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CONTENTS.

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Co-operative Research.

AT the first meeting of the British Association, held in 1831, the Rev. W. Vernon Harcourt proposed that the Association should "employ a short period of every year in pointing out the lines of direction in which the researches of science should move; in indicating the particulars which most immediately demand attention; in stating problems to be solved and data to be fixed; in assigning to every class of mind a definite task; and suggesting to its members that here is a shore of which the soundings should be more accurately taken, and there a line of coast along which a voyage of discovery should be made." This early suggestion adumbrating the organisation of scientific research met, apparently, with no response, and academic research continued to be conducted entirely on individualistic lines until a few years ago, when a Government department undertook the organisation of certain investigations which were realised to be of fundamental and national importance. In applied science the picture is a different one. Whereas the field for academic research is so vast and so ever-widening that the fear of duplication or mutual interference seldom arises, the problems of applied science, though very numerous, are more restricted in range, and therefore more amenable to organisation. For a long time past, organised research has been carried out by a few large manufacturing firms, but it was not until the British nation recognised, early in the War, that its existence depended upon certain industries which were based upon science, that steps were taken by Government to organise industrial scientific research.

If our ancestors, who were reared on the doctrines of *laissez-faire* and self-help, could see us to-day, they would marvel at the developments which have sprung Minerva-like from the bitter experiences of the War. As Sir Thomas Holland recently reminded us in his excellent address to the Royal Society of Arts on "The Organisation of Scientific Research throughout the Empire," the seeds of State-aided organisation of science were sown well back in the nineteenth century, but the credit for having transformed "an amorphous mob of scientific workers" into something resembling "an organised army" belongs to the Department of Scientific and Industrial Research. This Department, acting under a committee of the Privy Council, has never looked back since it was established in 1915, and the annual record of its activities has become a document equally important and interesting to the man of science and to the student of public affairs.

The latest report, covering the year 1924–25, of

which a summary is given elsewhere in this issue, deals with a large variety of topics, which are far too numerous to discuss in a single article, and it is therefore proposed to confine attention mainly to a matter which is becoming more and more important: the position of the research associations. These associations, it will be recalled, were founded with the direct object of assisting the industries of the country; a sum of 1,000,000*l.* (called the Million Fund) was allocated for this purpose, and disbursements from it were planned on the excellent principle that the State should help only those industries which can help themselves. Grants were to be made on the basis of 1*l.* for every pound subscribed by the industry concerned, and they were to be continued for a maximum period of five years, after which, it was anticipated, the associations would be self-supporting.

Experience has shown not only that this basic idea was thoroughly sound, but also that it has been admirably applied by the Department. The only rift in the lute is the general conviction that the limitation of State aid to a period of five years was a miscalculation. To what extent this error is admitted by the authorities, we do not know, but the fact that grants to many of the associations have been extended on a reduced scale (block grants of diminishing amount) seems to show that they share the general conviction. There is no doubt that the five-year period is inadequate. Devising a programme of research and planning its details, collecting an efficient staff, providing laboratory and other accommodation, are all slow processes; but the time required for these purposes is in most cases almost insignificant compared with that required to convince the manufacturer of the value of scientific research both to him and to the nation. It must, however, in fairness be stated that many manufacturers came in promptly. The success achieved in this direction can only be surmised, and it is to be hoped that the Department will publish figures showing not only the percentage of firms in each industry that have joined its association, but also the percentage of capital invested in the industry that is represented in the association.

Of the twenty-one research associations now in active operation, those connected with scientific instruments and photography have probably obtained the greatest measure of numerical support from the manufacturers concerned, and these are followed by the associations attached to the cotton and woollen industries; but the comparative non-success of other associations in no way reflects upon their management or upon the Department. Conditions vary very widely in the different industries, and some associations have encountered more opposition or reluctance than others from firms the refusal of which to co-operate has been matched only by abiding faith in empiricism and trade secrets. No one can envy directors of research who meet with opposition of this kind, and the fault lies with the supineness of the nation to science in general rather than with individuals.

The Department, we understand, has been very successful in directing the choice of directors of research, upon whom so much depends, and in allowing them a free hand. The director has not only to organise and direct research, to conduct the business affairs of his association, but also everywhere to be in contact with the human factor, in the handling of his own staff, and in maintaining amicable relations with the personnel of his constituent firms: it is all-important that he should be on the best terms with the scientific heads of these firms, for this is a vital link in the chain of efficiency. His task is also influenced by the composition of his subscribing firms: an association of which the membership consists of one or two powerful corporations and a few small firms is much more difficult to direct than one of which the constituents are homogeneous, and the difficulties may be said to vary directly with the disproportion between the percentage of invested capital represented in the association and the percentage of firms in the industry that have joined it.

As we have said above, experience has shown that a research association cannot become self-supporting in five years; in view of this fact, of the comparatively small cost incurred (about 100,000*l.* per annum), and of the success already achieved, it is unthinkable that Government will cease to give adequate support after the exhaustion of the Million Fund. At the present and prospective rates of expenditure, the balance that remains (518,200*l.*) will not last for more than a few years. The interest on the unexpended balance has recently been spent on other projects—a possible point of criticism—but it has now been decided to carry forward for future expenditure the sums accruing under this head, although the precise way in which they are to be spent is not specified. Sir Thomas Holland (*Journal of the Royal Society of Arts*, Nov. 20, 1925) has done good service in showing how small, in comparison with the values of the trades concerned, are the sums required to continue the work of the associations; thus, the annual cost of research on cotton, wool, and rubber would be covered by adding ¼*d.*, 1*d.*, and ½*d.* respectively to each *l.*'s worth of imported raw material. Given adequate support on existing lines, there is every prospect that the research associations will establish themselves as indispensable adjuncts of the industries with which they are connected.

Of the more distant future, one can speak with less assurance and with less optimism. For years past there has been a marked tendency for industrial firms to amalgamate, or to pool their resources and interests in other ways, the latest development in this direction being the unification of all the large German chemical companies into a huge corporation with a capital of about 32,000,000*l*. To what extent such aggregations are desirable from the points of view of the home consumer and the nation is a matter of opinion, but there is no doubt that large corporations can, and do, dispense with extraneous aid in carrying out all the research work they require, whether it be fundamental or incidental.

An interesting feature of the annual reports of the Department are the occasional references to matters of wider import than those which come strictly within its purview. In the present report it is stated that "the embarrassments and losses that the staple industries of the country are suffering are, in our belief, not primarily due to the neglect of science." Approval or disapproval of this statement will depend upon the connotations of the words "science" and "primarily." Most of our recent troubles, including unprecedented taxation, can be traced directly to the War, the occurrence and persistence of which were strongly favoured by lack of scientific foresight and scientific knowledge (*e.g.* of the basic materials glycerin, cotton, etc.), and not least by the impotence of science, and other purely intellectual disciplines, to restrain or sublime those primitive instincts of pugnacity and accretion which are "primarily" responsible for war.

There will be less diversity of opinion concerning the truth of the Prime Minister's statement (quoted in the report) that our trade will never be able to cope with unexpected emergencies, at home or abroad, until scientific method and scientific men occupy a better position in industrial affairs. Why the position of the scientific man is inferior to that of the financier and administrator, to what extent he himself is responsible, and how far it is due to the inherent and uncorrected perversity of others, are questions outside our present scope, but they all seem to centre around the larger problem of how to bring home to the people a sense of the actual and potential value of science in the maintenance and perfection of human life. Much of that value lies in research; and just as Malebranche declared that if he held truth captive in his hand, he would let it escape, so that he might pursue and capture it again, so we may say that if we held world supremacy in science and industry, we would let it go, so that we might be forced to use research in the struggle to regain it.

The Question of Race and Hormones.

Process of Physical Growth among the Chinese. By S. M. Shirokogoroff. Vol. 1: The Chinese of Chekiang and Kiangsu, measured by Dr. V. Appleton. Pp. vi+137. (Shanghai: The Commercial Press, Ltd., 1925.) 6 dollars.

THIS well-printed volume, dealing with a comparison of the process of bodily growth in two groups of Chinese, is one of a series of valuable studies of eastern Asiatic peoples undertaken by the anthropologist of the Museum of the Russian Academy of Sciences. Before he left Russia in 1917, Mr. Shirokogoroff was investigating the non-Chinese population of northern Asia: but when the circumstances of the times created obstacles that made it impossible for him to measure the children of Tungus, Manchu and Mongolian peoples, he transferred his attention to China. Dr. V. Appleton not only placed at his disposal her observations and measurements of 900 children made in the mission schools of Ningpo and Hangchow in Chekiang province, and at Shanghai in Kiangsu province, but also provided technical assistance for making the laborious statistical calculations. Dr. Appleton examined and measured the children of both sexes, and girls up to twenty years of age. Mr. Shirokogoroff made the measurements of adult men, for the interpretation of the process of whose growth he used the figures relating to the boys in his colleague's series.

The bulk of the volume is a collection of data rather than an argument that a reviewer can summarise. The author claims that the process of growth in the Chinese differs from that of other "ethnical groups"—he objects to the use of the word "race" and protests against the phrase "Mongol race" as "a baseless hypothesis." According to him, the Chinese differ from all other ethnical groups in the very pronounced and abrupt retardation of growth at the age of fifteen to sixteen years, and an equally distinctive acceleration four years earlier. His arguments are backed up by many tables of measurements and comparisons with data relating to other peoples, and statistical studies of the figures.

As Mr. Shirokogoroff explains in his introduction, the problem of interpreting the nature of physical growth is the real aim of his treatise; and he sets out to solve it by claiming that the "process is regulated, on one hand, by the interaction of the glands of internal secretion and metabolism which depend on heredity, and on the other hand, by the conditions of environment." He has made no observations of the endocrine glands. The argument is: the Chinese differ from other peoples in certain physical characters and mental aptitudes; therefore their ductless glands must be functioning in a different way from those of other people; hence

the physical characters and mental aptitudes of the Chinese have distinctive qualities! It is enough for him to accept without question Sir Arthur Keith's gay theories (NATURE, November 13, 1919; and *Johns Hopkins Hospital Bulletin*, 1922, pp. 155 and 195) as though they had been proved by observation or experiment, instead of being mere suggestions, which have never been seriously investigated or substantiated.

Mr. Shirokogoroff devotes a whole chapter to the "endocrine differences of the Chinese," which he sums up in the statement that "the endocrine complexes define not only the process of physical growth, but the psychic behaviour of ethnical units, so that the peculiarities of Chinese psychology and behaviour may be explained as the result of their glandular complexes." But when he becomes more explicit the fanciful nature of his argument is more clearly revealed. The longer legs of the Chinese infant, which the comparison of his measurements with those of other races indicates, are claimed to be due to the fact that "the pituitary gland is not inhibited by the thymus or pineal or sexual glands so intensively as among other ethnical groups. Among the Chinese of Chekiang it seems to be more active during the early period than among the Chinese of Kiangsu. Among both Chekiang and Kiangsu males this period is preceded by retardation (vide supra), which, we suppose, may be due to the inhibiting character of the sexual glands." In this strain of uncontrolled speculation Mr. Shirokogoroff devotes three pages to the process of building up a wonderful house of cards!

These statements are made without citing any evidence in support of them, or any data to suggest that there is any recognisable difference in the endocrine organs or their functional activities of the Chinese people. The only justification he offers for this vast claim is the reference to Sir Arthur Keith's views (which are also unsubstantiated by any control of experiment or observation) and Prof. Shellshear's observation that the thymus often persists throughout life in the Chinese. It is not uncommon to find an apparent persistence of the thymus in European adults; but as a rule histological examination reveals the fact that in such cases the distinctively thymic tissue has disappeared. Hence, until it has been checked, Shellshear's claim—the only anatomical fact so far adduced in support of the endocrine hypothesis—cannot be accepted as conclusive evidence.

In recent years the endocrine glands have been so widely exploited in applied medicine and in biological speculation, that one views with increasing suspicion the appeal to hormones to solve any difficulties for which no adequate explanation can be found. In such circumstances, Sir Michael Foster's maxim that a hypothesis not tested by observation or experiment is of no value in science should be applied with the utmost stringency. As my colleague, Prof. T. R. Elliott, said some years ago with reference to this very subject of the interrelationships of endocrine organs: "Medicine owes no debt of gratitude to those who teach to her theories without proof." Probably in all processes of growth and development hormones are exerting a regulating influence; but crude analogies between the effects of disease on the thyroid, pituitary, or suprarenal organs and the differentiation of races will not promote but hinder the progress of science, unless the serious attempt is made to collect evidence in proof (or disproof) of the claims made for such specific endocrine influence.

Perhaps the only coherent argument in support of such an evolutionary factor was made by Prof. Bolk, of Amsterdam, when he attempted to interpret (*Lancet*, 1921, vol. 2, p. 588) the derivation of the distinctively human traits from those of an ape by the restraining influence of the hormones, in virtue of which man retained the characters of the simian infant into adult life. His argument was pursued with such logical intentness that he seemed not to be abashed at the paradoxical conclusion. For, according to Prof. Bolk, the human brain, man's distinctive attribute, was acquired not by the active growth of a progressively developing organ, but simply by the inertia of a tissue that retained the relative proportions it had in the fœtal ape!

In all these speculations, fascinating by the very fact that they are so obviously fantastic, it seems to have been overlooked that while endocrine activity may influence the structure and metabolism of an individual and control his desires and behaviour, there is, as yet, not a scrap of evidence to prove that it plays the part of the determining factor in evolution which Mr. Shirokogoroff so confidently assumes.

The value of his volume depends wholly upon the new data he and his collaborator have so laboriously collected. Those whom he thanks in his preface for help in his "struggle with English" have not earned the gratitude he so generously bestows.

G. ELLIOT SMITH.

Sound Signalling.

The Principles of Sound Signalling. By Morris D. Hart and W. Whately Smith. Pp. v+139. (London: Constable and Co., Ltd., 1925.) 12*s.* 6*d.* net.

THE problem of sound signalling over considerable distances has a most important application to the question of safety of ships at sea in thick and foggy weather. This application, in the case of a maritime country like Great Britain, is probably more important than any other application of sound signalling.

From the time when Tyndall made his celebrated experiments on the transmission of sound signals through the atmosphere, much attention has been paid to the subject, but more particularly during the last ten or twenty years. Tyndall found, and it is now common knowledge, that the radius at which a sound may be heard is largely dependent on the state of the atmosphere. Apart from the effects of wind, large areas of silence have been observed in different directions and at different distances (sometimes small) from a source of sound. The loudness of the received sound, therefore, is no criterion of the distance from the source. The direction of the sound as perceived is not necessarily that of the actual source.

In view of these facts, both of serious import to ships in fog, a new system of sound signalling has originated in which the medium of transmission is no longer the fickle atmosphere but the much more homogeneous medium—the sea. Sound signals will travel great distances in the sea with little attenuation (when compared with that in the atmosphere) and with no observable change of direction. In the sea, areas of silence are unknown, and accuracy of directional reception is very great, within one or two degrees.

Both systems of sound signalling are in regular use around the coasts of Great Britain as well as those of other European countries, Canada, and North and South America. In addition to these systems of signalling, radio-direction finding is now rapidly increasing in its use and may ultimately supersede the older acoustic methods. A combination of radio-acoustic signalling, which gives a ship its exact position at sea, has also been tried with success by the Admiralty and by Trinity House.

The volume under consideration, although assuming the comprehensive title "The Principles of Sound Signalling," deals only with the case of atmospheric transmission of sound. The principles discussed are, therefore, applicable only to sounds in air, and are in general quite unsuited to the problem of sound signalling in water. These important points might, with advantage, have been indicated in the title or the preface of the book.

The first chapter deals with the question of "efficiency" in acoustics. Here the authors are somewhat pedantic regarding the popular use of the word. They appear to overlook the fact that the popular meaning is correct; it was in daily use *before* the engineer and physicist employed the word in its narrower sense, namely, "the ratio of power-output to power-input."

The processes of production, transmission, and reception of sound are each analysed and the efficiency of each subdivision, more than ten in all, is indicated by a special symbol. Although the authors may have found it convenient to employ these numerous efficiency symbols, the reader may find them somewhat bewildering. Regarding the principles and methods of reception of sound, dealt with in the second chapter, very scanty consideration is given to the better known forms of receiver. The authors apparently consider that all forms of receiver other than the unaided ear and the Tucker hot-wire microphone are of no importance. It is made quite clear that the hot-wire microphone in conjunction with a suitable Helmholtz resonator is particularly suitable for low frequency sounds, but no alternative is given for reception at higher frequencies. A statement is made later, on p. 121, that most sound-signalling apparatus is intended to work in conjunction with the ear, but no apparatus is described (other than the recognised amplifying and collecting devices by mirrors, resonators, and trumpets) which can assist the ear at the higher frequencies at which it is most sensitive and where the hot-wire microphone becomes more and more insensitive. A hot-wire microphone and reflecting galvanometer, however valuable for research purposes, would be of doubtful assistance to a navigator in a fog—the sound signal must be heard and an approximate direction perceived.

The two chapters on transmission of sound are very interesting, the deductions relative to the size and intensity of sources of sound being of considerable practical value. The second chapter on transmission deals with the fundamental difficulty of sound signalling in air, namely, the capricious effect of atmospheric conditions. In addition to the refraction effects produced by wind, temperature gradients, fog banks, and patches of dry air, are other important causes of abnormal changes of intensity and direction of a sound wave. The effect of humidity is well illustrated in the Joss Gap records reproduced on pp. 65 and 66. The value of these chapters on transmission might have been enhanced by the inclusion of data relative to attenuation (other than simple spreading and effects of large amplitudes) over long distances. The attenuation in transmission of sound through the sea is known to be a more important factor than the loss of amplitude due to spreading—it is conceivable that this is so also, and perhaps to a greater degree, in the case of sound transmitted through the atmosphere.

On p. 93 are enumerated twelve important features desirable in a source of sound for signalling purposes, and reasons are afterwards given for considering the centrifugal siren as superior to other forms of source. This information combined with the conclusions reached in the chapters on transmission should prove of considerable value to the acoustic engineer, who is primarily concerned with the production and transmission of sound over great distances. A statement on the lines of the

summary given on pp. 101-103 would have served as a useful introductory to the book.

The concluding chapter dealing with "Miscellaneous Considerations and Conclusions" might with advantage have been extended. Only five pages of the book are devoted to the choice of pitch, quality, and type of signal, whereas eighteen pages were devoted to a general discussion of the exact meaning of efficiency and the subdivision of the signalling process into many efficiency stages. Data relative to the transmission of sounds of different frequencies would have added greatly to the value of the book—but this section is dealt with in a few brief remarks.

Appendices III. and IV., on the measurement of acoustical energy and on experiments with sources of sound, are very instructive to any one interested in this subject.

Taken as a whole, the book gives a good indication of principles to be considered in the design of sound-signalling apparatus for use in air, and supplies also much information relative to that branch of recent acoustical work carried out by Major Tucker and his staff on behalf of the Royal Engineer Board. A. B. W.

Birds of Ceylon.

Manual of the Birds of Ceylon. By W. E. Wait. Pp. ii+496+20 plates. (Colombo: Colombo Museum; London: Dulau and Co., Ltd., 1925.) Rs. 10 (15*s*.).

SINCE Legge published his magnificent volumes on the birds of Ceylon, no attempt has been made to bring out any complete handbook bringing up-to-date and collating what is known about the ornithology of the island. Legge's work appeared in 1880, and though this work is still of the greatest use to any working ornithologist, it is expensive, very bulky and, naturally, in many ways completely behind the times. Mr. Wait now presents us with a single volume containing almost as much information as that contained in Legge's book, and also information that is thoroughly up-to-date and scientific. The classification adopted by Mr. Wait is that of Stuart Baker in the second edition of the "Avifauna of British India," which is now in course of production. No classification in zoology can, of course, be accepted as final, and though Stuart Baker's book is the latest work on the subject, as time goes on, alterations will have to be made in his work, even as he had to make alterations in the work of those preceding him. The author of "The Birds of Ceylon" has, however, done wisely in adopting the classification of a work with which it will undoubtedly be constantly compared by every ornithologist and field naturalist in the course of his work.

Mr. Wait has given us the scientific and trivial name of each species and sub-species dealt with; he then gives the vernacular names and a brief synonymy; a good description of the bird dealt with in its various phases of plumage and, finally, its distribution and most excellent field notes. The author himself is not only a scientific ornithologist, but is also a keen field naturalist, so that he has been able to add from his own knowledge much of interest and value to the oft-quoted notes of Legge, Holdsworth, and others. A very good outline map accompanies the letterpress, and on this is shown the amount of rainfall in the various districts, a most important matter in an island like Ceylon, where we have an extraordinary variation in the rainfall, affecting the flora generally and therefore the fauna also.

The total number of birds dealt with by Mr. Wait is 372, a very great increase when we compare it with the number about which Legge had to write in 1880. This number in Ceylon is not much affected by the modern method of dividing species into sub-species, for there are but few cases in which species are represented by more than one geographical race in this island, and we notice that in one of the few species which in Ceylon has been divided into two sub-species, that is, *Pellorneum fuscicapillum*, Mr. Wait has suppressed *P. f. babaulti* of Wells, perhaps with sufficient reason.

Some of the most important work which the author of this volume has been able to carry out is the proper identification of many of the older skins contained in the Colombo Museum, where his careful and painstaking work has resulted in many novelties coming to light, as well as the addition of a considerable number of most interesting birds to the Ceylon avifauna. The most important of these are *Puffinus carneipes carneipes*, *Parasula dacylatra persomata*, *Puffinus leucomelas* and *P. pacificus hamiltoni*.

At the end of the volume, Mr. Wait gives us 20 excellent plates containing nearly 100 figures in black and white of the birds of Ceylon. There are few students who will not be able to recognise the birds they come across from these plates alone, and they undoubtedly add considerably to the utility of the volume. The general appearance of the book is quite satisfactory, the printing and paper all that can be desired, whilst printers' errors are conspicuous by their absence. We congratulate Mr. Wait on having produced a book which has long been wanted and fulfils admirably the purpose for which it was written.

Our Bookshelf.

Cloud Studies. By Arthur W. Clayden. Second edition. Pp. xv+200+64 plates. (London: John Murray, 1925.) 15*s*. net.

WHILE the international classification of cloud forms comprising ten separate types is of the utmost value in world meteorology, it can scarcely be expected that it will satisfy completely the needs of those meteorologists who specialise in cloud study. One is accord-

ingly prepared when opening a book like "Cloud Studies" to find some amplification of the international classification, but it may be doubted whether the separation of clouds into forty named types really serves any useful purpose. Such a system must inevitably be too cumbrous for use in the daily work of meteorological observatories, and stands no chance of obtaining general acceptance. It may also be remarked that although Mr. Clayden pays lip service to the international classification, he makes it plain that in certain important respects he is not in agreement with it.

It is not intended by these criticisms to suggest that the book should be avoided or that it is unworthy of study either by meteorologists or the general public. On the contrary, it may certainly be read with profit and pleasure derived from the numerous cloud photographs with which it is illustrated. The most important change from the first edition published twenty years ago is the inclusion of a chapter on the formation of clouds, in which stress is rightly laid upon the primary importance of dynamic cooling in cloud production. Another useful chapter is devoted to the subject of cloud photography.

For the observation of clouds the use of a mirror of black glass is recommended, the reflected image of the cloud being observed. The same device has been used in obtaining many of the cloud photographs. The printer does not seem to have done full justice to all of these, the delicate texture of the high clouds being in some cases lost. Others are entirely admirable, among which may be mentioned Plate 36 which represents "Alto-cumulus Castellatus Fractus."

J. S. D.

Ergebnisse der exakten Naturwissenschaften. Herausgegeben von der Schriftleitung der *Naturwissenschaften*. Vierter Band. Pp. iii + 242. (Berlin: Julius Springer, 1925.) 15 gold marks.

THE 1925 volume of the "Ergebnisse der exakten Naturwissenschaften" contains eight articles. Dr. J. Stracke deals with the minor planets historically, treating their brightness, diameters, total mass, the statistics of the elements of the orbits, groups the orbits of which show great similarity, planets with unusual orbits, such as Eros, which is often closer to the sun than Mars, and Hidalgo, which at its aphelion is nearly as far from the sun as Saturn. The article gives a short account of the theories of the origin of the minor planets.

Prof. A. Prey's article on the theory of isostasy treats the development and the results of the theory; he does not consider it possible to account for mountain building by means of this theory alone, horizontal thrusts also being necessary. Prof. A. v. Brunn considers that for astronomical purposes the empirical time concept retains its importance, in spite of the Minkowski-Einstein conception. Prof. A. Wehnelt gives an account of oxide cathodes and their practical applications, and Dr. G. Heckmann of the lattice theory of solids, dealing with stability and energy relations, mechanics and electrostatics, acoustics, optics, thermodynamics, ionic lattices, atomic and molecular lattices. Dr. I. R. Katz investigates the swelling of such substances as rubber, nitrocellulose, and acetylcellulose, when soaked in certain organic liquids, the process being studied by X-ray methods. Dr. W. Hanle's article is on the influence of magnetism on resonance fluorescence, *i.e.* fluorescence occurring when the exciting light has the same wave-length as the natural vibration of the atom; and that of Prof. Strömgren deals with the orbit forms in the problem of three bodies.

A Practical Treatise on Fourier's Theorem and Harmonic Analysis: for Physicists and Engineers. By Albert Eagle. Pp. xiv+178. (London: Longmans, Green and Co., 1925.) 9*s*. net.

HARMONIC analysis appeals both to those interested in the mathematical eccentricities exhibited by Fourier expansions and to those concerned merely with the practical question of analysing empirical data into their constituent harmonics. The present volume, by catering in an interesting manner for the latter class, endeavours at the same time to focus the interest of its members on problems of more theoretical importance. In many respects the treatment is novel, and differs materially from that adopted in text-books of this nature. One is accustomed on picking up a "practical" book on harmonic analysis to find the usual medley of special methods unco-ordinated by any guiding principle for determining the coefficients. While certain of these find their place here, the author has centred a great part of his discussion around the expression for the coefficients in terms of the discontinuities of the function to be analysed and its successive differential coefficients, and on this as a basis he develops a number of elegant and at the same time comparatively accurate approximations to the coefficients. In practice these expressions are in a form suitable for numerical computation.

On the theoretical side, however, the book exhibits weakness in parts. There should scarcely be any necessity in such a work for a special section on the meaning of complex numbers, while the derivation of the power expansions for $\sin x$ and $\cos x$ from Demoivre's theorem and the evaluation of $\int \frac{\sin x}{x} dx$ are splendid examples on how *not* to treat limits. Altogether an interesting and valuable book, though slightly marred in places by elementary weaknesses and an irregular style.

Guide to Current Official Statistics of the United Kingdom. Vol. 3 (1924). Pp. 252. (London: H.M. Stationery Office.) 1*s*. net.

THIS guide consists of three main parts: a numbered list of official publications that contain statistics; a subject-index, giving under each entry the list-number of each publication containing relevant statistics, and some indication of their nature; a key from which the converse may be discovered, namely, the kind of statistics found in each publication. This last is of undoubted value; but we cannot see why the same information should not be more cheaply and conveniently given by adding the page-numbers to which reference is made after each entry in the list of titles, and in saying this we speak from practical experience with a similar publication.

The subject-index, on which the value of such a work depends, has been drawn up with much skill;

any reader who follows the instructions should certainly run down his quarry. If he cannot at once hit on an appropriate reference, he will find it by working down from one of the twenty-five main headings. The heading that will attract most of our readers is "Research." Under this are only two direct entries, but a cross-reference is given to the following, of which those italicised are also main headings: *Agriculture*, Atmospheric Pollution, *Fisheries*, *Forestry Commission*, Fruit and Vegetables, Industrial Fatigue, Medical Research, *Mining* (*General*), Radio Research, Royal Aircraft Works, Statistical Methods, Vivisection. One would have expected references to yet other subjects. None of these, for example, leads one to the entry "Seismological Data" (which is under Meteorology); possibly the accumulation of data is not regarded as research.

The Engines of the Human Body: being the Substance of Christmas Lectures given at the Royal Institution of Great Britain, Christmas 1916–1917. By Sir Arthur Keith. Second edition, revised and enlarged. Pp. xvi+343+2 plates. (London: Williams and Norgate, Ltd., 1925.) 12*s.* 6*d.* net.

THE second edition of Sir Arthur Keith's book, "Engines of the Human Body," is remarkable mainly for its appendices, of which there are thirteen. They are added for the purpose of expanding and amending the original text of the book, and indicate the directions of advance in anatomical and physiological knowledge, including subjects such as the needs of the muscles of athletes, the control and education of muscles, the effect of altitude, vitamins, and automatic nerve control. The only point which might be queried is the suggestion that beri-beri is due to lack of vitamin C; the accessory substance the absence of which is responsible for this disease is probably vitamin B.

Although the lectures on which this book is based were delivered to a juvenile audience, it may be read with advantage by student, expert, or any individual interested in the working of the human body. As an elementary explanation of the main facts of physiology, for simplicity of language and clarity of description, it has no equal. To the second year medical student it may be particularly recommended, for it gives him in the original lectures a general survey, and in the appendices some illustrations of modern work, than which he could have no better introduction to the subject of physiology.

Man's Life on Earth. By Prof. Samuel Christian Schmucker. Pp. xxx+299+4 plates. (New York: The Macmillan Co., 1925.) 10*s.* net.

DR. SCHMUCKER is skilled in the art of popular exposition. From this point of view his little book leaves little to be desired. It covers the conditions precedent to man's life on earth as revealed by geology and palæontology, as well as the evolution of man and his cultural history. The author shirks no difficulty and boldly tells his readers when any conclusion which he sets down is doubtful and when the evidence is inadequate, inconclusive, or unsatisfactory. He is a fervent admirer of Dr. H. Fairfield Osborn, and in most controversial questions follows that distinguished author. Consequently, his treatment of the early stages of man's history up to the beginning of the Neolithic period is both fuller and more satisfactory than it is for the later periods, where he is uncritical and not always exact. He accepts, for example, Pumpelly's very high dating for Anau, and his account of the rise of European culture is sketchy at best. The book is written for the American public; but two features will be helpful to English readers. One is a very clear account of the evidence for the Ice Age in America so far as ascertained; the second is an analysis of the peculiar social conditions in the United States which gave rise to the evolution controversy and culminated in the Dayton trial after this book was written.

Ethnographical Studies in Celebes. Results of the Author's Expedition to Celebes, 1917–1920. By Dr. Walter Kaudern. 1: Structures and Settlements in Central Celebes. Pp. xiii+404+6 maps. (Göteborg: Elandrs Boktryckeri A.-B., 1925.) n.p.

IN this volume Dr. Kaudern gives the first instalment of the results of an expedition, in the course of which some three and a half years were spent in the island of Celebes. He expects to complete his work in about ten volumes, each of which will be devoted to some aspect of native culture. Here he deals with the structures and settlements of N.W. Central Celebes, the home of the Mountain Toradjas. Some of the Toradja tribes have been visited by those well-known explorers, the brothers Sarasin, and by Dr. Kruijt. The author, however, so far as possible, confined his investigations to tribes which were practically unknown and untouched by civilisation. In regard to his special theme in this volume, his investigation was to some extent complicated by the slavery resulting from tribal warfare, which has affected the type distribution of houses and temples; but by a skilful analysis, which calls for no little praise, he has distinguished three types in the houses, paddy-sheds, and temples, one of which is of recent introduction, possibly of Chinese origin, and of the remaining two, one appears to be the primitive type of which the form was determined originally by its location on swampy ground.

A School Mechanics. By C. V. Durell. (Cambridge Mathematical Series.) Part 2. Pp. xv+187-322+xi-xvii. Part 3. Pp. xi+323-447+xix-xxvi. (London: G. Bell and Sons, Ltd., 1925.) 3*s.* each.

IN these two small volumes, Mr. Durell completes his combined course of statics and dynamics, of which Pt. 1 has already been published. The advantage of taking the two subjects together is less obvious in these later stages, when the selection of the topics to be treated in turn is purely arbitrary, but teachers who think such a procedure is desirable will find no book to compete with this, in which Mr. Durell's unequalled skill in the invention of problems has ample scope.

For moments of inertia the reader is referred to the calculus, which is not otherwise required, as the book-work on rotational dynamics is restricted to the discussion of constant forces only, the compound pendulum being treated by assuming the energy equation. More space might with advantage have been allotted to relative velocity, considering the difficulty it presents to young students.

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.*]

Highly-penetrating Radiation and Cosmical Physics.

IF stellar radiation originates in the annihilation of stellar matter, it seems likely to be generated by quanta of wave-length $1{\cdot}3 \times 10^{-13}$ cm., each quantum being produced by the simultaneous destruction of one electron and one proton. Such radiation may be either absorbed or scattered when it encounters matter. The absorption of a quantum will eject an atom with a velocity equal to 0·99999985 time that of light. If this strikes an atom, a new quantum is emitted of wave-length equal to that of the original radiation, the hardness of which thus remains unaltered by absorption and re-emission. Scattering, however, produces a softening, precisely as in the Compton effect, and a succession of scatterings will increase the wave-length of the radiation until it degenerates into ordinary temperature-radiation.

Even newly generated energy cannot travel far through the interior of an ordinary star without being changed in this way. On the other hand, there are astronomical bodies which are transparent to ordinary light, and probably also to high-frequency radiation. The most obvious examples are the irregular nebulæ, such as the Orion nebula, and the shells of the planetary nebulæ, but the most important to cosmical physics are the spiral nebulæ. On any reasonable computation the big spirals such as M. 31 (the great nebula in Andromeda) must be almost transparent to ordinary light, as is indeed shown by the circumstance that bright nuclear points, obviously located at the centre, are visible in many. On the best computation I have been able to make (*Monthly Notices R.A.S.*, April 1925, p. 534), the average optical thickness of M. 31 is only about 1 gram per sq. cm. It follows that these nebulæ must be almost completely transparent to newly generated radiation, so that practically the whole of the radiation they generate will escape into space without any change of wave-length. Space must be filled with such radiation, and its penetration into our atmosphere would seem to provide a natural explanation of the highly penetrating radiation recently investigated by Millikan.

On the supposition that the spirals are the birthplaces of stars, their radiation-generating capacity per unit mass ought to be at least as great as that of the youngest stars, and these have a capacity equal to about 500 times that of the sun. On the other hand, the visible radiation emitted by the Andromeda nebula per unit mass is only about 0·16 time that from the sun. We conclude that only a 3000th part of the total radiation of this nebula is visible. One part in 3000 of the total radiation generated inside the nebula is stopped by matter and transformed into light, while the remaining 2999 parts travel through space as high-frequency radiation.

The integrated light from the Andromeda nebula is about equal to that from a sixth-magnitude star, so that the high-frequency radiation received on earth from this nebula alone must be equal in energy to the visual radiation from a star of magnitude $-2{\cdot}7$. This represents an average fall of energy of 15^4 ergs per second on each square centimetre of the outer boundary of the earth's atmosphere.

To produce a single ion in air requires about 2×10^{-11} ergs (corresponding to an ionisation potential of 14 volts). To produce an average of 10 ions per cubic centimetre through 10 kilometres of atmosphere accordingly requires an inflow of energy at the rate of 2×10^{-4} ergs per second through each square centimetre of the outer boundary of the earth's atmosphere. Thus the high-frequency radiation from the Andromeda nebula alone would contain sufficient energy to produce about one-half of the observed ionisation. No doubt the radiation which strikes the earth is not all expended in ionising molecules, but when we add the radiation from all the other nebulæ in the sky, we seem likely to obtain a total effect of about the observed amount.

The essential point is that the hypothesis we have considered gives the effect of the right order. In this respect it would appear to have the advantage over the possibility, to which Millikan alludes (NATURE, December 5, p. 823), of the radiation being caused by nuclear changes such as the formation of helium out of hydrogen; an effect of the observed magnitude, which must presumably continue for millions of millions of years, would seem to require a quite incredible amount of hydrogen or similar matter to be scattered through space.

On our supposition that one part in 3000 of the total radiation is stopped by an optical thickness of one gram, the radiation should be reduced to $1/e$ times its original intensity after traversing 3000 grams per square centimetre, or about eight feet of lead. This corresponds roughly to the penetrating power observed by Millikan, but from it he deduces a wave-length of 4×10^{-12} cms. as against the $1{\cdot}3 \times 10^{-13}$ suggested by the annihilation hypothesis. If this latter wave-length can be shown to be inconsistent with the observed penetrating power of the rays, it may become necessary to suppose that annihilation takes place by successive stages, in which case our hypothesis would approximate more closely to that discussed by Millikan.

The interaction of this high-frequency radiation with matter, whether by absorption or scattering, must liberate free electrons moving with velocities almost equal to that of light. The majority of these will escape into free space with practically undiminished velocity. Hitherto we have thought of interstellar space as being traversed only by visible radiation, but one must now think of it as being traversed by super-γ-rays and super-β-rays as well. The effect on cosmical physics must be profound. The bombardment by these rays provides an obvious explanation of the luminosity of such objects as the irregular nebulæ, as well as of the negative charge of the earth.

J. H. JEANS.

Mendelian Genes and Rates of Development.

THE genetic research of the last quarter of a century, first especially by Bateson and later by the Morgan school, has given us a remarkable insight into the constitution of the hereditary material. We are now enabled to regard it as mainly or wholly composed of separable units (genes or factors), arranged in definite order and quantitative proportions in a series of groups (linkage-groups = chromosomes), and correlated with the appearance of the visible characters of organisms. However, very little is known as to the developmental mechanism by which this correlation is brought about. We thus have accurate pictures of the gene-complex and of the character-complex, but these pictures are, we may say, static, and the dynamic relations between the two are obscure.

Some progress towards filling this great gap in biological knowledge has been made, for example, by Onslow,[1] in his studies on the relations of genes to

[1] Onslow, *Proc. Roy. Soc.*, Series B, vol. 89, pp. 36-58 (1915).

the production of the substrates and enzymes of pigment formation, and notably by Goldschmidt [2] in his work on sex-determination, and on larval colouration in moths.

We have found in *Gammarus chevreuxi* a form which is in many ways convenient for the study of such relations. It has been known for some time that the red eye-colour (which arose by mutation from the normal black) darkens with age (Allen and Sexton).[3] We have studied this process quantitatively by comparing the eyes of our animals with an arbitrary colour-chart. By this means curves giving the rate of darkening can be obtained (Fig. 1).

Before proceeding further, the relations of the different eye-colours (black and red) must be mentioned. We have worked with the " no-white " form, in which the normal white inter-facetary pigment is not present (another mutation). In the facets of the normal " black " eye, both black and red pigments are present. The former appears to be a melanin : it is insoluble in all reagents tried. The latter, however, is soluble in alcohol, ether, chloroform, and a number of other substances. Their embryonic condition can also be studied. The eggs are laid in a

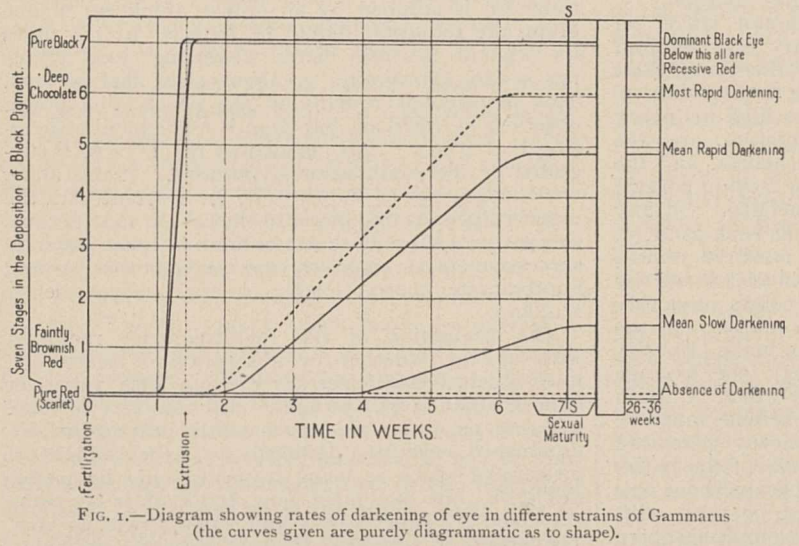

FIG. 1.—Diagram showing rates of darkening of eye in different strains of Gammarus (the curves given are purely diagrammatic as to shape).

maternal brood-pouch : here they hatch, but the young are kept in it for some further time before extrusion. It has been found possible to remove the embryos from the brood-pouch a day or more before they would normally be hatched in it, and to rear them successfully outside the body. It is then seen that the eye of the future black-eyed animal is first uncoloured : it then becomes pale pink, and later scarlet. This then starts to darken just at the end of embryonic life. The process continues until, at about the time of extrusion, the full black colour is attained ; this being about ten days from fertilisation at a constant temperature of 20° C. The darkening of the scarlet to black is entirely due to the deposition of insoluble melanin.

When the red-eyed individuals are examined, it is found that a similar darkening process occurs in them. The darkening is not due to a change in the red itself, but to a deposition of insoluble black pigment. The rate of deposition is, of course, always much slower than in the black-eyed forms ; also the process always starts after extrusion.

It was further found that both the time of starting and the rate of the darkening process differed very considerably among the red-eyed individuals. The time of starting is also closely correlated with the rate, and we shall here only consider the latter. The effect of its variation is to produce a range of final eye-colour from an apparently pure red to a deep chocolate easily mistaken for black. A curious point is the existence of a " stable phase " as regards the quantity of black pigment. This is usually reached at sexual maturity, or shortly afterwards. Another complication is found in the fact that immediately after each moult a definite lightening of colour is seen. This, however, disappears in a few hours and the normal curve is resumed.

This difference in rate of darkening in the reds was, we suspected, due to the presence of modifying genes. We accordingly mated up a number of pairs, each consisting of a rapid-darkener and a slow-darkener. The results have confirmed our expectations. The F1, in all cases but one, showed definite but incomplete dominance of rapidity. In the one exceptional case the brood was divisible into " rapids " and " slows " in a 1 : 1 proportion (15 : 17), indicating that the rapid parent had been heterozygous. From the remaining F1's the F2's were bred. The results indicated definite segregation, the total numbers obtained being rapid 89 : slow 31.[4] The variations were much greater among the former class than among the latter, indicating, once more, imperfect dominance among the heterozygotes.

The general bearing of these facts may now be considered. Gammarus happens to be an organism which (1) has no metamorphosis, and (2) exhibits continuous growth and differentiation long after sexual maturity is reached : a type of development which must be regarded as primitive. It thus has no single size or form which can claim to be typical. The specific characters of any species of Gammarus can be arbitrarily defined with regard to a definite instar (such as that at which sexual maturity is attained), but more logically they should take into account the rates of change of the various organs. In a holometabolous insect, on the other hand, the adult characters appear only at the imaginal phase, and no growth or differentiation occurs after this. In ametabolous insects, and warm-blooded vertebrates, there is continuous change before, but no (or negligible) change after, the attainment of a fixed adult phase.

Thus if Gammarus were a holometabolous insect and the same factors were operating in it, we should see merely a *cross-section* of the curves for the rate of pigment production, as indicated by the line S-S in the diagram. Such a cross-section would give a picture similar to that seen in the effects produced, for example, by multiple allelomorphs in Drosophila. We may thus, with some reason, conjecture that the difference between the effects of multiple allelomorphs, and possibly between other quantitatively different characters, are usually to be ascribed to a difference in the *rate* of formation of some definite substance. Such a substance might accumulate gradually, but

[2] R. Goldschmidt, " The Mechanism and Physiology of Sex Determination," London, 1923. Goldschmidt, Seiler und Poppelbaum, 1924, *Arch. f. mikr. Anat. u. Entw. Mech.*, vol. 101, p. 92.

[3] Allen and Sexton, *J. Mar. Biol. Assoc.*, vol. 11, p. 273 (1917).

[4] These figures are from families with a sharp distinction between 'rapids" and " slows " ; in others they are less easily separated. Presumably more multiple factors are here operative, and the results are being further analysed.

only show its effects suddenly, at a certain developmental stage.

One point here deserves mention. In two specimens of *G. chevreuxi* tested, slight darkening occurred, but starting only *after* sexual maturity; in an insect like Drosophila it could not have developed at all! Thus many apparent absences of a character may merely be due to extreme slowness in its development. Captain Diver informs us that similar phenomena are to be observed in the banding of Helix spp. It is also worth noting that the recessive "red" character is, at least in almost all cases, not due to an *absence* of black, but only to its slower deposition.

We here get a definite relation between Mendelian factors and the rates of a process which is continuous throughout most of the animal's life. We believe the line of thought thus raised to be a fruitful one for very various genetic problems, and hope that others may be induced to test its wider application.

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Oceanographical Expeditions to the Black Sea in 1924 and 1925.

THE first study of the Black Sea was undertaken by the General Hydrographic Administration of Russia in the years 1890 and 1891. This expedition discovered the peculiar character of this sea.

After thirty-five years, oceanographical views and methods have developed to such an extent that it was necessary to send a new expedition to study the oceanographical conditions of this sea basin.

The same General Hydrographic Administration of the Navy of U.S.S.R. undertook this work. As a first step, a cruise, repeated four times every year, along the meridian of the south cape of the Crimea, was established. Data were thus collected for the study of the seasonal variations of the oceanographical elements in 1923–25.

For the general study of the oceanographical conditions, two special expeditions, in June–July of 1924–1925, were organised, both under my supervision. In 1924 the eastern part of the sea was studied, 1200 nautical miles being covered with 28 stations. In 1925 both eastern and western parts of the Black Sea were explored. During a 36 days' cruise, 2300 nautical miles were traversed with 72 oceanographical stations, 35 of which were in deep water. A total of 4250 observations were taken, amongst which more than 2000 gas analyses were carried out on board. Deep-sea soundings were made and sections of deep-sea deposits were obtained about 60 cm. long.

The material collected during the last expedition is now being examined, but the four seasonal cruises and others have given data which lead to some conclusions on the oceanographical conditions of the Black Sea. The salinity increases from the surface to the bottom from 18 per mille to 22 or 23 per mille at 2000 metres. The seasonal variations disappear at 100 m. The density has a similar vertical distribution, being about 11·2 at the surface, and reaching 17·4 at the bottom. Seasonal variations also were not met deeper than 100 m. The surface density in any case cannot exceed that at 200 m.; because of this, convection currents do not descend deeper than 200 m.

The vertical distribution of temperature has a peculiar character. The seasonal variations are observed only in the layer of 100 m. deep. At the depth of about 200 m. a layer of constant temperature is observed—about 8°·7 C. From this depth to the bottom the temperature increases, and in the bottom layer it reaches 8°·92 to 8°·95 C. Near the shores the vertical distribution of temperature is more complicated.

These oceanographical conditions lead to a special vertical distribution of dissolved gas. Oxygen cannot penetrate deeper than the convection currents. In the open sea it reaches 150-160 m. only; near the shores, 200 m. or a little more. The deep layers below 200 m. contain hydrogen disulphide. In the open sea at the depth of 150 m. this gas is present to the amount of about 0·5 c.c. in a litre, at 0° C. and 260 mm. of atmospheric pressure. The quantity increases with depth and in the bottom layer, at 2000 m., it is 6·8-7·0 c.c. per litre.

Near the shores each of the surfaces, such as isothermobaths, isohalines, isopykns and those of the vertical distribution of gas, lies deeper than in the middle of the sea. This fact was observed in 1890–1891 also; most probably it is due to the dynamical influence of offshore winds, and of those of the opposite direction, which blow in the coastal parts of the sea, causing the water to descend, or to be raised, thus increasing the vertical convection.

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The Biological Conditions of the Black Sea observed in 1923–25.

THE observations in coastal waters, and also those made during the seasonal cruise and with the oceanographical expeditions in June–July 1924 and 1925 of the General Hydrographic Administration, lead to the following conclusions.

The Black Sea, from the oceanographical point of view, being formed of two sheets of water, namely, superficial layers of low salinity, and underlying water of great thickness and greater salinity, the conditions of life are determined by these conditions.

In the open sea the limit of life is found at the depth of 150-160 m. and sometimes at 125-110 m. Nearer the coasts this limit is deeper—sometimes about 200 m. The pelagic zooplankton is richer in the layers between the surface and 50 m. of depth; it is very uniform through the whole sea. From the depth of 50 m. to its inferior limit, the zooplankton is less rich. Near the shore it is more abundant, and in the middle of the sea its quantity varies greatly.

The seasonal variations of the zooplankton are very marked in the upper layers, and nearly disappear at the depth of 100 m.

The vertical distribution of the phytoplankton is under the control of some other causes as well as the temperature, such, for example, as the vertical distribution of light and some chemical components in the sea water, as also the hydrogen-ion concentration.

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The Line Fluorescence of Cadmium Vapour.

IN a previous communication (NATURE, August 1, p. 170) I gave a preliminary account of the study of the band fluorescence of cadmium vapour. In the further investigations leading to the results presented, special care has been given to the removal of possible impurities in cadmium vapour. In order to remove completely the gases adsorbed by the walls of the quartz bulbs in use, the bulb, joined to the pumps, was heated in an electric furnace to about 900° C. for

several days. The use of gas burners for heating the bulbs is not advisable, as at high temperatures the gases of the flame, first of all hydrogen, pass through the quartz wall and undoubtedly are occluded in it. Then, the bulbs being strongly heated when used, the gases may be liberated from the walls and pollute the vapour in question.

The mercury vapour was removed by the aid of a quartz mercury trap cooled in liquid air.

Pure cadmium previously three times distilled in vacuo was used. A few milligrams of it were distilled into the bulb, which was then placed in an electric furnace. The temperature being kept stationary, a beam of exciting light was projected through the bulb by the aid of a quartz lens. Attention was paid to its chromatic aberration, *i.e.* the position of the focus for the very short wave-lengths.

By increasing gradually the temperature, first traces of the fluorescence were observed at about 350° C. (pressure of cadmium vapour 0·2 mm.), a condensed spark with the electrodes of cadmium being used as a source of light. The intensity of the fluorescence increases rapidly with the increase of temperature; its colour, at first definitely bluish green, assumes gradually (at about 600° C.) the blue colour formerly described. The spectroscopic examination shows that the green colour is due to the intense emission of the first triplet of the principal series of the cadium arc spectrum: 5086·06, 4800·09, 4678·37 Å.U. In the ultra-violet part of the spectrum, other lines were found in the fluorescence. In the subjoined table is given a list of these lines as they are observed at different temperatures.

Line Å.U.	Series Notation.	Estimated Intensity						Remarks.
		220°	440°	550°	640°	750°	885°	
5086·1	$2p_1$–$2s$	0	0	2	2	2	2	
4800·1	$2p_2$–$2s$	0	3	4	5	5	4	
4678·4	$2p_3$–$2s$	0	3	4	5	5	4	
3261·2	$1S$–$2p_2$	2	4	6	5	4	3	Resonance line (Triplet system)
2288·8	$1S$–$2P$	3	4	0	0	0	0	Resonance line (Singlet system)

Remarks on the above table:

(1) Intensity 1 would denote a very faint line; 6, a very intense one; 0 denotes that the line in question was not visible at all.

(2) Intensity 0 of the line 5086 at 440°, and the small intensity at other temperatures, is due to the insensibility of the plates used for the blue-green light. Visually its intensity was not smaller than that of the line 4800.

It is also possible that the lines 2748·7 and 2573·1 Å.U. belonging to the spark spectrum of cadmium are present in the fluorescence at higher temperatures from about 750° C. They fall in a region of the very intense ultra-violet band fluorescence, so that it is very difficult to separate them from the continuous background and from the traces of the scattered exciting light.

It is interesting that the emission of the visible triplet and of the resonance line 3261·2 Å.U. of cadmium may take place also at the excitation over a *certain spectral range* by the emission lines of other elements, for example, of aluminium. Moreover, the intensity of the lines 5086, 4800 and 4678 excited by an aluminium spark is, other conditions remaining unchanged, much greater than when excited by a cadmium spark. Their intensity shows here also the maximum at about 750° C., whereas at higher temperatures (890° C.) it slightly diminishes. In the ultra-violet region only the presence of the resonance line 3261 was observed; its intensity reaches the maximum at about 600°; then it diminishes, and at 890° it appears as a weak and diffuse line. This appearance may be due to the mutual influence of atoms, for example, the Stark effect, intense at these high temperatures because of the considerable density of vapour.

There appears also, with the excitation with the aluminium spark, as well as with the cadmium spark, the resonance line of mercury 2537 Å.U., which originates from the traces of mercury vapour present as impurity in the bulb.

The light of the copper spark excites also in the cadmium vapour the emission of the visible triplet (although much weaker than for the aluminium spark) and the emission of the resonance line 3261. The iron, lead and mercury spark excite the emission of the triplet mentioned as well.

These data would prove that the spectral extent of its excitation must be rather broad, and it lies probably for the most part below 2000 Å.U., where the aluminium spectrum possesses intense lines. On the other hand, lead does not possess any strong lines in the farther ultra-violet region (below 2170 Å.U.), in spite of which it excites distinctly the emission of the visible triplet of cadmium. Therefore, the absorption must take place over all the wide spectral range.

It remains for the moment an open question, whether the deformations of the cadmium atom leading to the subsequent line emission are the direct result of the absorption of the radiating energy, or whether a number of intra-atomic and intra-molecular processes as well as collisions lead indirectly the atoms to the final excited state.

Impurities and small admixtures of other gases have a considerable, but not yet completely elucidated, influence on the emission of lines. The intensity of emission varies greatly with the bulb used. In a recently prepared bulb, which does not contain any traces of mercury vapour and from which the occluded gases were removed particularly thoroughly, the emission of the visible triplet takes place at the excitation by the cadmium and aluminium spark only at about 700° C., and it is weaker than in the bulbs previously used. Also the visible band fluorescence is here much weaker, whereas the ultra-violet one is very intense. There may be, therefore, some connexion between the band fluorescence and the emission of lines.

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October 20.

Weather Prediction from Observation of Cloudlets.

I FEAR Mr. Cave (NATURE, November 21, p. 749) misunderstands me, or I him. He controverts none of my facts, and his own are indisputable. Thus, though I, with amateurish powers of observation, find it difficult, no matter how long I watch, to perceive the waxing, and waning, of a cloud, I have always thought it probable that a thick or extensive mass, if exposed on opposite sides to unlike weather conditions (*e.g.* sun-heat), may condense at one extremity while dissolving at another. Also I know that the tendency is, on the whole, one way or the other. Again, I know that in our changeable climate, indeed in any climate, a waxing cloud does not necessarily imply rain; it may not condense sufficiently. Nor does a waning cloud imply fine weather; it may cease to wane. Nevertheless, "when clouds are seen wise men put on their cloaks," and exceptions do

not disprove the rule. They should merely direct attention to modifying circumstances—for example, to the variations of the barometer, the season of the year, the time of the day, the direction of the wind, and the colour of the sky. Whatever the modifying circumstances, it remains true that rain cannot come unless rainless clouds condense, or fine weather unless raining clouds dissolve. For most people, even I suppose for the weather expert, observation of this gathering, or breaking, of clouds is the most employed quick method of weather prediction.

It is usually impossible to base judgment on the behaviour of one cloud, or even of a few clouds. The bulk and opacity of these big masses renders observation of their changes difficult. Before we can be sure, each tends to drift out of sight, or be obscured by its fellows. Most of us, therefore, inspect the sky as a whole at intervals to ascertain whether it darkens or brightens. On the other hand, cloudlets—"the smallest and thinnest fragments of cloud that can be clearly isolated"—wax towards rain, or wane towards fine weather, with surprising swiftness. In my letter I wrote that five minutes' observation was usually sufficient. As a fact and as a rule, any one may satisfy himself within fifteen seconds. Cloudlets are small and diaphanous clouds which can be seen at the same time in every part. They do not fade at one extremity while developing at another. They are under the same atmospheric conditions as neighbouring clouds. If they change, their big neighbours are almost certainly changing in the same way. They furnish a quick and easy means of determining the atmospheric conditions not only at the moment, but also usually for hours to come. As compared to clouds, their changes are as easy to watch as the changes in a small smear of moisture compared to those in a cup of water.

That was all I wrote, or implied, in the letter (NATURE, November 7, p. 676) that Mr. Cave criticises. He writes, "I do not think that any of the explanations he gives accounts for the phenomenon." But I gave no explanations—unless the inference that changes in cloudlets are indices of changes in clouds be regarded as an explanation. It seems to me a truism. I stated easily verified facts—that and nothing more. "I do not think that the method . . . is at all of universal application." Of course it is not. No weather sign is. I mentioned some exceptions. He mentions another—that early on summer mornings cumuli sometimes wax and then wane without rain. But we have to deal with a rule, not with invariable succession. Moreover, the ordinary man, for whom I wrote, does not usually observe early on summer mornings. "The point is not to account for it, but to decide whether the waxing or waning of the cloudlets is to be taken account of in weather prediction." That certainly is the point. The test is most easy to apply. I think that even the expert will find it useful not only during all times of the day, but for more than the hundred days Mr. Cave mentions.

In this connexion, it is useful to discuss the origins of clouds and cloudlets. Now I really try to explain. How do clouds begin in the first instance? As new cloudlets? Or in a widespread and deepening mistiness? The first supposition seems to me improbable. It implies a sudden change in a minute portion of the drifting and mixing atmosphere. The second seems more likely and may, indeed, be often seen to be true, as when a misty sky gradually becomes grey, or when a ground fog develops. I suppose that the cumuli of which Mr. Cave writes are formed by the condensation of moisture as air rises to colder altitudes and there wane into cirro-cumuli. How do cloudlets originate? If *de novo*, then here again we have a sudden change in a minute portion of the atmosphere. It seems more probable that they are either the last remains of clouds, or else portions of them which have become detached, not by being torn off by the winds (we rarely, if ever see that), but by the dissolving of connecting links (which we often see). So a puff of steam breaks into vanishing wisps. It follows that the mere presence of cloudlets is an index of clouds that have dissolved. Whether they are still dissolving can be determined by a moment's inspection.

May I direct attention to the fact that I have done no more than indicate an easily observed weather sign. I have not tried to minimise the value of any other sign. G. ARCHDALL REID.

Sulphur Treatment of Soil for Wart Disease.

IN the *Annals of Applied Biology*, 12, 2, 1925, a paper was published by Roach, Glynne, Brierley and Crowther entitled "Experiments on the Control of Wart Diseases of Potatoes by Soil Treatment, with particular reference to the use of Sulphur." In 1922, treatment of a light soil at Ormskirk with sulphur had given promising results, whilst in 1924 the amount of disease was reduced from 73 per cent. in untreated soil to 8 per cent. with an incorporation of 10 cwt. of sulphur per acre, and to less than 4 per cent. with 20 cwt. sulphur per acre. On a heavy clay at Hatfield, clean plots were obtained with an application of 40 cwt. per acre.

During the past season a larger experiment has been carried out to test these results and the deductions drawn from them, and to determine whether the effect be a permanent one. As we have learned that experiments are being set up in other countries to test the efficacy of this sulphur treatment, it is desirable that the discrepant results obtained by us this season should be known so soon as possible. In our test at Ormskirk the following arrangement was adopted.

Plot.	Treatment.
1	None.
2	15 cwt. sulphur per acre in autumn.
3	10 " " " "
4	7½ " " " "
	7½ " " " spring.
5	5 " " " autumn.
	5 " " " spring.
6	15 " " " "
7	10 " " " "
8	None.

In the untreated plots the plants grew well and were heavily warted. In the treated plots a first set of tubers planted in May and a second set planted in July almost entirely failed to grow. The surviving plants showed in all plots considerable amounts of wart disease although much less than in the control areas. At Hatfield two tons of sulphur per acre was applied: the crop was damaged and a considerable amount of wart disease was present.

Unavoidable differences in the conditions (seasonal, manurial, etc.) under which the work was carried out in 1924 and in 1925 suggest certain explanations of these results, but we are not in a position to say that any one of them is correct. The results already published are not of course invalidated, but it is clear that the sulphur treatment cannot, in the absence of further information on the soil and other factors involved, be regarded as a trustworthy method for freeing soil of the parasite causing wart disease. A more detailed account of our work will be published in the *Annals of Applied Biology*, 13, 2, 1926.

W. A. ROACH.
WM. B. BRIERLEY.
Rothamsted Experimental Station,
Harpenden, December 1.

The Occurrence of Dwi-manganese (At. No. 75) in Manganese Salts.

IN a letter to NATURE of November 28 bearing the above title, the authors, Messrs. Dolejšek and Heyrovský, deduce the existence of element 75 from measurements of the potential of a cathode immersed in saturated manganese sulphate solution. Their conclusion is supported by an examination of the X-ray spectrum, with which I have nothing to do. I do not think, however, that their deductions from the potential-current curves are necessarily valid. They find for the deposition potential of manganese −1·34 volt (abs.), a figure in substantial agreement with my own (*Trans. Faraday Soc.* (1924), 19, 559 and 20, 1). Below that potential they find two humps in what should normally be a very flat curve. The first and smaller hump they show to be due to some common impurity removable by hydrogen sulphide. The second, commencing at a voltage of −1·00 volt, they attribute to the discharge of the new element, dwi-manganese. I see no reason why this potential should not represent the potential of incipient hydrogen discharge: the actual deposition of manganese at −1·3 volt is accompanied by violent hydrogen discharge. Assuming their manganese sulphate solution to be neutral, the equilibrium potential of hydrogen should be about −0·13 volt, which requires an overvoltage of 0·87 volt, a readily realisable figure if the cathode were smooth platinum. The oscillatory nature of the potential curve in the neighbourhood of the manganese deposition potential may be due to the simultaneous discharge of hydrogen and manganese.

It would be interesting to know the form of the current-potential curve at the same cathode in an electrolyte containing no manganese, such as sodium sulphate. The effect of superposing an alternating current on the direct might also be tried. In this case, if the inflexion is due to hydrogen discharge it would be greatly displaced by the superposition; if to dwi-manganese, probably but little.

The authors then proceed to isolate a product presumably rich in dwi-manganese, which they dissolve in hydrochloric acid. They give no experimental details, but it is worthy of note that in the electrolysis of manganous chloride solutions, manganese tetrachloride is undoubtedly produced (*Trans. Chem. Soc.*, 1923, 123, 892), which hydrolyses with great readiness in the neighbourhood of the cathode, and might conceivably produce potential relationships of considerable complexity.

It is not my intention to impugn the substantial results of Messrs. Dolejšek and Heyrovský, except in so far as I think their interpretation of the inflexions of their curves is not necessarily correct.

A. N. CAMPBELL.

Department of Chemistry,
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Microseisms and the Indian Monsoon.

WITH reference to the note on the above subject in the report of the seismological committee of the British Association, Southampton, 1925, and my letter to NATURE, October 18, 1924, p. 576, it is perhaps worth while to place on record that the observations made during the current year fully confirmed the views regarding the appearance of microseisms of a certain type as a precursor of the monsoon.

This year the microseisms of the monsoon type could be detected in the seismograms on May 13. On May 15 very pronounced microseisms developed, and these lasted for the next two days. They were apparently associated with a severe storm, which formed in the Bay of Bengal on May 12 and crossed the coast near Masulipatam on May 16. The storm caused strong winds in the south-east Arabian Sea and fairly widespread and locally heavy rain in the south of the Peninsula. With the dissipation of the storm the microseisms weakened, but they did not altogether disappear from the seismograms. During the last week of May, as the monsoon was being gradually established, they became more and more marked, and from the beginning of June onwards, so long as the monsoon conditions continued, their characteristic appearance day after day formed the most noticeable features in the seismograms. One could thus get very important indications regarding the advance of the monsoon in the south-east Arabian Sea long before it arrived on the west coast.

Following the discussion of Darwin on the variations in the vertical due to the elasticity of the earth's surface (Brit. Assoc. Report, 1882), a theory of the microseismic movements of the monsoon type has been worked out. This suggests that they are due to Rayleigh waves set up at the bottom of the sea by the train of water waves maintained by the monsoon currents. The periods of the movements, which vary from 5 to 9 seconds according to the strength of the wind, are correctly indicated by the theory. The complete paper on the subject will be published in due course.

S. K. BANERJI.

The Observatory, Bombay,
October 30.

Vitality of an Earwig.

AN earwig was found inside a high vacuum pumping set recently. How it managed to get there is not known, but it was possibly in the glass-blower's rubber tubing and was blown in when the apparatus was being modified a few hours previously.

The earwig was not observed until the pumps had been running a quarter of an hour, when it was seen crawling along the glass tubing. The pressure was about 0·001 mm.

In our efforts to extract the earwig it was rather roughly treated, as it fell into the mercury vapour pump (cold) and was eventually poured into a beaker with the mercury, being entirely submerged for a few seconds. It survived all this and actively crawled about on being released.

It is possibly well known that the skin and legs of this creature can withstand such knocking about, but it seems very remarkable that it could be active in a vacuum!

PHYSICIST

The Course of Instability of Elements.

URANIUM and thorium being the two amongst the old elements which are unstable, and being nearly at the end of the Periodic Table, is there any more reason to regard these as the last to remain unstable, than to regard them as the first to become unstable? If they represent the last to become unstable, we might suppose that all the other elements had passed through an unstable stage and in the course of ages to have become stable, thus throwing the greater part of the earth's history into the past, with less to come in the future. If, however, we suppose that only two elements have reached the unstable stage, all the remainder will have to come to this stage in turn, thus giving to the earth a tremendously long future as compared with that which is past.

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The Nature of Man's Structural Imperfections.[1]

By Sir ARTHUR KEITH, F.R.S.

II.

DARWIN regarded the appendix as one of man's vestigial structures, and Metchnikoff accepted this verdict without demur, although there were then anatomists, particularly Prof. R. J. Berry,[15] who refused to regard the appendix as a useless structure. Every child is born with a fully and well-developed appendix which varies in length round a mean of 35 mm. Ribbert's investigations[16] showed that amongst the Swiss the appendix has reached its maximum length, 97 mm., by the twentieth year; thereafter the average length falls slowly, so that by the sixtieth year it has become reduced to 85 mm. Prof. Berry[17] found in the population of Edinburgh that the appendix did not attain its full length, 89 mm., until the fortieth year, falling to 83 mm. by the sixtieth year. Drs. Garcia and Salloza[18] measured the length of the appendix amongst Philippinos—a people living chiefly on a vegetarian dietary. By the twentieth year the appendix of this people had attained a length of 81 mm.; its maximum length, 96 mm., was not reached until the fiftieth year, while the average length fell to 82 mm. by the seventieth year. An organ which increases in length until the twentieth year, or even until the fiftieth, does not merit the name vestigial.

The size of the appendix at birth in the various forms of anthropoid apes we do not know, but in adult gorillas, chimpanzees, and orangs the appendix usually attains a length of 150 or 160 mm.—nearly double the length of the human appendix. In the most primitive form of anthropoid known to us, the gibbon, the appendix is most variable in length. In six animals which I dissected fresh from the jungle, all of them adult, the appendix varied in length from 75 mm. to 175 mm. In two of the animals, the cæcal contents were laden with numerous fruit stones as large as those of a cherry; the appendix in these two cases held a row of fruit stones, showing that it shared in the digestive work of the cæcum. There is no evidence to lead us to believe that anthropoid apes suffer from appendicitis in their natural habitat; they become subject to this disease when kept in confinement. Of 61 chimpanzees dying in captivity, 10 of them suffered from appendicitis.[19] The evidence, such as it is, leads us to believe that when the appendix breaks down under the conditions of modern civilisation, it does so not because it is "vestigial," but because of its inability to withstand the conditions to which it is being exposed.

To express the real nature of the structural and functional imperfections seen in the human appendix, it is convenient to use a term coined by the late Sir William Gowers. He noted that in some families certain structures, such as the hair on the crown of the head, was apt to be shed as the result of a premature atrophy of the scalp. To such examples of premature senility on the part of any organ or structure he applied the term *abiotrophy*.[20] In this sense the appendix is an abiotrophic structure, one which is apt to suffer from a disordered life-history; in a large proportions of Europeans it becomes atrophic or senile when other parts of the body are in full vigour. On the evidence collected by anatomists and pathologists, it is permissible to infer that if we could follow the life-histories of 1000 modern Europeans from birth to their seventieth year, the following would be the fate of their appendices. By the end of the tenth year the lumen of this structure would be partially or completely obliterated in 40 of them; by the twentieth year the same fate would have overtaken 70 more; by the thirtieth year 60 others would have been added to the list; by the fortieth year 80 further cases of obliteration would have occurred; by the sixtieth year there would be 110 additional cases. Of the thousand people who reached the age of seventy, only 500 of them would retain their appendix in an unblemished functional state; in the other 500 the appendix would have undergone a premature atrophy at succeeding stages in the journey through life. In this the appendix keeps company with all structures which are of a lymphoidal nature. The tonsils, the thymus, lymphatic glands, and Peyer's patches have similar life-histories, but no one would describe them as vestiges or rudiments. There is much in the name we apply to structures; when we name them "vestigial," "congenital," or "useless," we shut the door on all further inquiry. As Paley declared a century ago, our list of "useless" structures decreases as our stock of knowledge increases.

The eye, which is man's chief organ of sense, has, under the stress of civilisation, become the subject of a wrong growth or abiotrophy. If we take a thousand men or women over the age of twenty-five years, we shall find that about 150 of them suffer from a degree of myopia which prevents them from seeing distant objects clearly; and yet in all of them, just as was the case of the appendix, the eye was normal at birth. The incidence of the disorder is somewhat similar to that of the appendix; it appears during the period in which the eye is undergrowing growth—a process of the most complex kind[21]; in a few, myopic changes appear by the fifth year, the highest rate of incidence taking place as puberty is reached and passed. We cannot believe that among our hunting ancestors, for whom distant sight was so vital, that every seventh man was myopic.

Myopia we must regard as a structural disharmony occasioned by the conditions which civilisation has entailed on us. Short sight, as Dr. John Kirk has stated,[22] is certainly a disorder of growth, and the essential problem is to discover not why 15 per cent. of our population suffers from it, but why it does not occur in the remaining 85 per cent. Children may be fed on the same food and undergo the same school

[1] Continued from p. 823.

[15] *Anat. Anz.*, 1895, vol. 10, p. 761; *Journ. Anat. and Physiol.*, 1906, vol. 40, p. 247.

[16] Prof. Ribbert, *Virchow's Archives*, 1893, vol. 132, p. 66.

[17] Prof. R. J. Berry, *Anat. Anz.*, 1895, vol. 10.

[18] Garcia and Salloza, *Phillipine Journal of Science*, 1921, vol. 18, p. 707. See also Fawcett and Blackford, *Journ. Anat. and Physiol.*, 1900, vol. 34, p. xxi; S. Rutherford Macphail, *ibid.*, 1917, vol. 51, p. 306.

[19] Weinberg, *Bull. de la Soc. de Path.*, 1908, vol. 1, p. 556.

[20] The reader will see later that I use this term in a somewhat wider sense—one which includes irregular as well as reduced growth.

[21] I have dealt with the incidence and nature of myopia in the *British Journal of Physiological Optics*, 1925, vol. 1, p. 369.

[22] *Brit. Med. Journ.*, 1921, vol. 2, p. 8.

tasks, yet only in certain individuals does the eyeball undergo abnormal elongation. They only are affected by modern conditions, the others are not.

Perhaps no structure in the human body illustrates abiotrophic changes so well as the lens of the eye. By the age of forty-five the elasticity of the lens has become so reduced in most of us that we have to seek the aid of spectacles. Some time ago Dr. Ernest Clarke [23] examined the eyes of 1200 people of all ages, and charted in graphic form the condition of the lens. From that chart we can see that some individuals at the age of forty-five retain the elasticity of lens which is normal at thirty-five years of age, while others have reached a stage usually found in men and women of sixty. It is with the lens of the eye as with the appendix, abiotrophy sets in prematurely in some; in others the change is delayed.

The consideration of the functional failure of the lens of the eye brings us to a problem which fascinated Metchnikoff. What is the term of life which is natural to man? Metchnikoff inclined to place it at a hundred years—that if we escaped accident and disease the inherent vitality of our tissues was sufficient to make a centenarian of every one. At the age of forty-five the lens of the normal man is already old; it has reached the term of its full utility. We have no reason to suppose that civilisation has shortened or is shortening its period of usefulness. The indication it affords supports the belief that Nature has worked out the evolution of the human family on a mean life tenure of forty-five years; she has hitherto run the human army on a short-service system. Unfortunately we have no vital statistics of our nearest allies, the anthropoid apes. Micky, a chimpanzee which died lately in the Zoological Gardens of London, lived there for twenty-six years, and was three or four years of age when he arrived. Thirty years ago I made an intensive study on the age changes of the teeth and skulls of the great anthropoid apes and came to the conclusion that very few of them reached the fifth decade of life. All the elastic tissue and cartilage of the body keep the lens company in their rate of aging; they lose their resiliency by the middle of the fifth decade. The age of forty-five years sees the end of the term of child-bearing which is normal for women. When we consult the rates of mortality which now prevail we find that a sudden rise sets in during the fifth decade, and this rise assumes a steeper and steeper gradient with every subsequent decade. All of these facts seem to show that forty-five years was the span allotted to man when he was the blind slave of Nature. Civilisation now permits many men and women to live the span of two such lives, but whether it would be an advantage for civilisation that all should live to be centenarians, as Metchnikoff believed, is a moot point. We must take civilisation in the round; if it has searched out the weak points in our inherited organisation, it has also added incalculably to the span and comfort of life.

All the structural imperfections of man's body which have been discussed up to this point are of a kind which perish in the grave. We have no means of telling whether or not our remote ancestors suffered from appendicitis or were the victims of myopia. Fortunately, from this point of view, there are certain of the durable parts of man's body which manifest abiotrophic changes—the teeth and jaws. During the last twenty years I have had an opportunity of examining the facial parts of more than three hundred individuals who lived in England more than a thousand years ago, some of them so much as eight or ten thousand years ago. Seven years ago I made an elaborate comparison between fifty of these ancient skulls—twenty-five of which were adjudged to be those of men and twenty-five of women, with equal numbers of individuals who had lived in England within the last two centuries.[24] In only three of the fifty ancient skulls did the upper and lower teeth fail to meet in an edge-to-edge bite; in all of the fifty modern skulls the bite was of the overlapping or scissors type. Our teeth are in an abiotrophic state; the failure of the wisdom teeth or third molars to form, or to erupt if they are formed, is but one symptom of this abiotrophic change; it affects crown, cusp, and root development. In the fifty ancient skulls, instead of 100 upper wisdom teeth, there were only 82, 13 being absent from non-development and 5 from non-eruption. In the fifty modern skulls, instead of 100 upper wisdom teeth, there were only 59; 30 of these were absent from non-development, 11 from non-eruption.

Such evidence shows that although abiotrophic changes had overtaken the dental system of the western European as early as the Neolithic period, yet these changes have been accelerated during the more recent centuries. Dental abscesses were nearly as common in the ancient skulls as in the modern; carious teeth, on the other hand, were three times more frequent in modern skulls than in the ancient. The researches of the Mellanbys [25] have proved that the quality of enamel and of dentine, particularly of secondary dentine, has a relation to the vitamin content of a dietary. Equally important for the proper formation of teeth, as McCollum and his colleagues [26] have demonstrated, is the presence in food of a due proportion of certain mineral salts. Nevertheless, although a school of children are exposed equally to unfavourable conditions, it is only in a certain number that dental defects will occur; in this respect the dental system behaves as do all structures which are liable to abiotrophic changes.

In not one of the fifty ancient skulls was the palate contracted, whereas of the fifty modern skulls there were thirteen in which this condition was present to a recognisable degree—in more than half of them to a marked extent. No matter which stratum of our population we make observations on, we shall find that every fourth or fifth child or adult we examine possesses a palate which, compared with the older type, may be described as both altered in form and reduced in size. I have never seen this defect and irregularity of palatal growth except in skulls from cemeteries of the eighteenth and nineteenth centuries. It may be thought that this irregular growth with reduction in the size of palate, and the defects in the formation of the jaws and face which usually accompany them, are merely the results of the soft and highly prepared kinds

[23] NATURE, 1916, vol. 97, p. 554.

[24] Some of the details of this comparison were published in "Five Lectures," issued by the Dental Board of the United Kingdom, 1924.

[25] Dr. E. Mellanby, *Brit. Med. Journ.*, 1912, vol. 1, p. 831; Dr. May Mellanby, *ibid.*, 1924, vol. 2, p. 354.

[26] *Johns Hopkins Hospital Bulletin*, 1922, vol. 33, p. 202.

of food we eat; with such a dietary the teeth, jaws, and chewing muscles are deprived of the work which fell to them in more primitive times. That this is not the true explanation is proved by this fact. When children are fed, clothed, and exercised exactly alike, all are not affected; only some of them develop irregularities of the palate and jaws. There is a special susceptibility to these imperfections in certain races and in certain families.

Amongst modern British people are to be seen various facial characters, particularly in the orbits, in the cheek bones, and in the bony supports of the nose, which are never to be noted in the facial framework of people who lived in Britain during the pre-Norman period. When a Continental cartoonist seeks to represent John Bull he always emphasises these new facial characteristics. Such changes in the form of the facial bones, like contraction of the palate, which they usually accompany, are not the result of a nasal obstruction such as might be caused by enlarged adenoids or tonsils; the cause lies deeper. The incidence of irregularities in the growth of the face follow the same laws as hold for all abiotrophic structures such as the appendix, the sclerotic coat of the eye, the thymus, and the tonsil. Further research will likely prove that the disorders of growth which overtake all these structures are linked to a disturbed action of lymphocytes and of all the constituent elements of the lymphoid tissues. Dr. W. Cramer has become convinced that lymphocytes are actively concerned in assimilation of food and in the nutrition of tissues, and that the nature of the dietary does directly affect their activities. It seems to me very probable that a fuller knowledge of the life-histories of lymphocytes, particularly of the office they perform in growing tissues, will go far to explain the disharmonies which civilisation is producing in the bodies of some of us. But the problem of explaining why some members of our community are highly susceptible to these new conditions, while others are less so, and why the majority remain unaffected, will still remain.

I have touched only the fringe of a great subject; I have left undiscussed the numerous imperfections and disharmonies which civilisation has made manifest in structures concerned in the maintenance of posture,[27] and in those which are concerned with the circulation of blood and with the duties of respiration. I have said enough, I believe, to show that Metchnikoff was right when he declared that civilisation had launched man on a great experiment. From this experiment there is no turning back. We cannot return to the conditions of human life which prevailed in Britain 6000 years ago; there are more people in one of the lesser back streets of London than could find an existence in the whole length and breadth of the Thames valley if we were to resume the manner of living of our distant ancestors. We cannot go back; we must go on. Seeing how differently we are now circumstanced in every relationship of life—in food, in drink, in shelter, in warmth, in occupation, and in amusement—the wonder is, not that structural imperfections and functional disharmonies should develop in a proportion of our numbers, but that so many of us should escape harm altogether and enjoy good health. It says much for the adaptational reaction which is inherent to the human body that it withstands the artificial conditions of modern civilisation so well as it does.

How are our bodies to be protected against these ills with which civilisation threatens them? Metchnikoff, a declared and open rebel against Nature, hoped that science might discover some short-cut for man's escape, some way of speeding up the evolutionary machinery of his body and so making it perfectly fitted for the life which ever-advancing civilisation is forcing on mankind. I also believe that science will find a means of escape, but not by Metchnikoff's way. The solution of our problem is a fuller knowledge of the use and working of those parts of our bodies which are most apt to give way under our modern manner of living—the use of such structures as the great bowel. When we have replaced our ignorance by real knowledge we shall then be in a position, not to adapt our bodily structures to our mode of living, but our mode of living to our bodily structures. This seems to me the best way out.

[27] I have discussed the "Imperfections of Man's Postural Structures" in the *Brit. Med. Journ.*, 1923, vol. 1, pp. 451, 493, 545, 587, 642, 669.

Hypothesis about Push or Contact Force.[1]

By Sir OLIVER LODGE, F.R.S.

ONE of the remarkable discoveries of our times has been the pressure of radiation. Though this pressure is ordinarily so extremely minute that it was difficult to discover—and perhaps would not have been discovered had it not been predicted mathematically beforehand by Clerk Maxwell—yet in certain circumstances the pressure of light can be very large and of cosmic importance. Whether it has an influence and ought to be taken into account in the intimate structure of atoms, I am not prepared to say, but I suggest it. The Boscovich contemplation of regions where force changes sign, and our whole knowledge of the stability of Bohr's atomic orbits, represent facts which have not yet been accounted for.

[1] From the first Norman Lockyer Lecture, "On the Link between Matter and Matter," delivered to the British Science Guild in the Goldsmiths' Hall, E.C., on November 16.

Moreover, I am going to suggest that the pressure of light may have to be taken into account before the most ordinary operations of daily life, even the propulsion of a wheelbarrow, are properly explained. The force of ether-waves may encroach on the region of mechanism, and be needed for a fuller interpretation of the familiar mechanical force exerted by one body in contact with another. When denying action at a distance we must not slur over a difficulty by pleading that the distance is small.

It may seem absurd to demand a theory of the manner in which one piece of matter pushes another. Even if one denies actual contact between atoms, it is reasonable to think of each atom as so surrounded by planetary electrons as to oppose similar electrifications to each other, and thus account statically for the repulsive

force. But the electrons are in motion, and that suggests further non-static possibilities. Moreover, one effect of close approach is attraction followed by cohesion, if the approach is close enough—the atoms themselves, being charged, naturally arrange themselves for some collateral mutual attraction—a sort of residual affinity between the molecules. Why should there be repulsion instead of attraction at a certain distance?

The one thing that always gives repulsion without reference to sign of charge is radiation. Can any of this repulsion be due to radiation pressure? The idea is not to be turned down off-hand without consideration, unlikely as it may appear at first. The alternations of attraction and repulsion, at different distances apart, have to be accounted for somehow.

The pressure of radiation is proportional to the energy in unit volume, and in the case of heat radiation depends on the fourth power of the temperature, which again is proportional to the square of the atomic speed. The speed associated with any given temperature is not great; for example, the speed of helium atoms at ordinary temperature is reckoned by Eddington at 1 mile a second, and at 4 million degrees is still only 100 miles a second. The speed of electrons at the same temperature would be 40 times greater, but even that is not quick for an electron. They may be moving at anything up to 100,000 miles a second in an atom. But they are moving regularly; and regular motion is not temperature: temperature requires irregular motion. Well, my point is that the mutual perturbation of approaching atoms may cause the necessary irregularity, and that the radiation thus caused, at really close quarters, may be very intense.

We know that radiation is emitted or absorbed whenever an electron jumps from orbit to orbit. I picture the electrons of closely juxtaposed atoms as jumping up and down, like caged birds, from perch to perch. Each bird jumping up consumes energy, each bird jumping down restores it. No matter whether radiation is emitted or absorbed, the result is still repulsion. At each jump a quantum is emitted, and at very high frequencies the quantum is by no means negligible. The temperature comparable to a thirtieth of the speed of light is some thousands of millions of degrees, and the energy and pressure of radiation corresponding to that temperature are enormous; quite enough to account for any mechanical force.

Between the contiguous surfaces I picture radiation going and coming, emitted and absorbed, continually. There is no loss of energy, the radiation does not escape, but it can be very intense and can produce an enormous pressure, as it does in the interior of stars.

I spoke of the orbital electrons being perturbed by proximity, but they cannot be perturbed infinitesimally. Nothing short of a quantum of disturbance is effective. An orbital electron will not yield to any inferior disturbance; it cannot respond slightly, it responds by a jump or not at all. It is apparently under some constraint to remain in a stable orbit, until it can jump out; and if it jumps, it either emits or absorbs radiation. The quantised orbits are not susceptible to continuous perturbation: every occurrence in an atom is discontinuous. The frequency of the radiation, and therefore the energy of the quantum, will be determined by the speed-energy-difference between the orbits.

What reason is there to suppose that proximity would introduce perturbation of any kind? Well, in inverse square orbits, equilibrium is only preserved by a certain tangential velocity. Any sluggishness or retarding force causes a projectile to drop in; any tendency to increase the speed makes it move farther away. The law of conservation of areas will no longer be obeyed when a repulsive force is applied in the plane of the orbit. On one side the particle will be accelerated, on the other retarded. Ordinarily, revolution of the apses would occur. But this may become too violent to be thus conveniently described, and it is doubtful how much ordinary perturbations are permissible in the very peculiar stable orbits of Bohr. In a quantised orbit the above sort of influence must at some stage of violence lead to a jump. A jump cannot leave the particle's energy as it was: it gains too much by a fall, some must be emitted.

That is my present idea of the force which keeps bodies apart and enables one to push another.

Parenthetically we may observe that in massive atoms the inner electronic speed is very great, and so, from these, extremely high radiation may perhaps escape, and may stimulate spontaneous radioactivity in other atoms, by getting down to and ejecting some of the deep-seated nuclear electrons. If two of those go away, an alpha particle is likely to be driven out violently by electrical repulsion.

The state of matter in or near a nucleus may be comparable to the state inside a star like the companion of Sirius, except that gravitation is inoperative. The close-packed density is prodigious.

These ideas are crude, granted; but a working hypothesis is a thing to be worked, its consequences to be traced, and then either improved or discarded. Anyhow our aim ought to be to explain those facts on dynamical principles, perhaps not the ordinary dynamics, but etherial dynamics, and that is far from having been worked out; perhaps it cannot be said to have been begun.

Already some attempt has been made to assimilate radiation with matter by the unlikely path of thermodynamics. Radiation has been used as the working substance in a theoretical heat engine. Its pressure has thus been mechanically employed. It has been dealt with almost like a gas. The laws of gases—the statistical behaviour of discontinuous random particles—have been applied to electricity, and even to radiation. By this means not only can the known law of Stefan, connecting *total* radiation with temperature, be deduced, but also a law regulating the distribution of energy among different wave-lengths has been formulated by the genius of Wien: which formulation, though it is not yet fully explained, is nevertheless true. The average energy associated with any particular wave-length must be equal to some function of the product of wave-length and absolute temperature, divided by the fifth power of the wave-length. That is Wien's law. This law involves an unknown function, as well as the curious idea of the temperature of space or of radiation; for it deals with the waves statistically, after the manner of the kinetic theory of gases. The flying about of the radiation inside a completely

reflecting enclosure has a complete irregularity, which justifies the application of the term "temperature" to the energy therein contained.

As for the unknown function—the discovery of that was elucidated by Rayleigh, and completed by Planck; and it is there that the "quantum" made its appearance. For if the energy could be absorbed or emitted continuously, all the energy of matter would go into the ether, and the universe would fade away and die, or at least would cease to be active. The effect of discontinuous emission and absorption saves the universe from destruction, and makes this lively planet possible. If radiation could go on from atoms continuously, all the energy would get into the ether: matter would have none, and none of us would exist.

These discoveries have no human significance, people think. They are chock-full of significance. We are down among the foundation-stones of reality, the laws which make activity possible, the laws which perpetuate the atoms of which our own bodies are composed.

Scientific and Industrial Research in 1924–25.[1]

THE latest report issued by the Department of Scientific and Industrial Research consists, as usual, of a short summary report by the Committee of the Privy Council, a long report by the Advisory Council, a summary of the work done by research institutions directly under the Department, numerous appendices, and a good index. In the first report the view is expressed that the embarrassments and losses which British staple industries are suffering do not arise primarily from the neglect of science, although in many cases delay in recovery is caused by lack of scientific leadership. The successful application of scientific discoveries to industry is a slow and expensive business, as witness the delay of two generations in applying Faraday's work on electro-magnetism, and the interval of twenty years which elapsed between the discovery of artificial indigo and its successful exploitation at a cost of 1,000,000*l*. The Fuel Research Station is apparently following these precedents, for in spite of an expenditure of more than 400,000*l*. in seven years, it has found no solution of the problem of producing smokeless fuel at an economic cost. It is, however, stated that the work has produced profits and economies in other directions which exceed in monetary value the total expenditure on fuel research. Attempts to manufacture power alcohol from beets, mangolds, and Jerusalem artichokes have also proved abortive, although the last-named are still being cultivated in various localities for use in future tests.

The Food Investigation Board has devoted most of its attention to the handling and preservation of food in order to reduce loss and to increase supplies. The problem of the freezing of beef has been attacked from the point of view of the freezing of colloids, and it has been found that if a mass of colloid, *e.g.* a disc of jelly, be frozen slowly, ice forms on the external surface, whereas if the rate of freezing be high, congelation takes place within the mass. When eggs are preserved by cold, protein is thrown out of solution and is not redissolved on thawing. In the living organism highly insoluble substances are often held in solution by other substances, and freezing apparently renders them permanently insoluble. Changes undergone by fruit and vegetables during storage and transport are still under investigation, but the work on fish preservation has been held up owing to the impossibility of conducting experiments at an inland station. Many problems connected with cold storage are being studied at the National Physical Laboratory, such as the inflammability of heat-insulating materials, the physical properties of refrigerants, hygrometry, rate of flow of fluid in the circuit of a refrigeration plant; and on the chemical side, work is being continued on the higher unsaturated fatty acids, glycogen, and the formation of fat by yeast.

The Geological Survey has surveyed the coalfields and adjacent areas, investigated mineral deposits, water-supplies, and examined rocks and soils exposed during the construction of new roads. The Museum of Practical Geology and the Geological Survey are to be permanently housed in buildings to be erected adjoining the Natural History and Science Museums at South Kensington. A site has been acquired at Princes Risborough for the Forest Products Laboratory, but for the next two years work will be continued at the Royal Aircraft Establishment in Hampshire. Investigations in progress include the cause of brittleness in timbers, preservatives for wood other than creosote, and the improvement of kiln-drying practice.

Building research is assuming greater importance owing to the serious housing situation, and so a new and larger research station is about to be opened at Watford. The fundamental problems that are being attacked, under the advice of four expert committees, include: (1) architectural acoustics, moisture-condensation on internal wall-coverings, and the rate of transmission of moisture through building materials; (2) setting and hardening of cements, including non-corrosive oxychloride flooring materials, and changes in volume of building materials due to moisture changes; (3) preservation of stonework, and attempts to express "weathering" in terms of temperature and moisture variations; (4) wind-pressure on roofs, bridges, etc., vibration due to machinery, or road and rail traffic, permeability of concrete and its movements due to moisture and temperature changes, standardisation of tests for compression, abrasion, and hardness. Some of these investigations are already yielding results of immediate practical importance.

The work of the National Physical Laboratory (N.P.L.) is so vast and diverse that reference can only be made here to some of the investigations in pure science which it has undertaken recently, namely, calorimetry at high temperatures, the magnetic properties of iron and other alloys, properties of dielectrics, the vertical-force magnetometer, the efficiency of power transmission by gears, ferrous alloys free from carbon, and methods of spectrographic analysis of metals and alloys.

Important duties are also carried out by the various co-ordinating research boards. In chemistry, the commercial production of formaldehyde as a cheap

[1] Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1924–25. Pp. 155. Cmd. 2491. London: H.M. Stationery Office. Price 3*s*. net.

disinfectant for wool has been investigated, but owing to the cost of concentrating the dilute solutions obtained, success appears improbable. The production of carbon tetrachloride on a large scale, the corrosion of metals, accumulators, and containers for liquid oxygen, have been studied experimentally, but work generally has been impeded by the lack of adequate laboratory accommodation. More rapid progress can now be anticipated in view of the completion of the new chemical laboratory at Teddington, where special attention will be given to the study of chemical reactions under high pressures. The Engineering Co-ordinating Board has dealt with researches recommended by the Aeronautical Research Committee, such as light alloys, fatigue of materials, elasticity of steel strip, strength and properties of materials at high temperatures, prevention of rust, and tests for motor tyres. Among the researches undertaken in physics are: the silencing of aeroplanes, a high-power source of sound, acoustical properties of building materials, elasticity of aircraft materials, yellow glass for railway and aircraft lights, standardisation methods for the specification of colour, and the general nature of phosphorescence.

The gross expenditure on the various programmes of research was 303,070*l.*, of which 50,471*l.* was incurred for fuel research, 22,927*l.* for engineering, 17,571*l.* for food investigation, 14,529*l.* for chemistry, 13,948*l.* for radio, 11,940*l.* for building research, and 140,138*l.* for research and standardisation at the National Physical Laboratory. In all, 173,455*l.* was expended on the N.P.L., but nearly one-half of this sum was recovered in fees for tests and special investigations made for outside bodies.

The number of research associations in being during 1924–25 was twenty-five, of which twenty-one were in active operation. The Glass Research Association and the British Portland Cement Research Association have been liquidated, and the future of the Scottish Shale Oil Research Association appears doubtful. Research on glass will for the present be continued at the N.P.L., by the British Scientific Instruments Research Association, and in the Department of Glass Technology of the University of Sheffield. It is anticipated that a research association for food manufacturers will be launched shortly. Several associations appear to be in financial low water, and have needed the assistance of increased or extended grants; on the other hand, no payment was made to the British Iron Manufacturers' Association (which is temporarily suspended), or to the newly formed British Colliery Owners' Research Association.

The total disbursement on grants was 100,118*l.*, and the unexpended balance of the Million Fund was 518,200*l.* Average grants made to some of these associations during their existence—ranging from two to seven years—have been as follows: glass, 11,720*l.*; electrical and allied industries, 9552*l.*; cotton industry, 9819*l.*; scientific instruments, 9212*l.*; linen industry, 7510*l.*; portland cement, 4418*l.*; Scottish shale oil, 1500*l.*; rubber and tyre manufacturers, 5061*l.*; non-ferrous metals, 4070*l.*; boot, shoe, and allied trades, 797*l.* The total expenditure on the 258 grants made to individual research workers and students in training was 35,000*l.*; and the cost of administration at headquarters was 35,920*l.*, or about 6·5 per cent. of the total expenditure of the Department (539,199*l.*).

Obituary.

PROF. J. N. LANGLEY, F.R.S.

"YOU will always find it easy to generalise so long as you are content not to inquire too closely into detail." In these words, or words rather like them, Langley once expressed something which was very near to being the pivot of his intellectual outlook. The occasion was somewhere about the summer of 1900, when he was working at the properties of adrenalin, and discussing whether it could or could not be regarded as a general stimulant of the nerve-endings of the sympathetic system.

He came into the old physiological library at Cambridge, Foster's old room, from his operating room next door, to snatch a couple of rolls and a glass of milk. These formed the standard laboratory lunch of those days, and Langley would fall to talking about his work. Having finished his lunch he would return and perhaps operate until four or five in the afternoon, having started at about half-past ten. When he was conducting a research he would work in this way at high pressure for days on end, carrying through a long and exacting experiment each day, his marvellous skill as an operator making it possible for the animal which he was studying to remain in good condition for a very long time. When his experiments on a particular point were finished, he would absent himself from the laboratory until the paper was written—I am now speaking of the days before he was professor; when it had gone to press he would take up the next point. He was essentially a worker who did one thing at a time and developed his thesis, or allowed his thesis to develop itself point by point.

Langley was never content not to look too closely into detail. "The exception which proved the rule" had no meaning for him. It just upset the rule, and Langley was always more content to remain ignorant of "the rule" than to compromise in the slightest degree with the detailed statement of facts. His attitude was possibly born of his experience in making his survey of the autonomic system. That was his great work, and alone it would have formed a sufficient basis for his equally great reputation. Whether or not it was a feat of anatomy rather than of physiology is a matter which might provoke discussion. I have thought at times that had Langley labelled himself as an anatomist he would have been accorded an outstanding position in that subject. It would have been difficult for him to adopt that label, for he was not a qualified medical man, and indeed I suppose he was one of the first men who were pre-eminent in physiology without being medical practitioners. As time has passed, Langley's example has been followed by many another, and I imagine that as chemistry plays an increasing rôle in physiology, an increasing number of physiologists will be "unqualified."

To return, however, to the autonomic system; the methods by which Langley explored it were partly physiological and partly anatomical. On the physio-

logical—or perhaps even the pharmacological side—he discovered that nicotine abolished the conductivity of a synapse. This discovery provided a method for the charting of all stations throughout the autonomic system. One such still bears his name—Langley's ganglion in the submaxillary gland. Also, of course, much of his routine consisted in the stimulation of nerve-trunks with the object of ascertaining what response was produced in the peripheral endings attached to them. But a great deal of the method was frankly anatomical. It consisted in cutting a nerve-trunk and seeking out through the innumerable ramifications of the sympathetic system the destination of all the cut fibres. These might amount to hundreds or even thousands. The cut fibres were allowed to degenerate and so could be recognised from their sound fellows by their histological appearance. When the fibres had degenerated the animal was killed, all the peripheral nerves involved were examined, and the sound fibres were separated from the degenerate ones and the latter were teased out into rows under the microscope and counted.

It is not very easy to appraise the value of Langley as a lecturer; in my student days he did not give elementary lectures; therefore I can only speak of his advanced lectures at first hand. My memory of these is that they were mines of information, and the notes which I took from them were of the utmost use to me in subsequent teaching. But I remember also that to get a clear idea of the lectures required very close attention on the part of the student. Langley's method was to pass from one subject to another by a very gentle gradation rather than by an abrupt change; so gradual indeed was the passage that unless the student was attending pretty closely he ran the chance of missing it altogether. If that happened—if, for example, you thought he was still lecturing about the spleen when he had really passed to the thymus—it was not very easy to pick up the threads. This habit, which provided an occasional stumbling-block to advanced men, presented, I imagine, much more difficulty to a class more ignorant and less able to concentrate. At all events it is certain that different persons derived very different amounts of benefit from his elementary course. No one, however, regarded the lectures as in any way trivial, or Langley as anything but the great physiologist which he was. It was a matter of conscience with him to demonstrate in person throughout the whole of every practical class in histology, and also many of those in the "machine room," his object being to get to know each man individually in so far as that object could be attained.

Langley was seventy-three years of age at the time of his death on November 5. He and Sir Edward Sharpey-Schafer formed the remaining two of a generation of experimenters which really placed British physiology in the position which it now occupies. That position has been amply sustained by a brilliant group of men ten years or so their juniors. Langley's whole life as a physiologist was spent in Cambridge, excepting a short time after the taking of his degree when he worked in Heidenhain's laboratory. It was there, I think, that his interest in the salivary and other secreting glands commenced. That interest, by a gradual transition, led to an investigation of the nerves which operated them. Those were days of antagonistic nerves; the salivary glands provided an outstanding example of their action, and it was not unnatural to hope that if the action of the chorda tympani and the sympathetic respectively on the protoplasm of the submaxillary gland was understood, a great stride would have been achieved towards the comprehension of living processes in general. It was not to be. Nearly fifty years have passed; much work has been done (the most recent being that of Anrep and Harris), and the submaxillary gland now appears rather the example of an anomalous meeting-place of the cutaneous and internal innervations than the *venue* of a typical process of life. Langley, I think, saw this. At any rate, he forsook the study of its cells and was led by that of its nervous supply to the investigation of the autonomic system as a whole.

In Cambridge, Langley took an active part in the organisation of the scientific side of things. He was chairman, at the time of his death, of the Special Board of Biology and Geology, and at an earlier period he served a term in the Council of the Senate. Langley's "distinctions" were so numerous as to make their mere recital tedious; they occupy about a dozen lines of small print in the year book of the Royal Society. Probably there was none that he valued more than the Royal Medal of the Royal Society itself.

The above account of Langley has of necessity dealt chiefly with his scientific work. It would be incomplete without emphasising the fact that, scientist as he was, he was singularly many-sided and the very antithesis of the stage professor. Excellent company, whether as a host or as a guest, and fond of outdoor exercise of many kinds, he excelled as a skater. At one time it was his custom to go to Switzerland for the winter, and in the early 'nineties possibly there were not a dozen such good skaters as he in England.

Langley has left two material monuments, the *Journal of Physiology* and the Cambridge Physiological Laboratory. Of the former he became owner and editor. By universal consent there is no better journal; it was rigorously edited, papers were ruthlessly pruned of anything which was redundant or confusing—"woolly," as Langley used to say. Yet as an editor Langley had a wonderful sense for the important, and, severe as was his critical faculty, he had a generous appreciation of any grains of real merit in a man's work. The Physiological Laboratory at Cambridge is no less the product of his power of minute organisation. He, aided by Dr. (now Sir Walter) Fletcher, set himself the task of producing a laboratory which should be adapted, down to the minutest details, for the very various kinds of work which went on in Cambridge at that time, the work of Gaskell, of Anderson, of Hardy, of Mines, of Fletcher, of Keith Lucas, of Rivers, of Hopkins,[1] of Hill, and of quite a number of others. Greater than any material monument, however, is that of the school of workers over which he presided.

J. BARCROFT.

PROF. A. V. HILL writes: "Attention has been directed recently in the Press to the faculty of prophecy which—within limits—mankind possesses. The

[1] The physiological laboratory as originally designed included a wing for biochemistry.

following letter sent to me just sixteen years ago (Nov. 11, 1909) by my late friend and master, Prof. J. N. Langley, is an example of those qualities of scientific judgment which, on occasion, enable men of rare intellect and knowledge to predict the future. In view of what has happened since he wrote, in the scientific study of muscle, physiologists will appreciate the accuracy and insight of Prof. Langley's forecast and advice; and they may be glad to read, as a tribute to his scientific memory, the words which he himself wrote in 1909."

HEDGERLEY LODGE,
CAMBRIDGE,
Nov. 11, 1909.

MY DEAR HILL—I have been thinking over the question of what piece of work it would be best for you to undertake. I am inclined to think that you might settle down to investigate the variation in the efficiency of the cut-out frog's muscle as a thermodynamic machine. A good many years ago Heidenhain and Fick worked at this, but there is an especial problem suggested by Fletcher and Hopkins' work, as to the efficiency of the muscle working with and without oxygen, which I don't think has been touched. Once started there are plenty of further experiments to do, and the question is a very important one for muscle physiology. . . . I have, I think, Blix' apparatus in the Laboratory [he had bought it some time before as a speculation for some future pupil] which he stated to be delicate enough to show the heat developed in frog's muscle by a single muscle contraction, and we can get any other apparatus you want.

So think it over. I enclose a couple of pages showing some of the bearings of the problem.—Yours sincerely, J. N. LANGLEY.

MR. THOMAS CASE.

MORE than one branch of learning is the poorer for the death of Thomas Case, late president of Corpus Christi College, and sometime professor of moral and metaphysical philosophy at Oxford. He was an accomplished musician, a learned student of architecture, and in his day a most successful lecturer on ancient history. Philosophy was with him only one among many interests which claimed his attention almost equally. In philosophy he was as one born out of due time. A man of singularly individual mind and temperament, he took his own line in philosophy, and vigorously resisted the semi-Kantian, semi-Hegelian idealism which in his earlier days became the prevailing philosophy at Oxford. But though he resisted it, the influence of Green and Wallace, of Bradley and Bosanquet, was too strong for him, and he remained to a large extent a solitary figure among Oxford philosophers—less fortunate in this respect than Cook Wilson, whose reaction against idealism carried with it the support of many of his younger colleagues. Wilson's realism was, it must be admitted, the better based and the more philosophical of the two.

Case was always somewhat too dogmatic in his mode of thinking and of presentment. His own insight was often keen and penetrating, and he was too apt to assume a readier assent to what to himself seemed clear, than he was actually likely to receive from the average reader. It must be confessed, also, that he was capable of strange blunders. In his first book, "Physical Realism" (1888), while he says much that is acute and well worth reading, he puts forward a theory of the object of perception which is one of the least plausible of all theories on the subject—that what we see or hear is our optic or auditory nerves coloured or resonant.

Apart from this book, Case's chief philosophical writings are the articles on logic, on metaphysics, and on Aristotle in the 11th edition of the "Encyclopædia Britannica." The article on metaphysics is a learned and able study of the main trends of metaphysical thought in modern times. That on logic, while devoted in part to expounding the views of Case's two heroes in philosophy, Aristotle and Bacon, shows considerable appreciation of the advances made by the subject in the nineteenth century. The article on Aristotle is notable for the attempt, in which Case to a large extent anticipated the brilliant German scholar Werner Jaeger, to trace a development in Aristotle's thought as between different writings and to use this as a reason for the determination of their dates. Two of his main contentions, that the "De Interpretatione" and the "Eudemian Ethics" stand on the direct line of development from Plato's thought to that most typical of Aristotle, and are therefore genuine and early works, are likely to stand the test of time.

To the younger generation at Oxford, Case's attitude on political and academic questions seemed to be that of extreme toryism. But he himself insisted that he was not a Tory but a Palmerstonian Liberal. He was, first and last, above everything else an individualist. What could not be doubted by any one was that he was an able, public-spirited, and extremely formidable fighter in whatever cause he espoused. Oxford had no more genial, clever, and amusing resident than "Tommy Case," as he was universally called, *amoris causa*.

SIR JOHN MACALISTER.

SIR JOHN YOUNG WALKER MACALISTER, who died in his seventieth year on December 1, had been for many years secretary and consulting librarian to the Royal Society of Medicine, a post in which his imagination, energy, and personal charm enabled him to do great things. The second son of Donald MacAlister of Tarbert, Cantyre, he was educated at Liverpool High School, studied medicine for three years at Edinburgh, and was then driven by ill-health into the quiet waters of librarianship, only to spend the rest of his life in overflowing his banks, much to the benefit of the surrounding country. He passed rapidly from a sub-librarianship at Liverpool to librarianships at Leeds, at the National Liberal Club, and finally, in 1887, at the Medical and Chirurgical Society, then uncomfortably housed in Berners Street. Under its new librarian's inspiration, the Society soon moved to a fine house at 20 Hanover Square, where it became the benevolent landlord of many other associations.

While the Medical and Chirurgical Society was developing in its new quarters, MacAlister put in eleven years of fine work as the honorary secretary of the Library Association, which he piloted until it obtained a royal charter in 1898. He also founded *The Library*, which for ten years was the organ of the Association, for twenty more an independent quarterly,

and six years ago was handed over by him to the Bibliographical Society, which itself had been founded, in 1892, at a meeting at 20 Hanover Square, brought together by MacAlister. By 1905 his ideals for the Medical and Chirurgical Society had taken definite shape, which led to the building of its present fine quarters at the corner of Wimpole Street, where it now thrives as the Royal Society of Medicine, with some four-and-twenty associated societies under the same roof. At the dinner which was given to MacAlister in 1920, after he had been knighted, Sir William Osler, who was in the chair, hailed him as the layman who had done more for the profession of medicine than any doctor, a fine achievement for a man who had been prevented himself by ill-health from adopting it as a career.

WE regret to announce the following deaths:

Mr. R. G. Backall, a pioneer in X-ray work at the London Hospital and the recipient in 1923 of the honorary certificate of the Carnegie Hero Fund, on November 29, aged forty-four years.

Prof. E. D. Campbell, chief of the chemical and metallurgical laboratory in the University of Michigan, member of the Iron and Steel Institute, known for his work on the constitution and magnetism of iron-carbon alloys, who was blind for the past thirty-three years, on September 18, aged sixty-two years.

Dr. W. R. Dykes, secretary of the Royal Horticultural Society and an authority on the genus Iris, on December 1, aged forty-eight years.

Mr. W. P. Hiern, F.R.S., author of "Dicotyledons" (1896–1900) and of a monograph on the Ebenaceæ (1873), aged eighty-five years.

Current Topics and Events.

OUR readers will accord hearty congratulations to Prof. W. C. Unwin, F.R.S., a veteran of the engineering world, who celebrates his eighty-seventh birthday this week, namely, on December 12. An Essex man, he was educated at the City of London School, and afterwards became a pupil in the firm of William Fairbairn, Manchester. Following the managership of engineering works, he was engaged as instructor at the Royal School of Naval Architecture and Marine Engineering, South Kensington, 1868–72; afterwards as professor of hydraulic engineering at the Royal Indian Engineering College, Coopers Hill, 1872–85. Prof. Unwin then took up a professorial post at the Central Technical College of the City and Guilds of London, occupying this for twenty years. One might have thought that this long period of strenuous work would have dulled endeavour, but it was otherwise. In 1911 he was president of the Institution of Civil Engineers. At a conference there in that year on the training and education of engineers, Prof. Unwin said: "I believe the idea that a college course unfits a man for practical work is a wholly mistaken one . . . the view of the employer who looks only to the immediate usefulness of the student is a short-sighted one." On retirement from office the late Sir William White emphasised that "Unwin was looked upon as a master and teacher of the science of engineering." In 1915 the professor was elected president of the Institution of Mechanical Engineers. His portrait, painted by Harold Speed, may be seen there—testimony to service. Prof. Unwin's views on the organisation of research work on British timber may be quoted as of current interest. Speaking at the Royal Society of Arts, in 1913, he remarked that if a forest laboratory were established on any considerable scale in Great Britain, the discovery of information about our colonial timbers would be of even greater importance than that dealing with home forest products. So recently as April last, Prof. Unwin took part in the discussion of a paper by Mr. G. A. Hankins on "Hardness Research Tests," at the Institution of Mechanical Engineers.

PROF. JOHN T. CASH, F.R.S., formerly Dean of the Faculty of Medicine in the University of Aberdeen, will be eighty-one years of age on December 16, and to him also our cordial congratulations are extended. After graduating at the University of Edinburgh, he engaged in scientific research at Berlin, Leipzig, and in London. He collaborated with the late Sir Lauder Brunton, F.R.S., in a series of medico-chemical studies, detailed in papers, notably "Contributions to our knowledge of the connexion between chemical constitution and physiological action"; "On the effect of electrical stimulation of the frog's heart and its modifications by heat, cold, and the action of drugs"; "Action of caffein and theine upon voluntary muscle."

IMMEDIATELY after the tragic death of Prof. Maxwell Lefroy on October 14, an appeal was made to the public to subscribe twenty thousand pounds to establish a memorial to him. The institution which made this appeal is called the College of Pestology (Incorporated), with a registered office in Bedford Square, London. The "College" is not included, however, in any standard book of reference of educational institutions, and apparently it exists as such an institution only in name, for there seem to be no laboratories or staff, except the honorary director, Mr. A. Moore Hogarth. It formerly existed as the Incorporated Vermin Repression Society, and the present name was assumed only two or three years ago. The "College" has, of course, no connexion with the University of London, and its title is therefore a little misleading to those who do not know the difference between a propagandist body and an educational institution. We have complete sympathy with what the organisation has done in directing attention to the danger and destruction due to rats, mosquitoes, and other pests, but it is another matter to ask the public to subscribe twenty thousand pounds for "a chair and centre of applied biology at the College of Pestology, Bedford Square." If a memorial is contemplated, surely the right place for it would be the Imperial College of Science, South Kensington, where Prof. Lefroy had his laboratory, and where he met with the accident which led to his death. In any event, a matter of this kind ought not to be in the hands of a small committee connected with such an unofficial organisation as the College of Pestology, but of a representative group

which would include Prof. Lefroy's scientific colleagues. We hope, therefore, that further consideration will be given to the proposal and the constitution of the appeal committee before subscriptions are sent in response to the circular letter recently distributed.

THE Streatfeild Memorial Lecture was delivered on December 3 at the Finsbury Technical College, London, by Mr. F. H. Carr, who spoke on "The Scientific Basis of Industry," and dealt chiefly with the training of chemical engineers, and with the possibility of prolonging the existence of the College in a new form. Like many others, Mr. Carr regrets the impending dissolution of "Finsbury," which was a pioneer in teaching the elements of engineering to chemical students, and in educating them for industrial careers. The view is often expressed, and Mr. Carr seems to share it, that the successful application of science to industry is the main pivot upon which civilisation hangs, and that the future belongs to those nations which can attain a higher standard of living and shorter hours of work by substituting machines for human labour. This material view of progress may be sound economically, and we know that there is a constant interaction between the material and the non-material, but surely such factors as character, courage, adaptability, and eugenics are at least of equal importance. Herein, we believe, lay the weakness of those who favoured specialised training for the immature in the isolated technical college, as against training in the much wider culture offered by the university proper. Man cannot live by bread alone, and even the highest technical efficiency cannot save a nation if it is wanting in the more spiritual virtues. It is therefore with interest that we note Mr. Carr's suggestion that the future of "Finsbury" should lie in a close association with the University of London. In the past, he says, chemists have been trained on lines that were too stereotyped; the student with little aptitude for abstract studies, but with great potential capacity for technology, has failed to profit from the ordinary degree-course in science; and the fault lies with the course of study, not with the student.

IN 1914, Great Britain was crying out for men who could apply science to industry, and particularly for chemical engineers. The need is still urgent. The Ramsay Memorial Laboratory of Chemical Engineering at University College, London, lacks endowment and the necessary means to develop. The Finsbury Technical College is about to be closed down. Why not, says Mr. Carr in effect, solve the three problems simultaneously by accommodating the Ramsay Laboratory in the Finsbury buildings, and asking the City and Guilds of London—or a private benefactor—for a generous endowment? The idea is ingenious and well worth examination; but whether it be accepted or not, there is no doubt of the need in Great Britain of a great school of chemical engineering comparable in magnitude and efficiency with those possessed by Germany, Switzerland, and the United States, which, as the lecturer pointed out, have been responsible for some of the greatest recent advances in applied chemistry. Such a school would require not only a different equipment, but also a different curriculum from those now in use in our universities. To obtain admittance, the student should have reached the standard of the London Intermediate Science Examination; training in engineering should not wait upon an advanced knowledge of organic and physical chemistry, but should precede or accompany it. Adequate provision should be made for research in applied chemistry, which demands a more mechanical type of technique than that upon which chemical technologists have been reared in the past; and special attention should be given to bridging the gap between laboratory and works. It is a fallacy to think that any one type of chemical education is suitable for all. The student who is to control plant or manage a works requires more than a good foundation of general science; he needs an insight into works' problems, and special knowledge that will help him to solve them.

AT the opening of the National Radio Conference, held at Washington in November, Secretary Hoover said that the interests of the listening public must come before all other interests. He first pointed out that the leading position in the international field is taken by American radio-telegraphic companies. Direct service with Sweden has been commenced, and in another year telegraphic communication will be established with practically every country in the world. During last year there was a great increase in the number and the power of the broadcasting stations in the States. Last year there were 115 stations using 500 watts or more and generating a total power of 67,500 watts. There are now 197 stations and the total power has increased to 236,500 watts. The desire for publicity is the basic motive, and furnishes the financial support for almost all the broadcasting that is taking place. Listeners may well object to their sets being monopolised at stated times by advertising matter. In the future it will be necessary to distinguish between unobtrusive publicity accompanied by an engaging entertainment and unobtrusive advertising. The problem of interference has become a serious one. In the States there is a total of 578 stations, no more than four of them being under the same management, and there are now pending 175 applications for new broadcasting stations. Something therefore has to be done. A few high power stations operating full time give a far better service than many smaller stations operating for part time only. Mr. Hoover considers that the allotment of wave-lengths, the control of power, and the policing of interference should be in the hands of the Federal Government. Although radio is not circumscribed by State lines and still less by city boundaries, it is possible to establish zones which roughly correspond to service areas. Each zone might be entrusted with the settlement of its own local problems.

EVERY year brings forward new evidence that insects are important factors with reference to

public health, and the list of diseases that are partially or entirely spread through the agency of these organisms is steadily increasing. The first human disease to be traced directly to an insect carrier was malaria, and this discovery gave the impetus which has led to the recognition of the extensive rôle played by insects in disease-transmission, either from man to man or from one animal to another. The efforts of the entomologist, coupled with those of sanitarians and doctors, have resulted in truly remarkable progress being made in the reduction and restriction of such diseases as yellow fever, malaria, typhus fever, and plague. The subject of "Insects in Relation to Public Health" was selected by Sir Wilfred Beveridge for a Chadwick Public Lecture delivered by him in the Barnes Hall of the Royal Society of Medicine on November 18. Apart from its value in economics and the prevention of disease, the study of insect life, Sir Wilfred maintained, generates the quality of accurate discrimination and develops the capacity for observation. A knowledge of entomology, he added, is essential to every medical man, but training in that subject is generally restricted to those who embark on public health work or practise medicine in the tropics. A knowledge of entomology likely to be of real value must not be confined merely to the study of insects which are at present known to be injurious, but should be sufficiently comprehensive to enable the student to be prepared for any new problem that may arise. The measures in vogue for combating flies and other insects carrying disease germs were referred to, and Sir Wilfred showed the importance of regulating our sanitary efforts so as to reduce the breeding places of such insects. In dealing with the planning of preventive measures, the importance of studying natural methods of control was pointed out, and how they should be emulated so far as may be possible in the campaign against noxious insects.

PROF. F. G. PARSONS delivered at St. Thomas's Hospital on December 4 an interesting lecture on the early inhabitants of London, illustrated by specimen skulls of the Long Barrow type—surviving among the miners of the Forest of Dean—the Beaker folk and the Celts or prehistoric Nordics. Evidence pointed to Cymbeline as a possible founder of London. His capital was at St. Albans, and the position of London may have been selected for purposes of trade at a point lower down the river than the earliest ford at Westminster. Cymbeline's name is recorded in the name of the Buckingham villages, Great and Little Kimble, in the Chiltern country, which was the limit of his kingdom. That the earliest site of London was in the south of Cornhill is indicated by two lines of evidence: first, the absence of Roman interments in that area, and secondly, the recently discovered relics of Boadicea's burning of London. The converging Roman roads are evidence of the importance of London. Melitus, the first Bishop of London, ruled in the early part of the fourth century. The lecturer also dealt with the second Nordic incursion and the relations of the Saxons, Franks, Angles, Frisians and so-called Jutes to London.

SIR RONALD ROSS is leaving for Ceylon on the s.s. *Yorkshire* on Friday, December 11. His journey is being undertaken at the invitation of the Ceylon Association and he will investigate conditions in the island from the point of view of malaria control. Plantations in various areas will be visited, and Sir Ronald hopes to be able to advise as to methods which should be adopted in combating the disease.

THE sixteenth annual exhibition of the Physical Society of London and the Optical Society, which is to be held on Tuesday, Wednesday and Thursday, January 5, 6 and 7, at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, will be open in the afternoon (from 3 to 6 P.M.) and in the evening (from 7 to 10 P.M.). The following lectures have been arranged:—Mr. J. E. Barnard, on "The Search for Ultra-Microscopic Organisms," at 8 P.M. on January 5; Prof. A. F. C. Pollard, on "The Mechanical Design of Instruments," at 8 P.M. on January 6; and Major W. S. Tucker, on "Electrical Listening," at 8 P.M. on January 7. Some seventy firms are exhibiting scientific apparatus, and in addition there will be a group of non-commercial exhibits by fellows of the Societies and others, including demonstrations of famous historical experiments in physics, recent physical research and effective lecture experiments. The exhibition will be open to the general public without tickets on the third day, January 7. On January 5 and 6 tickets of admission, obtainable from the secretaries of scientific societies or from Prof. A. O. Rankine of the Imperial College of Science and Technology, will be required.

THE scientific society known as the Priestley Club, founded in 1875 for the purpose of promoting the discussion of scientific topics and of facilitating the social intercourse of scientific men in Leeds and the West Riding of Yorkshire, is to celebrate the attainment of its jubilee by a dinner in the University, Leeds, on Tuesday, December 15. The members of the Club include chemists, physicists, biologists, mathematicians, medical men and technologists who, for the most part, are engaged in scientific work at the University of Leeds or other institutions, in the industries of the neighbourhood, or in the practice of the learned professions. The speakers will include Sir J. C. Irvine, Principal of the University of St. Andrews; Dr. J. B. Baillie, Vice-Chancellor of the University of Leeds; and Prof. Arthur Smithells.

THE weather in Canada during October, as shown on the weather map of the Canadian Meteorological Service, was abnormal in several respects. In arctic Canada the weather was warmer than usual in that month, in some places by so much as 6° F., while elsewhere it was a cold October, and in some parts, as Saskatchewan, the coldest October for fifty years. In British Columbia there was a remarkable deficiency of rainfall; in Saskatchewan the deficiency was less marked, and in Alberta all districts except the extreme south-east had an excess. In eastern Canada there was much more snow than is usual in October and precipitation generally was in excess of the normal. Threshing and ploughing in the prairies were carried

on with great difficulty, and in some districts considerable work was unfinished at the end of the month. Nowhere, in fact, was October a favourable month for agricultural work.

THE majority of modern scientific appliances are the results of team work, and the cinematograph is no exception to this. So long ago as 1870, Henry Heyl exhibited on a screen in Philadelphia a series of posed pictures showing the movements of a couple dancing, but it was C. F. Jenkins, of Washington, who invented the first practical projector for throwing on the screen life-sized pictures from films taken of living moving objects. His first public exhibition took place in 1894 in Richmond, Indiana. The following year the brothers Lumière gave a public exhibition of cinematograph pictures in a café in Paris. The site of this, the first cinema hall in the world, is No. 14 Boulevard des Capucines, and we note with interest that the municipality of Paris is to commemorate the event by placing a tablet on the building which now stands on the site.

THE lecture arrangements at the Royal Institution before Easter next year have recently been announced. The Juvenile Lectures will be delivered by Sir William Bragg on "Old Trades and New Knowledge," commencing on December 29 at 3 o'clock. On Tuesdays, at 5.15 P.M., beginning on January 19, there will be two lectures by Dr. J. A. Crowther on "X-rays and Living Matter"; two by Dr. E. K. Rideal on "Surface Action"; four by Prof. J. Barcroft on "The Egg"; and two by Dr. C. H. Desch on "The Growth of Crystals." On Thursday, January 21, at the same hour, Dr. C. J. Patten will give the first of two lectures on (1) "The Language of Birds," (2) "The Breeding Factor in Birds." These will be followed by three lectures by Dr. J. L. Myres on "Who were the Greeks?"; three by Dr. C. D. Ellis on "The Atom of Light and the Atom of Electricity"; two by Dr J. Holland Rose on "The Indecisiveness of Modern Warfare." On Saturday afternoons at 3 P.M. Mr. Henry Balfour will give two lectures, commencing on January 23, on (1) "The Evolution of Currency and Coinage," (2) "The British Coracle, or the Skin-covered Boat and its Affinities." On succeeding Saturday afternoons there will be two lectures on "The Nature and History of the Triad and the Perfect Fourth," by Sir Walford Davies, with musical illustration; two by Dr. George Macdonald on "Roman Britain"; and four by Sir Ernest Rutherford on "The Rare Gases of the Atmosphere and their Importance in Atomic Theory." The Friday evening meetings will begin on January 22, when Sir William Bragg will deliver a discourse on the work of the Davy Faraday Research Laboratory. Succeeding discourses will probably be given by Sir William Hardy, Prof. George Gordon, Prof. Robert Robinson, the Hon. J. W. Fortescue, Dr. C. Hagberg Wright, Sir J. J. Thomson, Mr. John Tweed, Sir Ernest Rutherford, and others.

THE Pathological and Bacteriological Laboratory Assistants' Association continues its successful career under the presidency of Prof. H. R. Dean, of Cambridge. There are now 102 registered members who have obtained certificates of proficiency in various branches of pathological laboratory work, 158 ordinary members and 97 junior members. Regular courses of lectures and practical instruction are organised by the branches, of which the one in London is the largest and most active, and the educational policy which has throughout been pursued is proving very satisfactory. The founders of the Association from the first had in mind the ultimate inclusion of all laboratory assistants in one federation, and the Association admits as associate members laboratory assistants in any recognised scientific laboratory. It is hoped that from this may spring sections following for other branches of scientific work the lines of the educational programme of the parent Association, which is prepared to offer financial and any other assistance which it can. The secretary is Mr. H. P. Hudson, Panama Villa, Trumpington, Cambridge.

THE opening meeting of the Illuminating Engineering Society on November 26 was, as usual, devoted to reports of progress and exhibits of novelties. The customary report of progress, presented by Mr. L. Gaster, referred to the course in illuminating engineering recently established at the Polytechnic, Regent Street, and to the varied work now being done by the committee working under the Department of Scientific and Industrial Research. The latter is dealing, amongst other matters, with methods of lighting necessary for difficult factory processes, and for authority and impartiality it cannot be readily paralleled elsewhere. Equally important is the work of the various British Engineering Standards Association committees concerned with standardisation. It is hoped that these activities will be described more fully at a forthcoming meeting. Another outstanding feature is the development of interest in illumination abroad. There have been frequent references made to this subject at international congresses, and the necessity for Great Britain to be strongly represented at such gatherings was urged. The exhibits included a new form of long-burning enclosed flame arc, from which much is expected; the mutochrome projector, by the aid of which any desired coloured pattern can be built up and projected on the screen; and a new form of integrating photometer exhibited by Col. Kenelm Edgcumbe. Another item was the demonstration of the use of partially colour-sprayed lamps with motor-car headlights; by this means, it is claimed, the greater part of the beam can be limited below a given horizontal plane, with the advantage that the "cut-off" is gradual, a mild diffused light being emitted above this level.

THE Department of Scientific and Industrial Research has published a *Bulletin* (No. 1) *of Building Research*, describing the preparation and use of magnesium oxychloride in flooring compositions. Details are given of the constituent materials, method of mixing and laying, surface treated, the advantages and disadvantages of the material, together with tables of analyses showing the effect of varying the composition on the tensile strength.

AN address delivered in the United States by Prof. Alex. Findlay, of the University of Aberdeen, entitled "The Appeal of Science to the Community," appears in *Science* of October 23. In spite of its immense utilitarian value to mankind, Prof. Findlay considers that the real claim of science to a fuller appreciation is for its idealistic aim, the seeking out of the truth. Prof. Findlay expresses disagreement with those who claim that, on account of the great benefits to be derived from the diffusion of scientific knowledge, men of science should have special power in the general government of the country.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—Works chemist and organic chemist—Research Department, The Walpamur Co., Ltd., Darwen, Lancs. (December 15). Assistant at the Commonwealth of Australia Solar Observatory at Mount Stromlo—High Commissioner for Australia, Australia House, Strand, W.C.2 (December 18). Assistant engineer for the Timber Mechanics Section of the Forest Products Research Laboratory, South Farnborough—Secretary, Department of Scientific and Industrial Research, 16 Old Queen Street, S.W.1 (January 1). Senior agricultural officer for the Department of Agriculture, Nairobi—Private Secretary (Appointments), Colonial Office, 38 Old Queen Street, S.W.1 (January 31). Several men with training in experimental psychology —Secretary, National Institute of Industrial Psychology, 329 High Holborn, W.C.1.

ERRATA.—The writer of the article "Does the Solar Heat Stream Vary?" (NATURE, November 21) directs attention to two corrigenda. The quotation from Mr. Clayton on p. 755, col. 2, should read "These were supplemented by telegrams of the maximum temperature observed at Seattle, Williston, and Chicago, in order to ascertain to what extent the temperatures at those stations were responding to solar changes." It should have been stated at the top of col. 1, p. 756, that, with *un*correlated variables, the standard value of a correlation coefficient, computed from 84 samples, was about 0·11.

Our Astronomical Column.

COMETS.—Further observations of Van Biesbroeck's Comet on November 27 indicated that the R.A. of the Möller-Strömgren ephemeris was too small by 1 sec., and its declination too large by 0·7′; these discordances are small, and are in the direction of making the perihelion passage a day or two earlier than September 29, and the perihelion distance slightly greater than 1·447 units. The proximity of the moon has probably prevented later observations.

Comet Wilk-Peltier was observed at Greenwich on December 5 and 6; the approximate position on December $5^d\ 17^h\ 16^m$ U.T. was R.A. (1925·0) $19^h\ 29^m\ 59{\cdot}7^s$, N. Decl. 1° 21′ 27″. The comet was bright with decided central condensation, and was visible before twilight ended.

The following elements and ephemeris for 0^h are by Dr. A. C. D. Crommelin from observations extending to November 24:

T	1925 Dec. 7·2828 U.T.
ω	126° 22·35′
Ω	141 0·16
i	144 34·17
log q	9·88281.

	R.A.	S. Decl.	log Δ.
Dec. 10.	$19^h\ 43^m\ 38^s$	3° 26′	0·0373
14.	19 52 58	7 0	0·0851
18.	20 0 11	9 58	0·1271
22.	20 5 55	12 29	0·1640
26.	20 10 38	14 39	0·1961

The comet will be lost in the sun's rays after January 10 (about), but may still be within reach when it emerges.

TOTAL SOLAR ECLIPSE OF JANUARY 14, 1926.—The Einstein problem has practically monopolised the attention of British eclipse expeditions since the War. It is now considered that sufficient evidence has been obtained to verify the prediction of light-bending, and the observers are free to resume the spectroscopic study of the corona. An article in the *Observer* of December 6 refers to Prof. E. A. Milne's predictions as to the relative intensities of the lines in the coronal spectrum, made on the basis of Bohr's theory. Special endeavour will be made in Sumatra to test these predictions. In addition to Mr. F. J. M. Stratton and Mr. C. R. Davidson, the party there will include Dr. F. W. Aston.

An article in *Science* for November 20 describes the programme of one of the American expeditions to Sumatra, consisting of Prof. H. T. Stetson of Harvard, Dr. W. W. Coblentz, Mr. W. Arnold and Mr. W. A. Spurr. They are taking a reflecting telescope of 20-inch aperture with radiometric and photometric accessories, and will make measurements of the coronal radiation by vacuum thermo-couples, and photometric studies of the colour and brightness of the corona by photographic methods; these will be in continuation of those made last January in Connecticut. This expedition, and that from Swarthmore College, will be located at Benkulen.

RECENT LARGE SUNSPOTS.—The last sunspot minimum occurred about the middle of 1923. Since that date, solar activity has been rising consistently, and for some months past the increase has been very marked. More recently, there have been three very large spot disturbances visible to the naked eye. Particulars of these are given briefly as follows:

Date on Disc (1925).	Central Meridian Passage (G.M.T.).	Latitude.	Area.
Oct. 14-26	Oct. 20·4	19° S.	1/900
Nov. 8-20	Nov. 13·6	15° S.	1/800
Nov. 18-30	Nov. 24·5	17° N.	1/650

(Areas are corrected for foreshortening and express the proportion of the sun's hemisphere.)

The first of these groups contained a large principal spot with smaller companions. The second consisted of a pair of large spots of remarkably rapid growth and decay, in the place occupied by a moderate spot disturbance in the previous rotation. The third group was a very large stream, some 17° of longitude in length. It was a conspicuous object through the mist and fog prevailing in London on several days towards the end of November, and it was picked up by several people previously unaware of its existence.

It is remarkable that no magnetic disturbances were recorded at Greenwich associated with the transit of these three large spot groups across the sun's disc.

Research Items.

THE FINNISH HOUSE.—Some interesting details of the plan and methods of construction of the traditional type of habitation in Finland are given by Mr. Donald Smith in Part 4 of *Observation*. These houses were constructed to contain several generations, and the communities were self-contained, the men being hunters, fishers, graziers, farmers, and artificers, lacking only a forge; while the women performed the operations of grinding, baking, brewing, spinning, etc. They grew their own tobacco. The first portion of the house to be erected was always the bathroom of round unshaped logs—of the "steam-bath" type, with a stove of rough blocks of granite. Then followed a vestibule used as a store-room and dairy connecting the bath-house with the living-room or house proper. This was roughly square with a seat fixed to the wall running round two sides, and an oven of clay and granite blocks in the right-hand corner. Smoke was emitted by the door or slits in the wall, but sometimes a hollow tree-trunk served as a chimney, its lower end being closed by a slide which was opened at intervals. A trough was provided to give the horses warm meals in winter, for which purpose they were brought in from the stables. The upper end of the room was divided into the man's corner and woman's corner, each pursuing their occupations on their respective side of the line, the woman alone crossing the line rarely as her duties required.

THE EARLIEST MAYAN DATES.—Among the contributions to the Göteborg session of the twenty-first International Congress of Americanists, of which the proceedings have just been published, is an examination of the earliest evidences for Maya dates and the inferences which can be drawn from them, by Dr. Sylvanus G. Morley. The earliest dates known at present are on the Leyden jadeite plaque and the Tuxtla statuette, which show Baktun 8 dates equated, that on the latter with 97 B.C. and that on the former with A.D. 61. It is probable, though by no means certain, that in both cases the dating is contemporaneous. Dr. Morley gives a table showing 29 early dates, of which 24 are certainly or probably contemporary and five non-contemporaneous, ranging from 97 B.C. to A.D. 275. Of the dates covering Baktun 8 and part of Baktun 9, the former come from two sites only, Uaxactun and Uolantun. It is established by Stele 10 at Tikal, the latest of the Old Empire monuments, that the Baktuns—the name given to the Maya cycle of 144,000 days—numbered 8, 9, and 10 fitted into a system which could not complete itself in more than sixty-four millions of years. Taking the evidence bearing upon dating as a whole, it would appear that Uaxactun was the first Maya city at which stone monuments came into use. Before that time, it is generally agreed, the stelæ were carved out of wood; and these have now disappeared. Exhaustive search in the region of the oldest cities has failed to reveal any simpler beginnings of the elaborate time count. Uaxactun is at the heart of the Yucatan peninsula and of the Old Empire. Its geographical and topographical position concur with the archæological and chronological evidence in pointing to it as the central point of distribution of Mayan culture to other regions.

TRYPARSAMIDE IN SLEEPING SICKNESS.—The efficacy of tryparsamide in the treatment of sleeping sickness in the Belgian Congo is the subject of a communication by Dr. Clement C. Chesterman in the *Lancet* for November 7, p. 965. He notes that though spontaneous recovery may sometimes occur without any treatment, he himself has observed no case in a series of 650 which has remained in good health. On the other hand, there is evidence that after single doses of atoxyl, soamin, arsacetin or tartar emetic, early cases may remain in perfect health, while with repeated dosage the number of cases which appear to be cured is greater. Bayer 205 likewise gives good results in cases in the first stage of the disease, which means that there is no involvement of the central nervous system as evidenced by changes in the albumin and cell content of the cerebro-spinal fluid. In the second stage of the disease, none of these drugs gives satisfactory results. In tryparsamide, first used in sleeping sickness by Pearce of the Rockefeller Institute of Medical Research, there is hope of permanent cure even in cases in very advanced stages of the disease. Of the first stage cases originally treated by Pearce in 1920, so many as 100 per cent. are still in good health and may reasonably be regarded as cured. Of cases in the second stage, Van den Branden and Van Hoof have carefully followed 35 which were treated with tryparsamide. Of these 45·7 per cent. have remained in good health for an average period of three years. Dr. Chesterman himself has obtained cures in 37·5 per cent. of 40 cases observed for two and a half to three and a half years. A number of cases, however, do not react to the drug, and the reason of this is obscure. The drug *in vitro* is only feebly trypanolytic, so that its curative action appears to depend on some factor in the human body. There is evidence that this may be found in the liver, and that when this organ does not function properly, the drug has less chance of acting favourably in sleeping sickness. Dr. Chesterman concludes that tryparsamide should be the mainstay of our attack on sleeping sickness. The principle has been adopted by the Belgian Government, which is responsible for the treatment of 50,000 cases annually.

GOLD COAST SURVEYS.—The report of the Survey Department of the Government of the Gold Coast for the year ending March 1925 shows a record of steady progress not only in the production of topographical and cadastral surveys, but also in the attainment of a high standard in local production of maps. In addition to a great deal of cadastral work including several town plans, the topographical survey is proceeding satisfactorily. Of the total area of the Gold Coast and mandated territories, some 92,000 square miles, 41,000 have been surveyed, including 2500 during the year under review. The scale is 1 to 62,500 from the coast to lat. 7° 30′ N., and half that scale to the northward. The reproduction of the smaller scale maps is now undertaken at Accra instead of sending them home. To judge from the sheet attached to the report, there is little scope for improvement. Experiments with the use of wireless in longitude determinations are leading to useful results.

AGRICULTURAL POPULATION IN EUROPE.—At the International Geographical Congress at Cairo last April, Prof. A. Demangeon opened a discussion on agricultural systems and schemes of distribution of population in western Europe. The subject evoked so much interest that an international commission was appointed to investigate the matter and prepare reports for a later Congress. In the autumn issue of the *Geographical Teacher*, Prof. Demangeon's paper is printed in full. His conclusions are as follows: The nature of the rural habitat is closely related to the system of exploitation of the land. The isolated farm and small hamlet, characteristic of western

France, Flanders, the Campine, and many parts of England, is very ancient in regions of predominant stock-raising, in contrast to the compact village which may be held to imply the existence, at least in origin, of some form of communal cultivation. The latter is found chiefly on fertile lands which lent themselves to early settlement by reason of lack of forest. Prof. Demangeon does not believe that the origin of the compact village can be ascribed to any one people. In France it appears to be a very ancient feature evolved before the Frankish conquest. The article concludes with some contributions by other geographers to the discussion at Cairo.

MIOCENE MOLLUSCA FROM JAMAICA.—A fine volume on the Miocene Pelecypoda and Scaphopoda from Bowden, Jamaica, by W. P. Woodring, part of a series of reports dealing with the geology and palæontology of the West Indies, has been issued as one of the invaluable Publications (No. 366) of the Carnegie Institution of Washington. The work, save for some brief but adequate introductory remarks, is devoted to a systematic description of the species met with. These are estimated to amount to 185 species and subspecies of bivalves and 20 of scaphopods, of which some 85 are claimed to be new, while new sections and genera have also been founded. The accompanying illustrations are included in 28 plates, and are some of the finest we have had the pleasure to meet with. In the treatment of his subject the author has taken a most important step for a palæontologist, since he acknowledges the importance of following the International Rules of Zoological Nomenclature and points out that the "time-consuming task of attempting to discover what generic names should be used has no direct bearing on the history of the earth and therefore may seem like wasted time for a palæontologist. But if the significance of the genera composing a fauna is considered, and their rise, spread, and restriction are analysed, the uniform use of generic names is essential."

MYCORHIZA OF PINE AND SPRUCE.—The relations of the fungus hyphæ of various species of Hymenomycete, including species of Boletus, Cortinarius, etc., to the roots of these forest trees have been very fully investigated by Elias Melin of Stockholm ("Untersuchung über die Bedeutung der Baummykorrhiza." Jena: Gustav Fischer, 1925, 7·50 marks). The fungi have been grown alone in pure culture, and seedlings of the conifers also raised in sterile culture, and their relation to the nutrient medium studied separately and when growing together. Melin concludes that whilst the trees can manage to assimilate inorganic or diffusible organic nitrogen (*e.g.* asparagin) readily, when the fungus is present they are able to utilise more freely complex organic nitrogen compounds. In this connexion he examines the fruit bodies of the fungi to obtain some light upon the digestive enzymes present in the fungi which may influence the utilisation of such nitrogen compounds. Melin has an interesting note on the effect of water-soluble "phosphatides," extracted from the conifer seeds by the methods of Hansteen Cranner, upon the growth of these fungi in culture. In quantities too small to permit of the result being due to their nutritive value, they excite a markedly catalytic action upon the rate of growth of fungi, which usually grow very slowly in the absence of the root system of the higher plant. Melin suggests these experiments may throw light on the relations of the fungi to the roots. In no case did he find evidence of fixation of atmospheric nitrogen, either by fungus or by fungus and host together.

ATMOSPHERIC ELECTRICITY.—The search for the cause of the potential gradient in the atmosphere has been stimulated by the theory of von Schweidler and Swann, and the September issue of *Terrestrial Magnetism and Atmospheric Electricity* contains a paper by Mr. C. H. Dwight on a search for rapid variations in the earth's electrostatic field. An insulated plate was suspended 8 metres above the roof of the laboratory and connected to one of the deflecting plates of a cathode ray oscillograph tube, the other plate of which was earthed. The two plates were shunted by a resistance of 12 megohms, which prevented secular accumulation of charge on the upper plate. The cathode rays were deflected by the field between the plates, and the light from the fluorescent spot they produced on the screen at the end of the tube was focussed on a revolving photographic film. The records show that there are no rapid variations of the electric field in the atmosphere except during actual lightning discharges.

THE "HOLWAY" DIATHERMY APPARATUS.—Messrs. Newton and Wright, Ltd., 471/3 Hornsey Road London, N.19, describe in a leaflet just issued the Holway diathermy apparatus, in which special attention has been paid to the spark gap. The spark gap consists of an aluminium chamber extensively ribbed on the outside, so that even with a large current it does not become unduly hot. This chamber is provided with an inlet and an outlet tap for gas dielectric, and can also be arranged for use with ether in cases where no gas supply is available. The actual gap comprises a large copper disc heavily silvered, bridging over the space between a pair of heavy copper electrodes, likewise silvered, so that the gap is in duplicate, an arrangement which conduces to a steady current, while affording means of convenient and delicate adjustment. The electrodes, which are mounted on thick mica diaphragms, are provided with radiation fins for cooling. There is no doubt that the surgical efficiency of some diathermy apparatus leaves much to be desired, and it is to be hoped that the design described will effect an improvement.

HYDROGEN PEROXIDE.—A solid hydrogen peroxide, sold under the registered name of "Hyperol," is described in *Chemistry and Industry* for November 20. Hyperol is a stable white crystalline compound of hydrogen peroxide and urea having the formula $CO(NH_2)_2H_2O_2$, and it contains 35 per cent. of hydrogen peroxide. The only impurity is a trace of citric acid which is not sufficient to affect methyl orange. It dissociates completely when dissolved in water or ether, and 1 gm. of "Hyperol" dissolved in 10 c.c. of water produces a 10-volumes strength solution of hydrogen peroxide.

STRUCTURE OF MALEIC AND FUMARIC ACIDS.—A description of an X-ray examination of maleic and fumaric acids carried out by K. Yardley appears in the September issue of the *Journal of the Chemical Society*. Preliminary investigation indicated that maleic acid has four molecules per unit cell, and from this it is shown that the planosymmetry given to the acid from chemical evidence does not exist in the crystalline state. A structure is suggested, and several projections of this on the planes of symmetry are given. On account of the poor nature of the crystals, the measurements with fumaric acid were more difficult; the minimum cell contains six molecules of fumaric acid. Further evidence shows that neither maleic nor fumaric acid has symmetry in the crystalline state.

The International Council for the Exploration of the Sea.

THE report of the British delegates just received shows that the last meeting of the International Council for the Exploration of the Sea, held in Copenhagen on September 1–4, was, though short, an important one in the Council's history, for at this meeting the machinery of the Council, which had grown rather cumbrous, was thoroughly overhauled and in a considerable measure replaced and renewed, in accordance with a plan prepared by the president, Mr. H. G. Maurice, with the help of Prof. Johan Hjort. To take the less important changes first: the main Committees of the Council are now formed on a regional basis, instead of being based partly upon geographical areas and partly upon the species of fish studied. The regional committees which came into being after the War proved to be a very convenient and practical means of getting co-ordinated researches carried out, and the logical step has now been taken of arranging all the main researches of the Council on this regional basis. The "Area Committees" now formed are seven in number—for the North-Eastern Area (the Norwegian Sea east of the 1000-metre line), the North-Western (Rockall, Faeroe and Iceland), the Atlantic Slope (Rockall to Morocco), the Northern North Sea, the Southern North Sea, and two committees for the Skagerrak, Cattegat and Baltic area. In addition, the Statistical, Hydrographical, Plankton and Limnological Committees remain in being.

For each of the area committees there has been appointed a chairman with very definite duties and responsibilities, who will see that the work done in his area is properly co-ordinated in accordance with the programmes agreed upon, and will report on the progress made. Now comes the most important point in the new organisation. The chairmen of these committees, together with the chairman of the Hydrographical Committee, will form a Consultative Committee which will advise the executive of the Council, the "Bureau," on the proper conduct of the scientific work, and must be consulted by the Bureau. (The two Baltic committees will be represented by one of their chairmen only.)

The criticism has sometimes been made of the International Council that its affairs are too much in the hands of administrative delegates, while too little power is allowed to the scientific experts. What truth there may be in this opinion it is difficult to say, but the voting power is limited to the official delegates, who are usually, but by no means always, scientifically qualified, and conditions are conceivable in which the opinion of the experts might not carry its due weight. The new arrangement gives the scientific members of the Council a more definite status and responsibility, for the members of the Consultative Committee are men of scientific standing and voice the opinions of the experts composing the area committees. We regard this new move on the part of the Council as a healthy and fruitful one.

Another new departure resolved upon at the last meeting is the founding of a scientific journal, which will deal with the many aspects of the Council's work, taking cognisance also of similar work done in other parts of the world. The useful short papers hitherto issued by the Council in the series of *Publications de Circonstance* will in future be published in the journal. We understand that the journal will contain also general articles of a comprehensive nature, reviews, and a bibliography, and will be published quarterly, commencing early in 1926. The new journal should serve a very useful purpose in knitting the work of the Council together, and disseminating its results. The editor will be *ex officio* a member of the Consultative and the Editorial Committees. The publication of short reports of a popular nature is also contemplated by the Council.

Apart from these matters of organisation, the delegates' report gives much interesting information regarding the Council's work. Since the War the number of participating countries has increased, particularly among the southern nations, and the area covered by the Council's organisation now extends over the whole seaboard and adjacent waters from the Barentz Sea right down to the coast of Morocco. Only one important country still stands out—Germany, which has not yet resumed membership. It is understood that Germany will shortly rejoin the Council.

Great Britain continues to do the lion's share of the work, particularly at sea, and we are glad to note that she is well represented in the new organisation, Dr. Alex. Bowman being chairman of the Northern North Sea Committee, Mr. J. O. Borley chairman of the Southern, while Dr. E. S. Russell is editor of the journal. Mr. Maurice continues his energetic work as president, and the other British delegate, Mr. David T. Jones (who has succeeded Prof. D'Arcy W. Thompson in this office), presides over the two North Sea Committees when they meet in consultation over problems common to both. Prof. Thompson remains chairman of the Statistical Committee and editor of the *Bulletin statistique*.

Other points of interest in the British delegates' report we can touch upon only briefly. At their request a special committee was appointed to study the very vexed question of the closure of the Moray Firth to trawling, consisting of Norwegian, Danish, Dutch, Belgian and British experts. Reference is also made in the report to investigations commenced by the English Department during the present year on the effect of the size of trawl mesh on the size of fish caught, which are yielding promising results. Finally, we are glad to learn from the report that His Majesty's Government has agreed to support the Council's work for a further period of five years. Results in fishery and oceanographical research cannot be obtained quickly, and the long view will prove in this case to be the wise view.

Relation between Physical and Mental Defects.

A PAPER on the testing of physically defective and of mentally defective children, by Dr. C. R. McRae, who was obliged to return to Australia some days before the recent meeting of the British Association at Southampton, was read before the Section of Psychology. The paper was divided into two parts.

(1) THE BINET-SIMON TESTS AND SPEARMAN'S PRINCIPLES OF COGNITION.—These principles, as enunciated in Prof. Spearman's book, "The Nature of 'Intelligence' and the Principles of Cognition," offer an explanation of the remarkable success of the Binet-Simon tests of intelligence. Of particular importance are the noegenetic principles concerning the eduction of relations and the eduction of correlates. On the basis of these principles an *a priori* analysis and criticism of each component test of the Binet scale was made. To test the validity of this analysis in practice, both physically defective and mentally

defective children were tested. The most satisfactory tests of innate ability should be those in which superior natural endowment enabled the physically defective children furthest to outstrip the mentally defective despite inferior educational opportunity, while the least satisfactory tests would be those in which superior educational opportunity enabled the mentally defective to approach nearest to the physically defective.

A close agreement between the theoretical judgment made on the basis of the noegenetic principles and the practical decision obtained by testing these children was found to exist. Thus it seems likely that Ebbinghaus's completion test is a satisfactory mental test, not because "intelligence" consists in "combination activity," but because the performance of the test is mainly a matter of educing novel correlates, or that the "opposites" test succeeds, not because "intelligence" consists in seeing differences, but because the performance of the test is essentially a matter of educing relations.

(2) PHYSICAL DEFECT AND MENTAL EFFICIENCY.—Children in metropolitan schools for the physically defective, and patients in the Lord Mayor Treloar Hospital at Alton, were tested. The London children show a retardation of 1·95 years, the Alton children of 1·14 years. This difference of almost a year in favour of the Alton children was found on analysis to be inexplicable in terms of social environment and heredity, of the nature of the physical defect or of educational opportunities. One explanation alone seemed feasible, that the alleviation brought to the physical defect by the medicinal measures and environmental conditions of the Hospital stimulates the mind as well as the body.

	Metropolitan Schools.	Alton Hospital.
No. of cases . .	117	62
Average age . .	11·13 years	11·85 years
Average mental age .	9·18 years	10·71 years
Average mental ratio	82·5	99·4

Sir Henry Gauvain, Medical Superintendent at the Hospital, is inclined to invoke as explanation of the mental superiority of the Alton children the setting free from the skin by ultra-violet rays of certain organic compounds which are essential brain foods. Whatever the true explanation may be, it would appear tolerably certain that physical defect, if widespread and of long duration, simulates the symptoms of some degree of amentia, and that these symptoms may be removed by such treatment as is afforded at the Treloar Hospital. In the ensuing discussion, Dr. Shrubsall questioned the validity of pooling the London children together, as they represented several specified categories of diseases. It was stated, however, on behalf of Dr. McRae, that this point had been considered in his full report, of which the present paper was a partial summary.

New Laboratories at St. Andrews.

NEW chemical and physical laboratories were opened by Sir William Bragg at the United College of St. Salvator and St. Leonard, University of St. Andrews, on the afternoon of Friday, December 4. Before proceeding to the new building, Sir William Bragg, who received a cordial welcome in the city of the scarlet gown, was promoted to the honorary degree of LL.D. at the hands of Sir James Irvine, Vice-Chancellor. Mr. William Whitelaw, chairman of the London and North-Eastern Railway Company, was the recipient of the same honour. In a memorable address, Sir William Bragg described the modern developments of atomic and molecular theory, pointing out the extreme delicacy of the method of X-ray analysis, not only in determining the structure of crystals, but also in measuring the length of one of the curious chain-like molecules which are based on carbon links. He emphasised the importance of inquiry into details in pure and also in applied science. It is that intimate examination of details which results in the advance of knowledge, and affords so fascinating a prospect to the inquirer.

The new building opened by Sir William adjoins the Chemistry Research Laboratory and runs southwards with a frontage of 170 feet. It is in the Renaissance style, two stories high, and faced with local sandstone from Nydie. Above the entrance doors are mullioned windows and a moulded gable, in keeping with the seventeenth-century type of work of the old quadrangle. The architect was Mr. J. Donald Mills, and the internal benches and fittings were designed in collaboration with Prof. J. Read, of the Chemistry Department, and Prof. H. S. Allen, of the Department of Natural Philosophy.

The chemistry accommodation, which is located in the northern part of the block, forms an extension of the institute for chemistry research, which was presented to the University and endowed by the late Prof. Purdie. This institute, which has been reorganised during the alterations, contains accommodation for twenty research workers, in addition to rooms for special purposes. For the past twenty years the research institute has been widely known as a centre of research work on sugars and carbohydrates, problems of optical activity, and general synthetic organic chemistry; during the War much important work was carried out within its walls under the supervision of the present Principal and Vice-Chancellor, Sir James Irvine.

The new accommodation for chemistry tuition comprises on the ground floor an elementary laboratory, containing bench space for forty students at once, together with a balance room and other service rooms. A fully equipped laboratory for advanced students occupies a position on the first floor; this has accommodation of the most modern type for eighteen students, and is provided with fume-chambers, apparatus for organic combustion work, steam-ovens, and other necessary accessories. Adjoining it are a small balance room and two physical chemistry rooms, to which low voltage current is supplied from an accumulator room. The addition also includes private rooms for members of the staff, a chemistry museum, a lecture room for advanced classes, and store accommodation. A telephonette system has been installed throughout the building.

The Physical Laboratories are contained in the southern block, and have been fitted up to provide for advanced teaching and research, as well as for the usual elementary courses. On the ground floor is a large laboratory for elementary students, together with dark rooms for photographic and optical work, and two rooms which are available for research work. On the same floor is a mechanic's shop provided with machine tools, each driven by its own electric motor. Above is a long room which is arranged as a photometer room. On the first floor is the advanced laboratory, which adjoins the reading room and reference library, so that students can write

a record of their experimental work and immediately refer to the standard authorities on the subject of their experiment. On the same floor are the professor's room, three research rooms, and an optical room. The laboratories are well equipped with gas, water, and electric light and power, provision being made for an electric supply from accumulators in a separate building. At the top of the main staircase is a large room which is being arranged as a laboratory for experimental mechanics. Research work is already in progress, and is at present directed to the study of band spectra, for which purpose two large spectrographs have been installed.

University and Educational Intelligence.

BIRMINGHAM.—The University has received a magnificent gift from Sir Charles Hyde, Bart., who writes to the vice-chancellor: "It will give me the very greatest pleasure to put at your disposal the sum of 100,000*l*. unconditionally for the immediate needs of the University." The donor mentions in his letter some of the more pressing needs of the University which are known to him, namely, a Union building for the students; an extension of Chancellor's Hall (the hall of residence for men); the extension of the Harding Library; the purchase of certain land (if it can be bought at a reasonable price); and "the endowment fund of the research committee, which I consider of the most supreme importance." The vice-chancellor (Sir Gilbert Barling, Bart.) states that the gift will be applied to all these objects. Sir Charles Hyde has long been a generous benefactor to the University, and during his tenure of the office of warden of the Guild of Undergraduates, he showed himself particularly interested in the welfare of the students and keenly alive to the advantage of providing residential facilities. Sir Charles Hyde's wisdom in making the gift "unconditionally" is much appreciated and indeed greatly enhances its value. It is understood that no part of the money will be used for the building of the new biology block which is in course of erection.

In addition to the generous gift of Sir Charles Hyde, referred to above, a donation of 2400*l*. from the Miner's Welfare Committee has been given towards the further equipment of the coal-mining department.

Dr. Ratcliffe has presented to the anatomical department casts of fossil remains of Rhodesian man.

The Council has decided to establish an honours school in geography.

CAMBRIDGE.—The University Commissioners have issued regulations for initial appointments to lectureships and demonstratorships under the new statutes. Roughly these regulations provide that, within certain age limits, all persons who have held college lectureships for three years or were University lecturers or demonstrators on October 1, 1924, are to be offered lectureships or demonstratorships under the new regime. An appointments committee is to be nominated by the Council of the Senate to fix the financial terms of each offer. It will be a matter of interest to note whether this committee merely contents itself with making such offers that each person concerned receives the same salary as heretofore, or if it makes a definite effort to interpret the spirit as well as the letter of the Statutory Commissioners' recommendations by regulating salaries according to services performed.

SIR THOMAS KIRKE ROSE, past-president of the Institution of Mining and Metallurgy, will deliver an address on "Metallurgy and Minting" at the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C.3, on December 15, on the occasion of the annual distribution of prizes and certificates.

FROM the Battersea Polytechnic we have received a copy of the Principal's report on the work of the session 1924–25. A summary of student hours per week shows that the decrease which has been going on since 1921 continued last year. The evening class work, however, showed an increase, and the number of students taking courses in preparation for university degrees increased from 190 to 210. Technological courses for flour millers and lectures on hygiene and sanitary science were attended by twice as many students as in the previous year. Forty-two students obtained degrees of the University of London, including 19 B.Sc. honours degrees in chemistry. The Polytechnic was attended by 68 university graduates for advanced technological instruction.

THE fourteenth annual Conference of Educational Associations will be held at University College, Gower Street, London, W.C.1, on December 31-January 8, under the presidency of Prof. A. C. Seward, vice-chancellor of the University of Cambridge. Prof. Seward will deliver his presidential address, entitled "The Relation of a University to Secondary Education," on the first day of the Conference. Other noteworthy features of the provisional programme are: a joint discussion on the relation of technical education to other forms of education and to industry (Dr. Schofield, Miss Fox, and others); a lecture by Dr. Harold Wager to the School Nature Study Union on "Some Aspects of Nature Study"; and a lecture by Sir Robert Blair to the London Head Teachers' Association on "Education and Industry." Exhibitions are being arranged of books and school apparatus.

THE annual report of the Royal Technical College, Glasgow, for the session 1924–25 records a decrease in the number of day students from 1006 to 936, and an increase in evening students from 3810 to 3817. Considering the depression in the Clyde industries, the decrease is surprisingly small. The Clyde engineering apprentices form the principal reservoir from which the College students are drawn, and the report points, with justifiable pride, to the fact that although only half as many apprentices have been engaged in the local shipbuilding and engineering works as before the War, the number of College engineering students taking a degree or diploma course is almost double the corresponding pre-War figure. There is evidence of revival in the demand for trained chemists and metallurgists: the College has not been able to respond to all the requests for qualified metallurgists and the list of unemployed chemists is small. Some indication of the range and standard of the evening classes is given by the number (148) of graduates of universities (English, Welsh, and Irish, as well as Scottish) enrolled in them and the number (2648) of students more than twenty years of age. Six students received the Ph.D. degree of the University of Glasgow, 95 the B.Sc. of Glasgow, and 4 the B.Sc. of London. The College received during the year substantial recognition of esteem in the form of a gift of 50,000*l*. from an anonymous donor and an undertaking by the Carnegie University Trust to continue for five years an annual grant of 1000*l*. and increase it by 120*l*., provided that sufficient money from other sources is forthcoming to form, with 5000*l*. of the Trust's grants, an endowment for a chair of metallurgy. The first number of a new official College journal appeared during the winter and contained the results of research work in the departments of chemistry, mechanical engineering, metallurgy and bacteriology.

Early Science at Oxford.

December 14, 1683. The peice of Iron which had been cast into an Ingot, lying North and South, was produced. We did not observe that it did in ye least draw ye needle. A letter from Mr. Aston gave an account that *Gerbertus* brought ye use of numeral figures into these parts of the world; it was ordered that enquiry should be made whence this appears. A letter from Dr. Tyson related to ye observations, lately made by Dr. Bagly on ye *Lumbricus latus*, with an account, and draught, of a little Insect, which he found in ye *Trachæa* of ye *rana Piscatrix*. Dr. Smith was pleased to oblidge us, with an account of some observations, made by ye learned Mr. Greaves, in Ægypt, and transcribed from his MS, by ye Doctor, to whom it was communicated by Mr. Stubbs, formerly of Wadham Colledge.

1686. The Minutes of ye Royal Society were read, which gave an account of some cubical *Stones* of a substance resembling a Marchasite. Dr. Plot tells us they are ye Ludus of Van Helmont, and that he has great variety of them by him, which have been found in Staffordshire, Pembrokshire, Merionyidhshire, and Carnarvonshire; and that in his History of Staffordshire he has mentioned them.

An account communicated by Mr. Caswell, how and in what proportion the Quicksilver may stand at different heights, reckoned on ye plates of different *Baroscopes*, though filled in ye same place, and with quicksilver equally free from air.

Some Observations of ye *weather* in ye hottest week of ye last summer 1686 made joyntly with ye Baroscope and Thermoscope at several hours of the day, in order to find how much heat affects ye Baroscope. By Mr. Caswell.

A peice of *Tin-ore* usually called Shoad found above-ground, and native copper as found in the West of Cornwall, were communicated by Dr. Plot.

December 15, 1685. A Letter from Mr. Molyneux concerning ye circulation of the blood as seen in the Lacerta Aquatica was communicated and read.

A Letter of Mr. Flamsteed's concerning ye eclipses of Jupiter's satellits in ye year 1686 was read.

Mr. LLoyd communicated some stones like ye *Lapides Judiaci*, and others like Shell-fish, which were gathered in this County.

A Paper of Mr. Bayly's containing an account of the application of a needle to a piece of iron held perpendicular, made by one in a voyage crossing ye line was read.

December 16, 1684. Our President, and Director, being now returned home, we had a full meeting, in which was read Sir William Petty's Catalogue of Experiments. Dr. Plott was pleased to shew us a piece of cloth, which he brought from London, woven and made with ye flax of ye Amianthus, or Asbestus-stone; which before Mr. Vice-chancellor, and some other Doctors of the University (who were then pleased to honour us with their presence) was heat for some considerable time red-hot, with no other alteration, after it was cold again, save only it appeared somewhat whiter, and cleaner, than before; and was, whilst hot, more brittle; but being cold, of ye same strength, and toughness, as before calcination; which it had now undergone 5 or 6 times; contrary to our Paper made of ye Anglessey-Asbestus, which, being of a shorter thread, was at ye first of a contexture not so tough and strong, as ye cloth, and after ye fire is so friable and brittle, as not to endure any bending, nor ye very handling, if any thing roughly: this paper, it was thought, might be made much finer, and whiter, if it could be made also tough, and tenacious for any use.

Societies and Academies.

LONDON.

Royal Society, December 3.—W. A. **Bone** and G. W. **Andrew**: Studies in catalytic combustion. Pt. ii. The union of carbon monoxide and oxygen in contact with nickel, copper, and other oxides. With nickel gauze at 365° C., the formation of a highly reactive Ni-CO (or possibly O-Ni-CO) complex in the surface layer may become a prime factor in the catalytic combustion. The action of the metal may really be of a dual character, involving (*a*) the "activation" by the metal of the two gases marked by a comparatively low rate of carbon dioxide formation, and (*b*) the intermediate formation of still more reactive CO-Ni-O complexes. With copper gauze at 135° and 250° C., for the real "catalytic" reaction, no prior formation of either copper oxide or any Cu-CO complex was required, but only the "occlusion" of the respective gases. With granular nickel oxide at 150° C., and granular copper oxide at 165° to 175° C., respectively, the catalytic action depends upon the formation at the surface of an "activated" oxygen film probably of more than monomolecular thickness. The real catalytic combination of carbon monoxide and oxygen over all these surfaces is independent of either the oxidation of a primarily formed "carbonyl" film or the reduction of a metallic oxide.—F. H. **Constable**: Immobile groups of atoms with strong specific external fields as the cause of catalytic activity. Copper surfaces made by electrolytic deposition, reduction of alkaline copper solutions, and by hammering and polishing, have an activity probably less than 1/9000th that of the reduced metal. When the surface was produced by sudden cooling of the vapour, or by thermal decomposition of copper salts of organic acids, or by reduction of copper oxides, a markedly active product was obtained. The passage of ammonia gas over the metal at 820° C. produced some activation. The physical appearance of the surfaces varied from a metallic colour, through dull yellow to red-brown. Generally the surface activity and the temperature coefficient of activity were nearly the same. A new method of comparing surface activities of preparations has been devised, depending on the behaviour of copper on alternate oxidation and reduction. The catalytic action is considered to be due to fixing groups of atoms in such a state of strain that strong specific external fields are maintained.—S. C. **Roy**: On the law and mechanism of monomolecular reaction.—F. A. **Williams**: The effect of temperature on the viscosity of air. The coefficient of viscosity of dry air free from carbon dioxide has been studied by a comparative transpiration method, with a silica spiral, from 15° C. to 1002° C. The results show that Sutherland's formula for the temperature coefficient of viscosity holds with great accuracy between 250° and 1000°, the value of *C*, the Sutherland constant, in this range being 172·6. Below 250°, Sutherland's law is no longer true, and the value of *C* falls off as the temperature decreases.—R. W. **Fenning**: Gaseous combustion at medium pressures. Pts. i. and ii. Pressure-time records of the explosion of a complete combustion, carbon monoxide-air mixture with additions of (*a*) hydrogen-air and (*b*) water vapour, give records identical with those produced by (1) carbon monoxide-air plus 1·2 per cent. of water vapour, (2) carbon monoxide-air plus 2·1 per cent. of hydrogen-air (nearly dry). Closed-vessel explosions of methane-air mixtures were also investigated, the initial temperatures ranging from 24° C. to 400° C., and the initial pressures from 30 lb. to 171 lb. per square inch. For a mixture

containing 9·9 per cent. of methane, the explosion-time was increased by (1) increasing the charge density, (2) reducing the initial temperature, and (3) adding a diluent such as combustion products or water vapour.—R. K. **Schofield** and E. K. **Rideal**: The kinetic theory of surface films. Pt. ii. In Pt. i. it was shown in the case of dilute aqueous solutions of the fatty acids C_4-C_6, that the ratio FA/RT (where $A=1/\Gamma$ is the area occupied by a gram molecule of fatty acid in the film) is not unity, but varies with F in a manner completely analogous to the variation of pv/RT with p for *real* gases. FA/RT, F curves for surface films of the sparingly soluble fatty acids C_8, C_{10}, and C_{12} on dilute hydrochloric acid have been constructed from the surface tension-concentration data of Frumkin. At high-surface pressures the curves are straight, and thus (like those for the lower acids) conform to the two-dimensional Amagat equation $F(A-B)=x$RT. At low-surface pressures the curves, though essentially similar, do not correspond exactly with those of fluids. This is attributed partly to the molecules in the film having two distinct parts with different cohesions, and partly to the elongated shape of the molecules, which become inclined to the plane of the interface when in the act of separating from one another, thus causing the critical area to increase with the length of the hydrocarbon chain.—H. B. **Dixon** and G. **Greenwood**: On the velocity of sound in mixtures of gases. The method adopted was by comparing the dust-figures produced in a standard gas and those in the mixture by the resonance set up in two similar tubes. The results obtained (i.) in mixtures of gases of different density, (ii.) in mixtures of gases of the same density, are in close accord with the theoretical values calculated from the density of the mixtures and the specific heats of their constituents.—A. **Fage** and L. F. G. **Simmons**: An investigation of the air-flow pattern in the wake of an aerofoil of finite span. The vorticity is distributed over an area forming a band roughly parallel to the plane and ending in regions approximately opposite the tips, where the intensity is high. Farther behind the aerofoil, the band disappears from the central part, and at about 13 chords away the vortex system resolves itself into two localised areas. In front of the aerofoil, and beyond each wing tip, the flow is irrotational. Over each of the planes of exploration behind the aerofoil, the velocity is sensibly uniform.—W. L. **Webster**: Magneto-striction in iron crystals. For the (1, 0, 0) axis there is an increase in length for all values of the magnetisation; for the (1, 1, 0) axis there is an initial increase in length, followed by a contraction as magnetic saturation is approached; for the (1, 1, 1) axis there is a continual contraction. A combination of these effects seems to explain the results for soft iron, which are similar to those for the (1, 1, 0) axis. The effect of stress on magnetisation in the same rods is measured, and the results applied to a thermodynamically obtained, reciprocal relation between magneto-striction and the effect of stress on magnetisation. The agreement is satisfactory.—R. W. **James** and W. A. **Wood**: The crystal structure of barytes, celestine and anglesite. The structures of the isomorphous sulphates of barium, strontium and lead are all very similar. The structure is based on a simple orthorhombic lattice having four molecules to the unit cell, and the space group is V_h^{16}. The positions of the atoms have been determined by a study of intensities. In calculating the structure factors, the figures for the diffracting power of ions at different angles calculated by Hartree have been employed with slight modifications. The absolute intensity of reflection observed is lower than, although of the same order of magnitude as, that calculated on the classical theory.—O. **Maass** and J. H. **Mennie**: Aberrations from the ideal gas laws in systems of one and two components.—R. G. **Lunnon**: Fluid resistance to moving spheres. A large number of measurements of the times of fall of spheres, differing in size and density, through distances varying from 3 to 538 metres, in coal-mine shafts and other places, have been made. The resistance of air is calculated, and the way in which resistance depends upon velocity and acceleration for any sphere in linear motion is deduced. The range of velocity is such that the values of the Reynolds number are in the critical region ($10^4<R\leq 10^5$), in which the resistance to uniform motion is proportional first to a power higher than the second, and later to a lower power. The effect of acceleration is to accentuate the rapid change in the resistant coefficient ($F/\rho V^2d^2$). An application of the theory of dimensions suggests that the fluid resistance may depend not only upon velocity and acceleration, but also upon the rate of change of the acceleration.—W. G. **Palmer**: The adsorptive equilibria of binary gaseous mixtures. The method of the "coherer" is now applied to the determination of the composition of films containing two gases in adsorptive equilibrium with mixtures of the gases. The present application leads to a purely empirical method. The hypothesis that gaseous films are commonly only one molecule thick is corroborated. Examples of the following cases are given: (1) each gas competes equally for all the spaces on the surface; (2) a complex containing both gaseous molecules is formed, and acts as a single unit on the surface; (3) one gas is adsorbed only on specific areas of the surface. The method is rapid and should form a useful adjunct to investigations of catalytic actions upon solid surfaces.—I. **Sandeman**: The secondary spectrum of hydrogen at higher pressures. (ii.) A P and an R series have been selected, fitting along with Richardson and Tanaka's 83Q into a P, Q, and R combination, and closely conforming with the combination principle. This band is one of four bands the null lines of which are given by the Rydberg formula:

$$18567\cdot47-\frac{109678\cdot3}{(n+0\cdot159883)^2},$$

where n takes the values 6, 7, 8, and 9. Indications have also been obtained of a band corresponding to the integer 10.—P. A. M. **Dirac**: The fundamental equations of quantum mechanics. The paper is a development of Heisenberg's work on a new quantum significance of kinematic and mechanical relations. It is assumed that the equations of motion of a multiply periodic dynamical system can be taken over as they stand into the quantum theory, but that special mathematical operations must be used for interpreting them, which are such that the different solutions of the equations of motion are all interlocked and cannot be considered separately. Any variable x is taken to be represented by harmonic components of the form $x(nm)\exp. i\omega(nm)t$, where n and m refer to two stationary states or two sets of quantum numbers, and the frequencies $\omega(nm)$ satisfy the relation $\omega(nm)+\omega(mk)=\omega(nk)$. The product of two variables x and y has the amplitudes of its components determined by the equation $xy(nm)=\Sigma_k x(nk)\,y(km)$. Multiplication is thus not commutative, but except for this the algebraic laws are the usual ones. Certain quantum conditions are necessary to complete the solution of the mechanical problem. It is shown that the energy is the same function of the action variables as on Bohr's theory, and Bohr's relation between the frequencies and energy levels is deduced.

Royal Meteorological Society, November 11.—C. G. **Abbot**: Measuring sun rays. Solar radiation measurements are made by the Smithsonian Institution on two desert mountains in Chile and Arizona, and by estimating the losses due to the earth's atmosphere, the "solar constant" or radiation in free space at the earth's mean distance is determined. The average value of the solar constant is now known to within much less than 1 per cent. The determinations show two sorts of variation, one with a range of 2 per cent. associated with the sunspot cycle, and the other of short and irregular interval ranging up to an extreme magnitude of at least 5 per cent. The latter variations also are associated with the passage of sunspots across the sun's disc, the radiation decreasing when the spot reaches a central position. About ten years ago, Mr. H. H. Clayton began to investigate the weather changes associated with these apparent solar changes. Since December 1918 official weekly forecasts of temperature and rainfall have been issued by the Argentine Government, but the accuracy is not yet great. The solar radiation observations are responsible for some of the errors, and the Argentine Government has recently equipped its own observatory at La Quiaca. Mr. Clayton is now making experimental forecasts for New York, three, four, five days ahead, for the day, week, and month, and the forecasts are steadily improving. The National Geographical Society of the United States has made a grant to establish a third solar radiation station in the eastern hemisphere, with the view of improving the solar radiation observations. The requirements are a stable government, ready means of communication, cloudless skies, and a high altitude, and Dr. Abbot is to examine possible localities in south-west Algeria, north-east Baluchistan, and south-west Africa.

PARIS.

Academy of Sciences, November 3.—H. **Deslandres**: The progress made in the study of the sun at Meudon Observatory.—A. **Béhal**: The sixth International Conference of Pure and Applied Chemistry.—V. **Grignard** and J. **Savard**: The constitution of pulegone, the tertiary alkylpulegols and the alkylpulegenes.—— **Romanovsky**: A method of interpolation of Tchebycheff.—G. **Foëx** and J. **Kampé de Fériet**: The application of photography on a moving plate to the study of the movement of projectiles, especially to the measurement of their velocity.—E. **Esclangon**: Measurements relating to the values of g at Paris and at Strasbourg. These experiments were carried out during the years 1922–1925 with the view of making the University of Strasbourg a new comparison centre. Use was made of a Deffonges pendulum oscillating in a vacuum, and incidentally it was noted that the effect of temperature on the period of oscillation could not be entirely accounted for by the resulting changes in the length of the pendulum. Variation in the elasticity of the knife-edges and suspension planes and in the coefficients of friction with temperature also produce effects to be considered.—A. **Dauvillier**: New researches on the Crookes' tube. Experimental studies on the disappearance of gas in the Crookes' tube and on the dark space.—C. **Chilowsky** and F. **Perrin**: A new method of distinguishing between natural pearls and cultivated pearls. In the natural pearl the layers are spherical and concentric, but in the cultivated pearl they are approximately plane. The method proposed consists in drilling a fine hole through the pearl and strongly illuminating the interior by means of a minute mirror: the natural pearl appears uniformly illuminated whilst the cultivated pearl shows striæ.—C. **Féry** and C. **Chéneveau**: The secondary reaction in the discharge of the lead accumulator. A new theory of the action of the secondary battery has been suggested by one of the authors based on the reversible reaction

$$2Pb + H_2SO_4 + Pb_2O_5 = Pb_2SO_4 + H_2O + 2PbO_2.$$

In the present note an attempt has been made to measure experimentally the variations in the weights of the plates during charge and discharge. The results are in marked disagreement with the usually accepted theory and are nearer those predicted by the above equation, but the differences are such as to suggest that there is a secondary reaction taking place. A possible secondary reaction is indicated.—Pierre **Jolibois**: Methods permitting the study of the chemical effects of the electric spark on gases at low pressure. The apparatus described and figured permits the measurement of the energy of the spark and the change of pressure produced in the gas under examination.—A. **Girard** and E. **Fourneau**: A new method of great sensibility for the detection, separation and estimation of bismuth. If a benzene solution of tetraethylammonium hydrate is shaken up with an aqueous solution containing potassium iodide and a trace of bismuth, a complex red compound is formed which is soluble in the benzene layer. A quarter of a microgram can be detected. The preparation of the reagent and mode of working will be described in a future communication.—Emile **André** and Henri **Canal**: Contribution to the study of the oils of marine animals. Squalene and spinacene. The oil from *Cetorhinus maximus* gave a well-crystallised chlorhydrate which proved on fractional crystallisation from acetone to contain two different products. The oil from *Scymnus licha* behaved in a similar manner. The conclusion is drawn that squalene and spinacene are not definite chemical compounds.—Louis **Longchambon**: Cristobalite.—— **Fromaget**: The extension and affinities of the fossil fauna of Indo-China.—Jean **Motte**: The cytology of the mosses.—F. **Henrijean**: The genesis of the rhythmic contraction of the heart.—L. **Fage**: Forms of the polychetal annelids.—René **Fabre**: Contribution to the study of hæmatoporphyrin. The application of the spectrophotometer to the determination of the distribution of the intensity in the fluorescence spectrum. Curves are given which may be utilised for the direct determination of hæmatoporphyrin.—L. M. **Bétancès** and J. de **Luna**: The rôle of the lymphocytes and granulocytes in the reparation of wounded tissues in the crayfish.—H. **Guillemard**: Azotemia in the course of mountain sickness. The experiments described indicate that there is a notable accumulation of non-proteid nitrogenous substances in human blood during the crisis of mountain sickness.—J. **Duclaux** and P. **Jeantet**: The transparency of natural waters to the ultra-violet rays.

Official Publications Received.

Department of Commerce: U.S. Coast and Geodetic Survey. Serial No. 271: Topography; Aerial Survey of the Mississippi River Delta. By G. C. Mattison. (Special Publication No. 105.) Pp. 16+9 plates. (Washington: Government Printing Office.) 10 cents.

Transactions of the Edinburgh Geological Society. Vol. 11, Part 3. Pp. 271-424+vii+plates 26-49. (Edinburgh.) 7*s.* 6*d.*

Records of the Geological Survey of India. Vol. 57: Quinquennial Review of the Mineral Production of India for the Years 1919 to 1923. By the Director and Senior Officers of the Geological Survey of India. Pp. viii+398+lxxi+5 plates. (Calcutta: Government of India Central Publication Branch.) 5.10 rupees; 9*s.* 3*d.*

Proceedings of the Edinburgh Mathematical Society. Vol. 43 (Session 1924–25), Part 2. Edited by Dr. T. M. Macrobert and Prof. H. W. Turnbull. Pp. 85-145+viii. (London: G. Bell and Sons, Ltd.) 5*s.* net.

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Twenty-ninth Session adopted at the Annual Meeting of Governors held on the 20th October 1925. Pp. 81. (Glasgow.)

Ceylon Journal of Science. Section G: Archaeology, Ethnology, etc. Vol. 1, Part 2, October 1st. Edited by A. M. Hocart. Pp. 43-90+plates 9-31. (Colombo: The Archaeological Commissioner; London: Dulau and Co., Ltd.) 3.5 rupees.

United States Department of Agriculture. Department Circular 364: The Color Grading of Honey. By E. L. Sechrist. Pp. 8. 5 cents. Department Bulletin No. 1355: Food Habits of the Vireos, a Family of Insectivorous Birds. By Edward A. Chapin. Pp. 44. 10 cents. Department Bulletin No. 1350: Blue-Fox Farming in Alaska. By Frank G. Ashbrook and Ernest P. Walker. Pp. 35. 10 cents. (Washington: Government Printing Office.)

The Origin and Antiquity of the American Indian. By Aleš Hrdlička. From the Smithsonian Report for 1923. (Publication 2778.) Pp. 481-494+17 plates. (Washington: Government Printing Office.)

Diary of Societies.

FRIDAY, DECEMBER 11.

MANCHESTER ASSOCIATION OF ENGINEERS (at the Engineers' Club, Albert Square), at 7.15.—A. P. M. Fleming: Physics and Engineering.

RAILWAY CLUB (at 65 Belgrave Road, S.W.1), at 7.30.—J. R. Hind: Some Little-known Features of Railway Publicity.

SATURDAY, DECEMBER 12.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS, at 3.—J. T. Pringle: The Housing of Workmen.

INSTITUTE OF TRANSPORT (North-Eastern Local Section) (at the Town Hall, Newcastle-on-Tyne), at 3.—R. C. Mayes: The Organisation and Working of the Royal Victoria and Albert, and King George V. Docks of the Port of London Authority.

INSTITUTE OF BRITISH FOUNDRYMEN (Lancashire Branch, Junior Section) (at the College of Technology, Manchester), at 7.—J. S. G. Primrose: The Physical Testing of Foundry Products.

HULL ASSOCIATION OF ENGINEERS (at the Technical College, Hull), at 7.15.—D. Weir: Rolling Mills and the Manufacture of a 40,000 kv.-a. Turbo-Alternator (Lecture).

MONDAY, DECEMBER 14.

ROYAL IRISH ACADEMY, at 4.15.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Prof. L. W. Collet: The Alps and Wegener's Theory.

ROYAL SOCIETY OF MEDICINE, at 5.—Surg.-Comdr. J. L. Priston: The Prevention of Scurvy in the Royal Navy.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—E. H. Shaughnessy: Post Office Wireless Stations.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Section) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Lt.-Col. K. G. Maxwell and A. Monkhouse: Recent Improvements in the Insulation of Electrical Machinery.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—V. F. Cornish: Mechanical Transmission of Power on Electric Locomotives.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Centre) (at Chamber of Commerce), at 7.—W. Ferrier Brown: Sleeve-Valve Engine Development.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.

INSTITUTE OF METALS (Scottish Local Section) (at 39 Elmbank Crescent, Glasgow), at 7.30.—Dr. H. Hyman: Aluminium and its Alloys as used for Engineering Purposes.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—Prof. J. L. Stocks: The Unity of Thought.

MEDICAL SOCIETY OF LONDON, at 8.30.—C. A. R. Nitch and others: Discussion on The Treatment of Genito-urinary Tuberculosis.

TUESDAY, DECEMBER 15.

ROYAL STATISTICAL SOCIETY (at Royal Society of Arts), at 5.15.—Sir R. H. Rew: The International Statistical Institute and its 16th Session.

INSTITUTION OF CIVIL ENGINEERS, at 6.—A. Honeysett: Pressure-Boosting Station for the Waterworks of the City of Monte Video.

INSTITUTE OF MARINE ENGINEERS (at 85-88 The Minories), at 6.—J. A. Sim: Economic Application of the Scott-Still Engine.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (at Engineers' Club, Manchester), at 7.—Prof. S. P. Smith: An All-Electric House.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. H. Featherstone: Home Kinematography with the Baby Ciné-Camera and Projector.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Otto Kahrs: The Economic Value of Bunker Coal.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.15.—Capt. Pitt-Rivers: The Inhabitants of Aua Island.

BRITISH INSTITUTE OF PHILOSOPHICAL STUDIES (at Royal Society of Arts), at 8.15.—Sir Frederick Pollock, Bart.: Do we need a Philosophy of Law in England?

WEDNESDAY, DECEMBER 16.

SOCIETY OF GLASS TECHNOLOGY (London Meeting) (in the Chemistry Lecture Theatre, University College), at 2.30.—Prof. W. E. S. Turner: The Composition of Glass suitable for Use in Automatic Machines.—Violet Dimbleby and Prof. W. E. S. Turner: The Relationship between Chemical Composition and the Durability of Glass.

ROYAL METEOROLOGICAL SOCIETY, at 5.—I. D. Margary: The Marsham Phenological Record in Norfolk, 1736-1925, and some others.—C. D. Stewart: Experiments on the Shielding of Raingauges.—Dr. H. Jeffreys: On the Dynamics of Geostrophic Winds.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Dr. W. D. Lang and Dr. L. F. Spath: The Black Marl of Black Ven and Stonebarrow in the Lias of the Dorset Coast.

RADIO SOCIETY OF GREAT BRITAIN (at Institution of Electrical Engineers) (Annual General Meeting), at 6.—D. Sinclair: Some Facts and Notions about Short Waves.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—Sir C. R. S. Kirkpatrick: The Development of Harbour and Dock Engineering (Lecture).

ILLUMINATING ENGINEERING SOCIETY (at the Lighting Service Bureau, 15 Savoy Street, Strand), at 7.—A Report on Progress in Electric Lamps and Lighting Appliances.

INSTITUTION OF AUTOMOBILE ENGINEERS (Birmingham Graduates' Meeting) (at Chamber of Commerce), at 7.30.—F. G. E. Clarke: Press Tools.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Watergate House, Adelphi) (Graduates' Meeting), at 7.30.—C. A. Edwards: Sales and Service.

GLASGOW UNIVERSITY ALCHEMISTS' CLUB (at Glasgow University), at 7.30.—Prof. E. P. Cathcart: Problems of Metabolism.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Dr. W. Cramer and Dr. R. J. Ludford: Bile Canaliculi and the Golgi Apparatus in Hepatic Cells.—Dr. C. Da Fano: Recent Methods for the Study of the Neuroglia.—Miss A. Lorrain Smith: Some Lichen Dyes.—F. I. G. Rawlins: The Theory of Dimensions in Microscopy.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at the Royal Society of Medicine, 1 Wimpole Street), at 8.30.—Dr. J. Glover: Divergent Tendencies in Psychotherapy.

EUGENICS EDUCATION SOCIETY (at Royal Society), at 8.30.—Prof. J. S. Huxley: The Courtship of Animals and the Present Position of the Sexual Selection Theory.

SOCIETY OF CHEMICAL INDUSTRY (Chemical Engineering Group, jointly with Nottingham Section) (at Nottingham).—R. G. Parker and D. N. Jackman: Some Effects of Humidity on the Properties of Fabrics, with Special Reference to the Control of Humidity during Strength Tests.—Dr. E. B. R. Prideaux and E. C. Roper: The Analysis of Commercial Bifluorides.

INSTITUTION OF STRUCTURAL ENGINEERS (Lancashire and Cheshire Branch) (Students' Evening).—J. L. Manson: Factors in the Development of Structural Practice.

THURSDAY, DECEMBER 17.

LINNEAN SOCIETY OF LONDON, at 5.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—Dr. H. S. Hele-Shaw and T. E. Beacham: A New Form of Air-Compressor.—A. Livingstone Oke: Notes on Diamond Prospecting, Gold Coast Colony.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—C. E. Webb: The Power Losses in Magnetic Sheet Material at High Flux Densities.

ROYAL AERONAUTICAL SOCIETY, at 6.—Informal Discussion on Aero-engine Starting Gear.

CHEMICAL SOCIETY (Informal Meeting), at 8.

INSTITUTE OF CHEMISTRY STUDENTS' ASSOCIATION (London), at 8.—Discussion on Regulations of the Institute.

ROYAL SOCIETY OF TROPICAL MEDICINE AND HYGIENE (at 11 Chandos Street, Cavendish Square), at 8.15.—Sir T. C. Evans: The Surgical Aspects of Amœbiasis.

ROYAL SOCIETY OF MEDICINE (Study of Disease in Children and Dermatology Sections), at 8.30.—Discussion on The Ætiology and Treatment of Infantile Eczema.

INSTITUTION OF MECHANICAL ENGINEERS (Birmingham Branch) (at Birmingham).—H. F. L. Orcutt: Characteristics and Uses of Ground Gears.

FRIDAY, DECEMBER 18.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (at Liverpool University), at 6.—Dr. W. Clayton: Coagulation and Flocculation in Colloid Systems, with Special Reference to Industrial Problems.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), 7.—Discussion on The Work of the Mechanical Engineer in Non-Engineering Industries, introduced by W. P. F. Fanghanel.

JUNIOR INSTITUTION OF ENGINEERS, at 7.—Lecture and Demonstration of Industrial and Domestic Electric Lighting at the Demonstration Rooms of the Lighting Service Bureau.

PHOTOMICROGRAPHIC SOCIETY (at 4 Fetter Lane), at 7.—Members' Meeting.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—F. L. Emanuel: An Artist's Remarks on some Old Photographs.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Literary and Philosophical Society, Newcastle-upon-Tyne), at 7.30.—Prof. T. H. Havelock: Some Aspects of the Theory of Ship Waves and Wave Resistance.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (in the Royal Technical College, Glasgow).—L. Rothera: Speed Control in Relation to Modern Rolling Mill Drives.

SATURDAY, DECEMBER 19.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Newcastle-upon-Tyne), at 2.30.

PUBLIC LECTURES.

SATURDAY, DECEMBER 12.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Dr. H. G. Cannon: Floating Life in the Sea.

MONDAY, DECEMBER 14.

DYERS' HALL (Dowgate Hill, E.C.), at 6.—Prof. G. T. Morgan: Recent Researches on Mordant Dyes.