of earthquake-waves, which originate "within the shell not very far below the surface," is entirely opposed to any theory of the existence of a molten interior in the earth at the present day, while the conception that such an interior might have arisen by condensation of solid particles in the past is incompatible with the planetesimal hypothesis. He has probably not yet had time to consider J. Joly's startling suggestion that changes within the earth may give rise to bursts of radioactivity, and that these may bring about the complete melting of a previously solid earth. Chamberlin remarks that the proofs given by Coleman and others of the batholitic nature of the granite that invades the outer and ancient sedimentary crust are destructive of the idea of an underlying crust of light material, such as might have gathered round a molten globe. To many this argument will not appear entirely sound. The occurrence of batholites forming intrusive gneisses over very wide and separated areas seems to imply the existence of a crustal layer of granitic composition from which they have ascended as remelted representatives.

WEATHER IN THE PHILIPPINES.—Hourly meteorological observations made at the Central Observatory of Manila during the calendar year 1919, prepared under the supervision of Rev. José Algué, S.J., Director of the Weather Bureau, have recently been received. Hourly readings are given of barometer, temperature, humidity, and wind velocity. During the year nine typhoons visited the Philippine Islands, and in all there were twenty-five depressions or typhoons throughout the Far East. These were all observed from June to December, no typhoons occurring from January to May. The Manila rainfall broke all records since the formation of the Observatory in 1865, both as to the monthly and annual amount. In August the total fall was 78·09 in.; the previous maximum fall in any month was 57·88 in. in September 1867. In the whole year the total rainfall at Manila was 154·39 in., almost double the normal annual fall; the greatest previous record in any year was 117·27 in. in 1867. The lower parts of the city of Manila and of several provinces of the western part of central Luzon were flooded from the

end of July until about the middle of September. During the first part of the year the weather had been rather dry throughout the Archipelago. Extraordinary seismic activity occurred during the year. There were 151 earthquakes felt within the limits of the Archipelago; only two shocks, on April 28 and August 14, were of destructive character. In the Central Observatory, Manila, the seismographs recorded 420 disturbances due to insular and distant earthquakes. At Butuan the seismic disturbances numbered 1076.

ULTRA-VIOLET PHOTOGRAPHY OF OLD MANUSCRIPTS.—In a paper by Prof. The Svedberg and Hugo Andersson, which has just been published in the *Photographic Journal* (No. 63, 1923, pp. 30-32), a very instructive example is given of the use of ultra-violet light in photographing old manuscripts. When a palimpsest is illuminated with intense ultra-violet light it is found that those parts of the parchment where the old, and subsequently erased, writing was, have lost the power of strong fluorescence which is

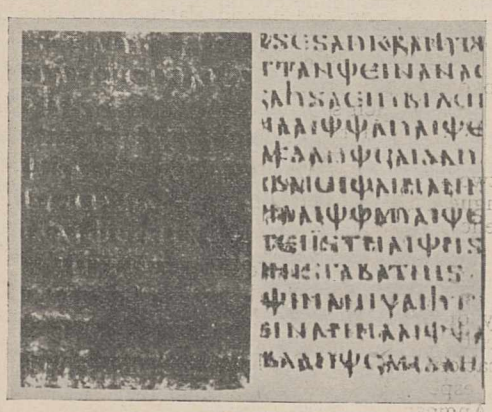

FIG. 1.

still exhibited by the untouched parts of the parchment. Kögel, in 1915, worked out this method for deciphering such parchments, and Svedberg and Nordlund used it later for deciphering the famous "Codex Argenteus" in the University Library of Upsala, and for other similar purposes. The difficulties attaching to this method lie in the very long exposures necessary to obtain a negative by means of the comparatively feeble fluorescence, several hours' exposure being necessary through the filters used to cut off the visible light from a quartz mercury lamp. The Wratten department of the Kodak Company has recently put a new U.V. filter on the market, and by means of this filter, Prof. Svedberg and Mr. Andersson have succeeded in cutting down the exposure to 15 minutes, with the results illustrated in Fig. 1, which shows the comparison between an ordinary photograph and the fluorescence photograph. The Wratten filter is superior to the Zeiss U.V. filter hitherto used for such purposes, in that it is much more transparent (about 10 times) in the long-wave part of the ultra-violet (391-344 $\mu\mu$).

THE FADING OF COLOURS.—An interesting problem, the fading of colours of objects in museums when exposed to light, was dealt with in a paper read by Sir Sidney Harmer, Director of the Natural History Departments of the British Museum, before the Royal Society of Arts on December 13. It is common knowledge that many colours fade when exposed to strong sunlight, but the relative injuriousness of diffused daylight and artificial illuminants is less known. Experiments by Dr. Russell and Sir William Abney led to the following main conclusions: (1) fading is due to the action of light and not to moderate heat; (2) it does not take place *in vacuo*, *i.e.* in the absence of oxygen and moisture; and (3) the rays of the violet end of the spectrum produce the greatest amount of fading. Experiments with various glasses devised to check the transmission of ultra-violet rays have been made. Some of these have a useful effect, but it appears that in general the use of tinted glasses merely delays fading and does not prevent it, in the case of fugitive colours. The best glass for the purpose had a distinct yellow coloration, rendering its use for cases scarcely practicable. As examples of the length of continuous exposure necessary to cause fading it is mentioned that the wings of certain moths showed appreciable fading in 10-21 days; on the other hand, the fur of the tiger required 175 days, and of a brown horse and antelope 1485 days, before there was perceptible change of colour. According to these experiments direct sunlight was about from 20 to 70 times as injurious as electric light, and diffused daylight about six times as injurious. While too much importance should not be attached to such figures, there seems little doubt that illumination by electric light is less liable to cause fading than natural light, and the question arises whether very valuable specimens, or those with highly fugitive colours, might not be lighted entirely by artificial means. Most artificial illuminants contain less ultra-violet energy than daylight. But apart from this it is possible that a much lower intensity of illumination might suffice to enable specimens to be seen.

STANDARDISATION OF EXPERIMENTAL TANK DATA.—In view of the fact that nearly all the important maritime nations of the world have experimental tanks, the introduction of international systems for the presentation of results would be extremely helpful to experimenters and designers. Mr. Telfer, in a paper, "The Presentation of Ship Model Experiment Data," read before the North-East Coast Institution of Engineers and Shipbuilders, on December 8, discusses the existing systems of presentation and their relative usefulness. He points out that the basis of any system should be dimensionless, and that the units forming this basis should be international, besides giving results finally that can be readily interpreted by practical men without any arithmetical unravelling. Experimental work up to the present has been presented in widely different forms. Froude used expressions Speed/(Vol.)$^{\frac{1}{6}}$ and Power/(Vol.)$^{\frac{3}{2}}$(Speed)^{3}, giving results for a one cubic foot model. Taylor, on the other hand, expresses his results per ton of displacement. Mr. Telfer suggests that results could be made international by adoption of the metric system and presenting results for models of one metric ton displacement, adopting Power/(Volume)$^{\frac{3}{2}}$ and Speed/(Volume)$^{\frac{1}{6}}$ as the basis of the presentation. He also suggests the adoption of definite symbols, these being selected "from international philological considerations, all related symbols being mnemonically appropriate and above all typographically simple rather than typographically unique." Such an international code is greatly needed. There is at present an awkward disregard for standardisation of symbols even among experimenters of the same nation. It is to be hoped that this present paper will help forward in ship model data what has already been adopted in aeronautical work. Before setting up an international system such as is suggested, it would be best for a representative committee to inquire into the basis to be adopted, and also to undertake the transference into this system of all existing data.

The Distribution of Life in the Southern Hemisphere, and its Bearing on Wegener's Hypothesis.

ONE of the most important results of the acceptance of Wegener's theory of the palæogeography of the world would be the simplification of the facts of the Permo-Carboniferous glaciation of Australia, India, South Africa, and South America by bringing the glaciated areas together into one single glaciated region. It is undoubted that if this were done much of the difficulty of accounting for the simultaneous glaciation of regions so diverse in latitude would disappear. Considerable interest, therefore, attaches to the recent discussion on Wegener's hypothesis, which was held before the Royal Society of South Africa, for its bearing on this important aspect of the subject.

The general attitude of the geologists who took part in the discussion was one of suspended judgment. It is admitted that the folded ranges of the Sierras of Buenos Aires appear to be of similar age and structure to those of the southern folded belt of the Cape Province, and would be brought into fairly accurate alignment if the South American coast were fitted into the African coast after the manner of Wegener's map of Carboniferous land distribution, but it was held that this might be accounted for in several other ways more in accord with the known facts of geology. On the other hand, the very close and detailed homology of the Tertiary deposits of Grahamland and Patagonia as described by Gunnar Andersson forms one of the most relevant pieces of combined geological and palæontological evidence from the southern hemisphere in support of the theory.

Discussing the zoological evidence, Mr. K. H. Barnard concludes that the zoologist, far from being able to help in formulating an explanation of the palæogeographical history of the continents, was, in reality, entirely dependent on the geophysicist and geologist, and that in some cases the facts of present-day distribution were capable of interpretation in terms either of a far-reaching equatorial Gondwanaland or a compact polar Gondwanaland. There is little to choose, for example, between Watson's theory of the dispersal of acarid snails from S.E. Asia [equatorial Gondwanaland] and Hedley's theory of their origin in Antarctica [polar Gondwanaland], and whichever geological theory best explains the palæogeographical changes must be used as a basis by zoologists. Similarly, if the ancestors of the fresh-water crayfishes originated in an arm of the Indo-Pacific which gradually penetrated into polar Gondwanaland in pre-Jurassic times, the same results will follow as those sketched out by Ortmann for post-Jurassic times. The distribution of Peripatus, on the other hand, is apparently best explained on the polar Gondwanaland hypothesis. If the distribution of the species of Peripatus is plotted on a polar projection map, it is remarkable that the Peripatopsidæ, the more specialised group, occupy a central position, while the Peripatidæ, the more primitive, are peripheral. The most important zoological evidence in support of Wegener's theory is provided by the isopod, Phreatoicus. At the present time it is found in Australia, Tasmania, New Zealand, and South Africa. There is the closest possible likeness between some of the Australian species and the Cape form. In Australia there is also a fossil species of Triassic age, which provides almost positive proof that the animal was not only palæogenic, but also austrogenic, and that the regions where it exists to-day were once in the very closest relationship to one another.

Dr. Peringuey, discussing the entomological evidence, concludes that the present distribution of insects is as readily accounted for by the geological theories now obtaining as by Wegener's hypothesis, and believes that the latter will receive little if any support from entomology. He agrees that the key will be found in palæo-entomology, but is forced to admit that the evidence from fossil insects is at present too inadequate to be of value. Discussing the special case of the Coleopteron genus Carabus, first found in Jurassic times, Dr. Peringuey points out that it is unknown in the Old World south of the Sahara, but one species occurs in St. Helena and seven in Chile. He regards the St. Helena and Chilian forms as survivals from an equatorial Gondwanaland, in isolated spots at high altitudes, and not as evidence of the former connexion of South America and St. Helena, in their present form, with South Africa, where the genus is absent, or with Australia, where the genus is unknown but where its vitality should have ensured its success. On the other hand, the nearest ally of Carabus, the genus Calosoma, has three species in South Africa, three in Australia, one in the Galapagos Islands, and one in Patagonia, a distribution which seems to support the unity of the continents alleged by Wegener. In Australia there is a group of large Curculionidæ, one of the families of Coleoptera, which so much resembles a purely South African group of the same family that, at first sight, the two might be taken to represent the same stock in two now widely separated continents. Dr. Peringuey, however, regards this as a case of convergence.

Prof. Compton regards the botanical evidence as completely opposed to Wegener's theory. The perfection of the means of dispersal of plants renders many of the facts as to the modern distribution of ancient groups (Cryptogams) almost valueless as an indication of former land connexions. Recent phyla only, especially the Angiosperms, can be relied on. The Angiosperms arose during Cretaceous times, and most modern families are represented in the Eocene. The Wegener hypothesis contemplates a wide disruption of South Africa and Australia in the Jurassic epoch, but South Africa and South America were only separated by a very narrow strait at the end of the Cretaceous period. Yet the floristic resemblances between temperate South Africa and South America are much less conspicuous than between temperate South Africa and Australia. The floristic relationships between South Africa, South America, and Australia are best explained as being due to lateral migration, perhaps in the warmer Miocene, from a comprehensive tropical belt of vegetation, containing most of the great Angiosperm families, which stretched round the world except the Pacific. The south temperate floras, therefore, are linked through the tropics except for South America and New Zealand, which certainly seem to have been connected by land, via Antarctica, in the Miocene. The modern distribution of the Rutaceæ is an excellent instance of the progress of migration southwards as well as northwards from this tropical belt, and tentative explanations of the distribution of the Proteaceæ and Restionaceæ may be given on the same lines. Dr. Du Toit regards the palæobotanical evidence as too fragmentary for botanists to do more than make guesses at the probable origin of the South African flora.

The net result of this interesting discussion is to emphasise the importance of further work on the palæontology of the southern hemisphere. In that direction alone will be found the key to the correct interpretation of the known facts of the present day distribution of animals and plants, and of the palæogeographical changes which have taken place.

The Position of the Scientific Worker.

AT the annual council meeting of the National Union of Scientific Workers, held at the Caxton Hall, Westminster, on January 13, and at the annual dinner which followed, the main theme of the resolutions which were adopted, of the various speeches made, and of the reports presented, was the methods by which the position of the scientific worker could best be improved. The late Government, it was alleged, had adopted a short-sighted policy with regard to most of those State activities which promised to have the most uplifting and far-reaching effect upon the efficiency and well-being of the nation. It had practised so-called economy by reducing expenditure on education and scientific research, at a time when our chief commercial rivals were increasing their expenditure in that direction.

To the want of appreciation and understanding of the importance of science by the members of the late Government, culminating in drastic reductions in the various research departments, were attributed most of the present troubles of scientific workers. Within the past twelve months "economies" have been effected in those departments of the State and municipal services which do not show an immediate return for the money expended. The inevitable effect will be stagnation in peace, and in war hurried, and therefore uneconomical, research. It is true that the Geddes Committee last year expressed the view that there is little possibility of a further war of any magnitude for the next ten years; but just as their prognostications in that respect appear doubtful at the moment, judged by the trend of current events, so is their corollary to the effect that research in this country can either be slowed down, or, in some instances, abandoned altogether. This is a doctrine of despair, and was characterised as such by members of the council of the Union, and by their guests, Sir Thomas Holland, Mr. William Graham, and Mr. H. N. Brailsford.

Mr. Graham said that there were three aspects of the work of the National Union of Scientific Workers which particularly interested him. The Union must be interested in conditions of employment and remuneration, and he felt that it was a serious mistake, if not a positive crime on the part of the community, to starve the body of investigators upon whose efforts so much depends. The Union would also be alive to the importance of according greater recognition to the work of the universities, and to the contribution that science can make to the restoration of economic prosperity in the world. He thought there was a distinct danger to the universities in the present economy campaign. Before the war the country was making only a limited provision for the universities and other educational institutions. As a member of the Oxford and Cambridge Universities Commission, he had had an opportunity of making a careful examination of university departments and university finance, and he hoped that the Bill to be presented to Parliament next session would result in the present grant being more than trebled. It would not do to rely in the future, as in the past, on philanthropy. Much larger sums of public money would be required, and scientific workers could argue strongly that they did not claim it selfishly, but for the benefit conferred on the nation by their investigations. The methods of science are needed in these days of reconstruction, and if adopted would undoubtedly increase production and help in resisting the lowering of the standard of life, which is a pressing danger in every country. Sir Thomas Holland fully endorsed these views, adding that the Government should understand that at least 80 per cent. of the expenditure of a teaching and research institution must be disbursed as salaries to the staffs. A strong and united body of scientific workers is a necessity if salaries are to be improved and the right atmosphere created. Unfortunately the dignity of the work in most people's eyes is apt to be commensurate with the sums paid for it, so there is every reason why the Union should put the question of remuneration in the forefront.

Dr. Alan A. Griffith, the retiring president, in his address, dealt with this matter from a rather different point of view. He suggested that scientific workers should free themselves from the necessity of having to beg from their beneficiaries the wherewithal to improve the efficiency of their labours, by setting up a business organisation for the exploitation of their discoveries and inventions. In providing specifically for the evolution of great inventions based on pure research, it would fill the gap between science and industry, which has, in the past, so seriously hampered the material utilisation of scientific discoveries.

The Hydrogen-ion Concentration of Sea Water.

A RECENT number of the Journal of the Marine Biological Association (vol. xii., No. 4, October 1922) contains a series of papers by Dr. W. R. G. Atkins which make a contribution of conspicuous value towards our knowledge of the fundamental conditions that control vital production in the sea. After a short review of the literature the author considers what lines of research his study indicates, and then follow six memoirs which deal, in the most interesting way possible, with some of the problems that have suggested themselves.

First in importance is a series of determinations of the H-ion concentration in the open sea between Plymouth and Ushant, and round Land's End into the mouth of the Bristol Channel. In the open sea the "pH" values varied between 8·27 and 8·14; round Land's End the variation was between 8·18 and 8·14, and in Plymouth Sound it was about 8·10. Now "pH" means the logarithm of the reciprocal of H-ion concentration expressed in grams per litre of water. High values (up to about 10) mean high values of the "alkalinity" as represented, for example, by the quantity of N/100 acid necessary to decolorise sea water made pink by the addition of phenolphthalein. Low values (down to about 6) mean "acidity" of the sea water by reason of the presence of unusually large quantities of carbonic acid.

Biological relationships are associated with these variations in the pH-values. Thus, there is a decrease of about 0·05 between high and low water, and this is due to the influence of the water draining away from the shore zones; over a bed of Laminaria the water was more alkaline than in the immediate neighbourhood, and in rock pools pH sank by as much as 0·25: this is the result of photosynthesis by algæ which remove carbonic acid. In the aquarium tanks the pH-values sink to 7·6. When it is less than this, carbon dioxide is in excess, and at 7·3 there is evident distress in the respiration of fishes. At 7·1 the water becomes

foul and smells badly, and at 6·4 we have the conditions produced by seaweeds rotting in a jar of water. From the change in *p*H-values the quantity of carbon removed from solution in the sea in the form of carbon dioxide, and built up, by photosynthesis, into the tissues of marine plants, can be calculated. Represented as a hexose, the author gets the surprisingly great production of 250,000 kilograms produced per square kilometre of sea, in the English Channel between July and December. From similar observations made at Port Erin, Moore found a production of 300,000 kilograms per square kilometre during the six months that included the vernal maximum of diatom reproduction.

The other researches are equally important, especially as they deal with methods. The practice of determining organic matter by oxygen consumed in water samples is criticised. The reaction of the sap in the cells of marine algæ has been studied: it is shown to be almost neutral, in contrast with the acid sap of most land plants. Methods of finding the H-ion concentration in living algal cells are developed, and the influence of changes in *p*H is shown to be a factor in the distribution of shore weeds. Finally—a most useful result—the preparation of permanently acid-free formalin solutions is described. This series of papers by Dr. Atkins has particular interest for marine biologists. J. J.

The Structure of Coke.

SIR GEORGE BEILBY has contributed an interesting paper entitled "The Structure of Coke, its Origin and Development," to the Transactions of the Society of Chemical Industry (November 15, 1922). The paper contains a critical discussion of the changes that have been observed in coal and similar substances during the process of carbonisation, and an account of experimental work carried out on the micro-structure of coke and charcoal.

Use has been made of the new knowledge concerning solids and their internal constitution, for which Sir William Bragg is so largely responsible; and, in another direction, of the technique for cutting and studying sections of coal, introduced by Mr. Lomax. A number of specimens for examination were photographed at their natural size, and with different magnifications and illuminations. It was observed how very much the structure of coke was determined by the size of the bubbles blown in the viscous mass during the semi-liquid stages of carbonisation, and even what have hitherto been commonly regarded as the solid vitreous cell-walls of the pores have been shown to be permeated by minute bubbles. Bound up with this is the control of the bubble formation which can be effected by blending coals of different behaviour, and the practical possibilities forthcoming in this way are discussed at some length. It is shown, for example, that the blending of a coal which swells and froths inordinately with another coal of the non-caking variety may be utilised for securing a strong and firm coke with small and evenly distributed pores.

The relevance of work by Messrs. Sutcliffe and Evans on the briquetting of pulverised coals as a preliminary to carbonisation is indicated. It has been claimed by them that the control of structure could be extended almost indefinitely by the briquetting of finely ground coal by pressure as a preliminary to carbonisation. It was by working along such lines that Sutcliffe and Evans were able to produce a material stated to have at least three times the gas-absorbing capacity of the best wood charcoal, and specially suitable for use in gas masks. Sir George Beilby points out that the combustion of these close-grained "pressure" briquettes proceeds definitely from the outer surfaces inwards, showing that the internal circulation of the oxidising gases is much more restricted than in the case of metallurgical coke — which raises an interesting question.

Seventeen figures are used to elucidate the argument of the text. They are all photo-micrographs of coke produced commercially in gas retorts, coke ovens, etc., or in the laboratory under special and controlled conditions. J. W. C.

University and Educational Intelligence.

ABERDEEN.—The Thomson Lecturer for 1923 at the Aberdeen United Free Church College is Prof. J. Arthur Thomson, LL.D., whose subject is "What is Man? The Nature of Man Scientifically Considered."

EDINBURGH.—Mr. G. G. Chisholm, reader in geography, is to retire at the end of September next, in consequence of which the University Court will shortly proceed to appoint a lecturer who will be responsible for, and in charge of, the teaching of geography in the University. The status of reader may be attached to the office. Applications for the post must reach the Secretary by, at latest, February 28.

THE late Mr. C. T. Milburn, of Newcastle-on-Tyne, bequeathed the sum of 10,000*l*. (in addition to 20,000*l*. given in his lifetime) to Armstrong College, expressing a wish that the legacy should be used for the endowment of a chair for the education of mining engineers or of naval architects, and that his name should be associated with it.

THE annual prize distribution at the Sir John Cass Technical Institute, Aldgate, E.C.3, will be held on Wednesday, January 31, when Sir Thomas Holland, after making the presentations, will deliver an address on "Humanism in Technical Education."

MESSRS. NORTON AND GREGORY, LTD., offer two engineering scholarships to be competed for annually, one of value 100*l*. per annum, and one of value 50*l*. per annum, tenable for three years at any university in the United Kingdom or British Dominions. The honorary committee which will award the scholarships consists of Sir Joseph Petavel (Chairman), Prof. C. E. Inglis (Vice-Chairman), Prof. E. G. Coker, Mr. J. Talbot, Mr. G. H. Burkhardt, and the Chairman and Managing Director of Messrs. Norton and Gregory, Ltd. Candidates must have reached the age of 17 but not the age of 19 on March 1 in the year of examination, be domiciled in the United Kingdom, and undertake to pursue a three years' course in engineering with the view of following it as a profession. Papers, which will cover two days' examination, will be set in English, mathematics, mechanics, and general physics. The main object of the examination will be to prove that candidates have received a good general education on broad lines and not necessarily specialised in engineering. The examination for the 1923 scholarships will be held in March at a date to be fixed later, and all application forms must reach the committee not later than February 15. Official application forms may be obtained from the Secretary, Scholarships Committee, Messrs. Norton and Gregory, Ltd., 1 and 2 Castle Lane, Westminster, London, S.W.1.

Societies and Academies.

LONDON.

The Royal Society, January 18.—Sir Charles Sherrington, president, in the chair.—J. **Barcroft**: Observations on the effect of high altitude on the physiological processes of the human body. Three principal factors appear to have a positive influence in acclimatisation. (*a*) The increase in total ventilation, which usually raises the alveolar oxygen pressure ten or twelve millimetres higher than it would otherwise be; (*b*) The rise in the oxygen dissociation curve so that at any oxygen pressure the hæmoglobin will take up more oxygen than before; (*c*) The rise in the number of red corpuscles, and correspondingly in the quantity of hæmoglobin. These factors are not independent variables. Blood has been found to give, at the alveolar carbon dioxide pressure of the Andes (about 27 mm. carbon dioxide): (1) A reaction which is apparently almost unchanged, or even more acid, as measured by the ratio of combined to free carbon dioxide; (2) A more alkaline reaction by the platinum electrode; (3) An oxygen dissociation curve which rises apparently out of proportion to the change in reaction. On making the ascent, there was a marked increase in the number of reticulated red cells; after the descent these cells fell to below their normal percentage. In the natives the ratio of reticulated to unreticulated red cells was not greatly increased, but the absolute number of reticulated cells per cubic millimetre was about 50 per cent. greater than normal. We argue a hypertrophy in the bone marrow. There were no nucleated red cells. The increase in red blood corpuscles is such as to cause an absolute increase in the amount of oxygen in each cubic centimetre of blood in the majority of cases, in spite of the decrease in saturation. A number of mental tests of the ordinary type were performed at Cerro and at sea-level. These revealed no particular mental disability. The pressure of oxygen in the blood was so nearly the same as that in the alveolar air that we attribute the passage of gas through the pulmonary epithelium to diffusion.—E. W. **MacBride**: Remarks on the inheritance of acquired characters. During the last fifteen or twenty years a series of experiments have been carried out by Dr. Paul Kammerer at Vienna, which tend to show that acquired qualities, or, in other words, modifications of structure induced by modified habits, are inheritable. One of the most interesting of his experiments was to induce Alytes, a toad which normally breeds on land, to breed in water. As a result, after two generations, the male Alytes developed a horny pad on the hand, to enable him to grasp his slippery partner. Mr. J. Quastel, of Trinity College, Cambridge, when in Vienna, saw and photographed one of these modified males; the animal has also been seen by Mr. E. Boulenger.—C. F. **Cooper**: *Baluchitherium osborni* (? syn. *Indricotherium turgaicum*, Borrissyak). *Baluchitherium osborni* is an aberrant rhinoceros, apparently the largest known land mammal. The remains were first found in Baluchistan. Further fragments have been found in Turkestan, and, recently, in China. While resembling the rhinoceroses more than any other of the Perissodactyla, Baluchitherium is still isolated and of uncertain zoological position. Adaptations to weight have brought about a superficial resemblance to the limb bones of elephants. Some of the foot bones and neck vertebræ resemble those of the horse; due possibly to descent from a small eocene form, Triplopus, which likewise shows an intermingling of horse and rhinoceros characters. In some structures, notably the excavations of the vertebral canal to ensure a combination of lightness and strength, Baluchitherium stands alone among mammals.—J. A. **Gunn** and K. J. **Franklin**: The sympathetic innervation of the vagina.—H. G. **Cannon**: On the metabolic gradient of the frog's egg.—Basiswar **Sen**: On the relation between permeability variation and plant movements.—H. L. **Duke**: An inquiry into an outbreak of human trypanosomiasis in a *Glossina morsitans* belt to the East of Mwanza, Tanganyika Territory.—Louis **Dollo**: Le Centenaire des Iguanodons (1822–1922).

Geological Society, December 20.—Prof. A. C. Seward, president, in the chair.—W. A. **Richardson**: A micrometric study of the St. Austell granite (Cornwall). The problem of the effect of sampling a coarse-grained rock by means of slices is considered in detail. Qualitative and quantitative study of the minerals reveals three types of rock: (*a*) a biotite-muscovite-granite of coarse grain confined to the east: (*b*) a lithionite-granite occupying by far the greater part of the outcrop; and (*c*) a gilbertite-granite confined to a small area near St. Stephen's Beacon, and furnishing the "china-stone" rock. A high negative correlation is found between quartz and orthoclase—true for this area, but not for granites in general. When mapped, the minerals fall into groups that are distinctly connected with the areas occupied by the different types, and in each of which there is an outer zone rich in quartz surrounding an inner region with a high content of orthoclase. The magma probably invaded the area progressively from the east to the west; it had always partly crystallised before injection into the present level.—W. G. St. J. **Shannon**: The petrography and correlation of the igneous rocks of the Torquay promontory. Two stages of vulcanicity occurred—in the Middle and in the Upper Devonian, as shown by basic tuffs and a spilite. The intrusions form an alkaline suite. An augite-lamprophyre in limestone, and a soda-porphyrite in Middle Devonian slates are described from Babbacombe. A preliminary account of the tectonics is attempted, particularly of the inversion, at Ilsham, of the faulting and of the north-to-south strike of some of the folds.

Aristotelian Society, January 8.—Prof. T. P. Nunn in the chair.—W. Adams **Brown**: The problem of classification in religion. The differences in existing religions may be explained in three different ways. They may be regarded, as variations from a single standard type; as moments in the development of one all-embracing religion; or as recurrent parallel contrasted types. If the last view be taken, the principle of classification may be found in the variations of the individual personal experience, or in differences in man's social attitude. Most recent study of religious types has followed the first of these methods. This method, helpful so far as it goes, can be usefully supplemented by an analysis of man's social relationships. The new classification is based upon the attitude of religious people to social institutions. There are three possible attitudes which one may take towards the existing social order. One may accept it as it is without question and yield its institutions willing and loyal allegiance. One may protest against it as corrupt or negligible and find in one's own inner life a sufficient refuge and compensation. One may believe that society is itself in process of being transformed into new and better forms and that each man and woman may have part in that remaking. These three attitudes have their counterpart in religion. One man believes that he communes with God most

perfectly through allegiance to some existing organisation the triumph of which in the world he identifies with the victory of God's will. Another believes that he communes with God most deeply when he withdraws his attention from all that is finite and transitory, and concentrates it upon the attempt to realise the immediate presence of God. A third is persuaded that he communes with God most truly as he joins his fellows in remaking the institutions of society (including the church itself) according to a constantly clearer apprehension of the will of God, as that will is being progressively revealed to all who seek it in humility and faith. These three types may be designated imperialism, individualism, and democracy. Each has given rise to institutions appropriate to its genius.

Mineralogical Society, January 9.—Dr. A. E. H. Tutton, past-president, in the chair.—A. **Brammall** and H. F. **Harwood**: Dartmoor occurrences of (1) rutile, brookite, and anatase; (2) zircon. (1) Anatase, with less abundant brookite and scanty rutile, is common in Dartmoor stream-sands, etc. Anatase and brookite, absent from the unaltered grey granite, have been found in pneumatolysed rocks, especially "red" granites, and the mode of genesis of these two minerals is discussed. Data provided by chemical work on "baueritised" Dartmoor biotite (containing about 1·8 per cent. TiO_2) and by the occurrence of anatase granules encrusting detrital grains of ilmenite are examined in their bearing on the possibility that some anatase may have developed (or existing crystals may have continued to grow) in detrital material after sedimentation. (2) Two strongly contrasted kinds of zircon crystals are described: differences in crystal habit, nature of inclusions, and mode of occurrence in the granite suggest that the dominant kind, which is tawny, zoned, and rich in inclusions, crystallised out from the magma early, and that the subordinate kind, water-clear, and containing few inclusions, separated out at a much later stage.—Dr. L. J. **Spencer**, with chemical analyses by E. D. **Mountain** and microscopical determinations of the pseudomorphs by W. Campbell **Smith**: A davyne-like mineral and its pseudomorphs from St. John's Island, Egypt. Two small crystals found with peridot, garnierite, etc., showed the physical characters of davyne, but consist of a complex silicate (with sulphate and carbonate) of aluminium, calcium, magnesium, and sodium, together with a considerable amount of water. Pseudomorphs after this material are more abundant; they consist of a complex of hydrated silicates of aluminium and magnesium together with small amounts of corundum and spinel.

Royal Meteorological Society, January 17.—Dr. C. Chree, president, in the chair.—C. **Chree**: Aurora and allied phenomena. Brilliant aurora in England seems always to be accompanied by a magnetic storm, and any outstanding magnetic disturbance is accompanied by aurora. Thus presumably they have a common cause, now generally believed to be electrical currents in the upper atmosphere, originated by a discharge of some kind from the sun. Our knowledge of the height of aurora is mainly due to Norwegian men of science. Prof. Carl Störmer discovered how to photograph aurora, and by taking simultaneous photographs from the ends of a long base, and measuring the apparent parallax, he is able to calculate the height. For the lower level of aurora he finds heights in the neighbourhood of 100 kilometres. The height of the highest visible appearance varies greatly. Heights exceeding 300 kilometres are not very uncommon, and some measurements have exceeded 600 kilometres. Travelling northwards from the south of England, aurora and magnetic disturbances both increase, the former at least very rapidly. The auroral frequency in Shetland is said to be 10 to 20 times that in the extreme south of England. There is thus within the British Isles a great variety in the frequency or intensity of aurora, and it is also believed in the intensity of magnetic disturbance. An observatory provided with magnetographs has recently been established in Shetland, and if adequate means are forthcoming for the intensive study of auroral and magnetic phenomena, substantial contributions to knowledge may reasonably be expected.

PARIS.

Academy of Sciences, January 3.—M. Albin Haller in the chair.—The president announced the death of Gaston Bonnier, member of the section of botany.—R. **de Forcrand**: The alcoholates of thallium. Thallium differs from sodium and potassium in that it does not displace hydrogen directly from the alcohols. Alcohol vapour acts upon thallium in the presence of oxygen, giving the compound C_2H_5 . OTl as a dense oily liquid (density 3·55). This liquid added to an excess of anhydrous methyl alcohol gives thallium methylate, CH_3 . OTl, as a solid. With the same thallium ethylate as the starting point, corresponding compounds have been prepared from glycol, glycerol, and phenol.—Paul **Vuillemin**: The classification of the monocotyledons.—Bertrand **Gambier**: The curves of Bertrand.—Stanislas **Millot**: Probability *a posteriori*.—J. **Haag**: The study of certain problems in kinetic theory, with the hypothesis that the intermolecular force is some function of the distance.—Margaret G. **Tomkinson**: The catalytic hydrogenation of sulphur dioxide. A mixture of dry hydrogen and sulphur dioxide in the presence of reduced nickel at about 400° C. gives water, sulphuretted hydrogen, and sulphur. The nickel is wholly converted into nickel sulphide, but in spite of this, the catalytic reduction can be carried on indefinitely.—A. **Mailhe**: The catalytic decomposition of castor oil. The oil was decomposed by passing over alumina and metallic copper at 550° to 570° C. The gaseous products contained 36 per cent. of unsaturated hydrocarbons: from the liquid portion oenanthylic aldehyde, hexane, and heptane were isolated. At temperatures above 600° C. aromatic hydrocarbons were also identified.—Mme. A. **Hee**: Study of the Algerian earthquake of August 25, 1922, from the microseismic observations. A discussion of the seismographs from eight observatories. The epicentre was deduced from these to be near Cavaignac, and this is in agreement with the macroseismic observations.—Emmanuel **de Martonne**: The Pliocene delta of the Var and the erosion levels of the valleys opening into it.

SYDNEY.

Linnean Society of New South Wales, November 29.—Mr. G. A. Waterhouse, president, in the chair.—J. **Mitchell**: Descriptions of two new trilobites and note on *Griffithides convexicaudatus* Mitch. A species of Cordania is described from Australia for the first time. A new species of Ptychoparia forms an addition to the fossil fauna of North-west Queensland. *Griffithides convexicaudatus* Mitchell is transferred to the genus Phillipsia.—Marguerite **Henry**: A monograph of the freshwater Entomostraca of New South Wales. Pt. ii. Copepoda. Twenty-three species of copepods, one of which is recorded for the first time in Australia, four for the first time in New South Wales and three which are new, are described. Two

of these species belong to the division Harpacticoida.—C. P. **Alexander**: New or little known species of Australian Tipulidæ (Diptera), Pt. i. An account of twenty-three specimens from a number of Australian collections.—H. S. Halcro **Wardlaw**: The effect of suspended respiration on the composition of alveolar air. Inspirations were held in the lungs until the composition of the alveolar air ceased to alter. Circulatory disturbances were minimised by holding an inspiration for a number of consecutive short periods instead of for one long period. Similar final values were reached whether the initial inspiration consisted of air alone or of air mixed with a percentage of carbon dioxide higher than the normal alveolar percentage. Similar final values were reached also whether the inspiration was held under normal or under negative intrathoracic pressure; this was not the case when circulatory disturbances were allowed to exert their effect.—A. M. **Lea**: On Australian Anthicidæ (Coleoptera). Notes on synonymy, variation, and distribution are given, and 53 species are described as new.—J. **McLuckie**: A contribution to the parasitism of *Notothixos incanus* (Oliv.) var. *subaureus*. The structure of the fruit, the mechanism of seed-dispersal, the structure of the haustorium and its relation to the host-tissues, are described.—T. Thomson **Flynn**: The phylogenetic significance of the marsupial allantoplacenta. In a typical mammal, the placental cycle is divisible into three stages,—metrioplacental, omphaloplacental, and allantoplacental. The last stage is absent in all marsupials except Perameles. Examination of the allantoplacenta of Perameles shows its definite relation to that of Monodelphia. It is considered that the ancestors of marsupials were, therefore, placental.

Official Publications Received.

The Institution of Civil Engineers. Engineering Abstracts prepared from the Current Periodical Literature of Engineering and Applied Science, published outside the United Kingdom. New Series, No. 14, January. Edited by W. F. Spear. Pp. 186. (London: Gt. George Street.)

Agricultural Research Institute, Pusa. Bulletin No. 136: The Hydrogen Ion Concentrations of some Indian Soils and Plant Juices. By Dr. W. R. G. Atkins. Pp. ii+12. Bulletin No. 137: Note on the Probability of an Inter-relation between the Length of the Stigma and that of the Fibre in some forms of the genus Gossypium. By Ram Prasad. Pp. ii+7+2 plates. (Calcutta: Government Publications Office.) 4 annas each.

Schriften der Naturforschenden Gesellschaft in Danzig. Neue Folge. Fünfzehnten Bandes Drittes und Viertes Heft. Teil 2: Jahresbericht für 1921. Pp. ii+55. Teil 3: Wissenschaftliche Abhandlungen. Pp. viii+112. (Danzig).

44 Bericht des Westpreussischen Botanisch-Zoologischen Vereins. Pp. iv+30. (Danzig).

Geological Literature added to the Geological Society's Library during the Year ended December 31st, 1914. Compiled by Arthur Greig. Pp. iv+193. (London: Geological Society.) 5*s*.; 3*s*. 9*d*. to F.G.S.

Hampstead Scientific Society. Report of the Council and Proceedings, with a List of the Members, for the Period October 1920 to September 1922; with Reports of General Meetings, 1919-1920. Pp. 63. (London: Stanfield House, Prince Arthur Road.)

Diary of Societies.

SATURDAY, JANUARY 27.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Walford Davies: Speech Rhythm in Vocal Music (2).

MONDAY, JANUARY 29.

BRITISH PSYCHOLOGICAL SOCIETY (Æsthetics Section) (at Bedford College for Women), at 4.30.—L. Abercrombie: Communication *versus* Expression.

INSTITUTE OF ACTUARIES, at 5.—W. Palin Elderton: Notes on the Treatment of Extra Risk.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. R. L. Knaggs: Osteitis Fibrosa.

ROYAL SANITARY INSTITUTE, at 5.30.—Dr. L. C. Parkes: Introductory Lecture to Students in the various Courses.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Prof. W. A. Brown: The Problem of Classification in Religion.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—Capt. J. E. T. Phillips: Kigezi and the Birunga Range, Uganda.

TUESDAY, JANUARY 30.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—R. D. Oldham: The Character and Cause of Earthquakes (1).

INSTITUTE OF MARINE ENGINEERS, INC., at 6.30.—A. Keens: Some Deductions from Indicator Diagrams.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—T. Bell: On the Thames with a Camera.

WEDNESDAY, JANUARY 31.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. M. Woodman: Malignant Disease of the Upper Jaw, with special reference to Operative Technique.

INSTITUTION OF MECHANICAL ENGINEERS (Students' Meeting), at 6.—T. R. Wilton: Foundations in Dock and Harbour Works (Vernon-Harcourt Lectures) (2).

ROYAL SOCIETY OF ARTS, at 8.—T. H. Fairbrother and Dr. A. Renshaw: The Relation between Chemical and Antiseptic Action in the Coal Tar Dyes.

ROYAL SOCIETY OF MEDICINE (Social Evening), at 9.—Prof. W. Wright: Leonardo da Vinci.

THURSDAY, FEBRUARY 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. I. M. Heilbron: The Photosynthesis of Plant Products (1).

ROYAL SOCIETY, at 4.30.—Prof. O. W. Richardson: The Magnitude of the Gyromagnetic Ratio.—Sir Richard Paget: The Production of Artificial Vowel Sounds.—F. Simeon: The Carbon Arc Spectrum in the Extreme Ultra-violet.—Prof. J. Joly: Pleochroic Haloes of various Geological Ages.—Prof. H. A. Wilson: The Motion of Electrons in Gases.—Dr. H. Hartridge: The Coincidence Method for the Wave-length Measurement of Absorption Bands.—A. Berry and Lorna M. Swain: The Steady Motion of a Cylinder through Infinite Viscous Fluid.—W. Jevons: The Line Spectrum of Chlorine in the Ultra-violet (Region λ 3354-2070 A).—M. H. Evans and H. J. George: Note on the Adsorption of Gases by Solids and the Thickness of the Adsorbed Layer.

LINNEAN SOCIETY OF LONDON, at 5.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—G. S. Baker: Ten Years' Testing of Model Seaplanes.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—P. J. Robinson: The Maintenance of Voltage on a D.C. Distribution System by means of a fully Automatic Substation.

CHEMICAL SOCIETY, at 8.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8. Dr. W. R. White-Cooper and H. K. Griffith: (1) A Case of Inversion of the Uterus occurring in the Third Week of the Puerperium; (2) A Case of Obstructed Labour due to Contraction Ring.—B. Whitehouse and Dr. H. Featherstone: Note on the Use of Spinal Anæsthesia with Tropococaine in cases of Cæsarian Section.—Dr. S. Cameron: Cæsarian Section.

CAMERA CLUB, at 8.15.—J. E. Saunders: Off the Beaten Track at the Zoo.

FRIDAY, FEBRUARY 2.

ROYAL SOCIETY OF MEDICINE, (Laryngology Section), at 4.45.—Dr. I. Moore: Operative Procedures in the Treatment of Bilateral Paralysis of the Abductor Muscles of the Larynx, with Special Reference to a New Method by means of which, it is suggested, the Air-way may be Re-opened and the Patient Decannulated.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. C. A. Joll: The Metatastic Tumours of Bone.

ROYAL ASTRONOMICAL SOCIETY (Geophysical Discussion), at 5.—Col. E. M. Jack: The Projection for the International Aeronautical Map. Other speakers, Capt. G. T. McCaw, Col. Sir C. F. Close, Col. J. L. Winterbotham, and probably A. R. Hinks. Chairman, Sir G. P. Lenox-Conyngham.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—A. E. L. Chorlton: The Use of Light Alloys in place of Iron and Steel.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—P. J. Waldram: Ventilation and Lighting of Factories.

ROYAL SOCIETY OF MEDICINE (Epidemiology and State Medicine Section), at 8.—Dr. R. J. Reece: Progress and Problems in Epidemiology (Presidential Address).

ROYAL SOCIETY OF MEDICINE (Anæsthetics Section), at 8.30—Dr. J. S. Goodall: Some Cardiovascular Conditions in relation to Anæsthesia.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—C. F. Cross: Fact and Phantasy in Industrial Science.

PUBLIC LECTURES.

SATURDAY, JANUARY 27.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Capt. W. H. Date: Wireless Telephony and Broadcasting.

TUESDAY, JANUARY 30.

GRESHAM COLLEGE, at 6.—A. R. Hinks: Astronomy. (Succeeding Lectures on January 31, February 1 and 2).

WEDNESDAY, JANUARY 31.

KING'S COLLEGE, at 5.30.—Sir Frank Dyson: The Measurement of Stellar Distances.

THURSDAY, FEBRUARY 1.

FINSBURY TECHNICAL COLLEGE (Leonard Street), at 7.30.—Sir Oliver Lodge: The Basis of Wireless Communication (Silvanus Thompson Memorial Lecture).

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—G. T. Forrest: London's Unhealthy Areas (Chadwick Lectures (1)). (Succeeding Lecture on February 8).

SATURDAY, FEBRUARY 3.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—F. Balfour-Browne: Insect Pests and their Control.