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Inland Water Survey

THE announcement made in the House of Commons on December 7 by the Minister of Health that he had "decided that a comprehensive inland water survey shall be undertaken for Great Britain" will undoubtedly be received with a feeling of widespread satisfaction. It marks the successful culmination of a movement which has been constantly supported and earnestly advocated by NATURE, with, as we confidently believe, the sympathetic interest of our readers, especially those who are in any way concerned with the technical use and exploitation of water. The solitary position of Great Britain, alone among the more important nations of the world in failing to keep a systematic and reliable record of its water resources, has long been a reproach to its administrators and a source of regret and inconvenience in scientific and engineering circles. It is welcome news that the defect is to be remedied. The statement of the Minister of Health goes on to explain that "a water survey committee, composed of persons outside Government Departments, will be appointed to advise on the survey and on the progress of the measures undertaken". The precise constitution of this committee remains to be seen, as also the scope of the proposed operations ; but on these points there may be occasion for comment later.

There is one feature, however, of the ministerial statement which, it must be avowed, produces a sense of disappointment. Reading the verbatim report of Sir Hilton Young's speech in the House of Commons, as also the supplementary remarks which he made the same day to the Institution of Water Engineers, any member of the general public, unacquainted with the inner history of the movement, might certainly conclude that the Ministry of Health is moving in the matter quite spontaneously and on its own initiative.

The inception of the proposal for a national survey can, however, be traced back a century, when the eminent engineer, Telford, was commissioned to report on the "Means of Supplying the Metropolis with Pure Water" and put forward a suggestion of this nature. In the subsequent period down to the present day, the recommendation was reiterated on numerous occasions in the proceedings of scientific and technical societies and in reports presented by successive departmental commissions of inquiry. These various reports were duly 'received', filed—and forgotten.

The matter developed with relative rapidity to its present stage quite definitely within the last eight or ten years, through the agency of a small private organisation, known as River Flow Records, promoted by Capt. W. N. McClean, who undertook gauging operations in certain river basins in Scotland with the object of giving practical demonstration of the way in which gauging records of the principal water areas in Great Britain might be kept. At the meeting of the British Association at York in September 1932, he introduced a discussion on the subject with a memorandum in which he directed attention to the essential value and fundamental importance of reliable records of water measurement in all problems connected not only with supplies of water for domestic consumption, but also for purposes of industry and commerce, power, navigation, irrigation, drainage and many other matters of public service. In the discussion which followed, the speakers were unanimous in affirming their conviction of the necessity for a national survey. Accordingly, on the joint recommendation of Sections A, E and G (Mathematical and Physical Sciences, Geography and Engineering), the General Committee of the Association approved the appointment of a research committee with instructions "to inquire into the position of Inland Water Survey in the British Isles and the possible organisation and control of such a survey by central authority". The Committee at its first meeting elected Vice-Admiral Sir Percy Douglas as chairman, Lieut.-Col. E. Gold as vice-chairman and Capt. W. N. McClean as hon. secretary. It also co-opted, with official cognizance and approval, representatives of the various Government Departments interested.

The Committee then made a careful and painstaking investigation extending over many months into all the available sources of information, and the following year it was in a position to present its first report (a lengthy document of 69 pages with numerous appendices containing detailed information) to the meeting of the Association at Leicester. This report was summarised in the issue of NATURE of November 11, 1933 : its main conclusions were : (1) that a systematic survey of the water resources of Great Britain is urgently required ; and (2) that the survey, in order to be of maximum utility, should be conducted by a central organisation, preferably under a Government department, independent of any interest in the administration, control or use of water.

At this stage, having regard (on account of the economic conditions prevailing at the time) to the impracticability of obtaining a grant from the public funds for the purpose of instituting the proposed survey, it was decided to invite the co-operation of the Institution of Civil Engineers, the Council of which body had offered to appoint a committee to investigate the feasibility of carrying out the objects outlined in the report on a self-supporting basis. Unfortunately, from lack of the necessary financial support, this scheme was found to be impracticable of realisation. It was then decided by a joint committee of the British Association and the Institution that the time had arrived when an appeal should be made to the Government on grounds of national utility and importance, exemplified by the situation arising out of the recent drought. The Prime Minister was approached through a memorandum signed by the respective presidents of the Association and the Institution, asking that he would be good enough to receive a deputation on the matter. As Mr. MacDonald was then on the point of leaving for Canada, the deputation was received in his stead by Sir Hilton Young on July 17 last. Having listened to the representations put forward, the Minister of Health promised that they should receive the most careful consideration of the Government.

No action or decision had, however, been announced from Whitehall at the time of the Aberdeen meeting of the British Association in September, when there was a full discussion of the subject and four Sections of the Association (this time including Geology) passed a joint resolution expressing the hope that the Government would decide upon "the establishment of an organised survey of the water resources of the country on a scientific basis". Now after two years of sustained investigation and advocacy by its promoters the fiat has gone forth that the survey is to be undertaken.

The foregoing account sets the present development in its proper sequence and enables the matter to be viewed in the right perspective. We have no wish to undervalue the care and attention which has been given to the proposal by the Ministry of Health and other Departments, but we have every reason for attributing the successful issue of the movement to the untiring efforts of its advocates. It is to the British Association and the Institution of Civil Engineers that credit must be given for the realisation of the demand for a national water survey.

Planning of Industry and Labour Supply

THE reports of the investigations into the industrial conditions in certain economically depressed areas of the north of England, South Wales and Scotland* afford an impressive piece of evidence of the necessity for industrial planning on national lines if untoward social consequences are to be avoided. The picture of Durham and Tyneside, where whole areas have been drained of vitality, with the production of an attitude of resignation and of an incapacity to return to work when opportunity offers, through sheer lack of confidence and vitality, is appalling. Even this, and the urgent necessity of arresting the present decline, cannot overshadow Mr. J. C. C. Davidson's significant remarks on the need for a continuous survey of the problems of the depressed areas, and his endorsement of the recommendations of surveys recently made by the University of Liverpool that the State should devote greater resources to continuous intensive regional research, and play a greater part in regulating the initial location of new industries or businesses. His further conclusion that the worst problems in West Cumberland cannot be treated in isolation, but that the district must be treated as a whole, is in keeping with the conclusions reached by Sir Arthur Rose for Scotland and Sir Wyndham Portal for South Wales. All four commissioners, in fact, are at pains to emphasise the necessity for a national policy in regard to industrial transference and the development of new industries.

The report on West Cumberland indicates that this area is likely to have, for years to come, a substantial surplus of labour with no hope of outlet locally. There is little prospect of attracting new manufacturing industries, but on the other hand agriculture appears to offer greater possibilities than in the other areas, and afforestation also offers scope for development.

The need for a national policy is brought out very clearly by Capt. D. Euan Wallace in his report on Durham and Tyneside. He urges that steps be taken towards the national planning of industry, and recommends the unification of coal-mining royalties, the formation of an Industrial Development Company for Tyneside and a land settlement scheme financed by the Exchequer, as well as the clearance of derelict sites. Similarly, Sir Wyndham Portal directs attention to the danger of the situation in South Wales, which is practically dependent on the coal trade alone, being repeated in other parts of the country which rely on a single industry. If the economic planning of factories is not accompanied by the economic planning of labour supply, distressed areas may spring up in other places; planning of industry involves the simultaneous planning of labour supply. Already dangerous tendencies exist in the starting of steel and tinplate industries in Lincolnshire. The chief hope of industrial development in South Wales appears to be in the adoption of more scientific methods of utilising coal, and special reference is made to the possibility of the hydrogenation of coal being undertaken in South Wales. Pembroke, moreover, has outstanding claims for Government controlled works, and special stress is laid on the recommendation that some such factory should be located in the South Wales area.

The report on Scotland indicates that the problem there is not strictly one of derelict areas. There is evidence of definite surpluses of labour in the shalefields, North Ayrshire and Lanarkshire. The conditions in the whole area are mainly due to world conditions, and the removal of hindrances to international trade would go far to remedy matters. The tendency for industry to move south has deprived Scotland of the advantages of the new industrial developments, and it is considered that a designed direction of Government orders in rather larger proportions to the Clyde area would alleviate in a remarkably wide degree, and out of proportion to what it would do in other areas, the widespread and severe conditions of depression.

All of the commissioners allude to the growing volume of juvenile unemployment through the increasing number of 'school-leavers', and emphasise the importance of strenuous efforts at transfer. None of the reports, however, discusses the absorption capacity of other districts for this surplus, and Capt. Wallace is alone in referring to the effect on juvenile unemployment of raising the school leaving age, in spite of the close relation of this step to that of juvenile unemployment in Great Britain as a whole. The reports are thus silent on one of the most critical and serious problems of the whole country—the prevention of the development of a hard core of juvenile unemployables, who have never known regular occupation, or at most, known it only for a year or two before displacement by fresh school-leavers.

* Ministry of Labour. Reports of Investigations into the Industrial Conditions in Certain Depressed Areas of (1) West Cumberland and Haltwhistle, (2) Durham and Tyneside, (3) South Wales and Monmouthshire, (4) Scotland. (Cmd. 4728.) Pp. 240. (London: H.M. Stationery Office, 1934.) 3*s*. 6*d*. net.

Principles of the Art of Electrical Communication

Signals and Speech in Electrical Communication. By John Mills. Pp. vi+281. (New York: Harcourt, Brace and Co., 1934.) n.p.

THE development of the methods used in communicating by electricity of recent years has been so rapid that few appreciate what has already been done and fewer still can make a guess at the nature of the developments the future has in store. In this connexion a suggestive collection of essays by Mr. John Mills will prove helpful to the ordinary reader, enabling him to understand the general principles used in the art of electrical communication and the limitations to which it is subject.

The first essay is on the 'vivisection' of speech. We may say that an engineer can now 'anæsthetise' a sound wave by means of a transmitter, lay it out on a pair of telephone wires, remove various of its components and amplify and rearrange others. We then hear to what extent the sound has become less recognisable. The Bell Telephone Laboratories have made many useful researches on the effects of distorting the wave. In the days before the advent of electrically cut records, the graver of the phonograph was operated directly by the sound waves it recorded. It was moved by a diaphragm at the base of the horn which acted like an ear trumpet in catching the sound. As a complex sound wave had to be recorded, any faint component notes had little chance of being preserved on the wax. In the process of recording the human voice and the lower notes of musical instruments, the fundamental tones lost nearly all the higher overtones and frequently some of the lower overtones. We now see that the human ear was an unrecognised but invaluable helper of the phonograph industry in its early days. Its inadequacy as an analyser of a complex musical sound explains how it could tolerate such imperfect reproductions of music.

Perfection is always expensive and in many cases is not necessary. What is done and what can be done in the way of transmitting and reproducing speech and music by means of a limited number of tones is marvellous. Experiments show that if we transmit all the component tones of speech the vibration frequencies of which lie between a hundred and three thousand, then it is easy to understand. Radio broadcasting has now for some time utilised the range to five thousand. The regulations at present limit it to this amount.

Mr. Mills discusses the question of whether an electrical system will ever transmit for us the particles necessary for taste and smell. So far, no solution of these problems has yet been suggested. Those delicate and discriminating senses which lead so directly into our emotional substrata seem destined never to reach us from a distance. Even if the chemist and the psychologist could reduce the range of these senses to a limited number of elementary sensations, the synthesis seems to require at the receiving end the actual presence of the necessary elements. On the other hand, the sense of feeling presents none of these difficulties. Doubtless mechanisms could be devised for this purpose by striking blows and exerting pressures, but it is difficult to see any useful end that would be served.

The essay on modulation, which the author calls the marriage of currents, gives a clear picture of what is meant by carrier currents. The marriage of two harmonic currents, one with a frequency of twelve and another with a frequency of two, gives rise to two offspring, one with a frequency of 14 and the other with a frequency of 10. A carrier current and two side band currents surge backwards and forwards according to their respective frequencies. The carrier current comes from the generator, and the current to modulate the carrier from the telephone line from the studio. The intelligence is carried by the side bands. International regulations do not allow these bands to extend over a width of more than five kilocycles above and below the licensed carrier frequency. The operation of demodulation, that is, of detecting the original modulating current, is more complicated and requires delicate adjustments.

The further a telephone signal proceeds from its source the weaker it becomes. In technical language, this is called attenuation. Heaviside, by analysing the causes of attenuation, saw that this could be largely overcome by loading, that is, by putting inductance coils in the line. Then came the notion of electrons, which clearly explained the Edison effect and the Fleming valve and led to the repeater valve, which enables signals to be sent over thousands of miles.

Good manners over the telephone have been so fostered by telephone companies and business organisations that they have become almost universal. Consequently the possibility of countering telephone discourtesy has been little appreciated. A person who after calling has left his telephone for an inconsiderate time, while nominally seeking some desired information, might be hurried by making the telephone make a brief howl. To do this, all that is generally necessary is to hold the telephone against the mouthpiece. With a handset this would of course be as impossible as whispering into one's own ear. The principle used is the same as that of a repeater,

which makes a receiver talk into a transmitter and then amplifies the sound.

When hearing is under consideration, it is convenient to describe sounds by the number of steps above a sound which is just audible and gives the threshold of hearing. The telephone engineer describes sound by the number of 'decibels' above the threshold. For the layman it is sufficient to remember that for every ten decibels there is a tenfold increase of power, and that an increase of three decibels, which corresponds approximately to doubling the power, is about the smallest increase that he is able to detect. His ears, for frequencies lying between 500 and 2,000 cycles per second, the range where hearing is keenest, can accommodate themselves to sounds extending about 130 decibels above the minimum audible intensity. For more intense sounds, auditory perception is masked by pain and the threshold of 'feeling' is reached. This also is about the level of the noise in busy streets. Near an aeroplane engine, the noise will be about thirty decibels higher than in a busy street. The ears of listeners will therefore be subjected to a sound power a million times larger. In a quiet suburban garden, the noise level may be only ten or twenty decibels above the level of zero sensation.

Science or Propaganda?

Heredity and the Social Problem Group. By E. J. Lidbetter. Vol. 1. Pp. 160+26 plates. (London: Edward Arnold and Co., 1933.) 21*s.* net.

THE book before us is based on an extremely painstaking study of persons receiving assistance from the Poor Law authorities in an area of East London, and their relatives. The results are embodied in twenty-six pedigrees, some of which contain several hundred individuals. They are classified according to the amount, if any, of assistance received from the rates, and also on a basis of physical and mental defects and of criminality. The investigation has been going on since 1913, and the author must be congratulated on his industry. A second volume is promised, dealing with a control group, and drawing conclusions. It may be hoped that this volume will include a statement of the criteria employed in assessing mental defect, and also as to the proportion of the whole pauper population which is included in these records. Unless this proportion is quite high, it is obvious that false conclusions may be drawn from the selection of the material.

The author states "that in this volume nothing more is attempted than to present a record of comparable facts, and that generalisations and analysis are reserved to a later volume". If this were true, the work would be a valuable social document. But it is far from true. The title alone begs two questions. It seems to be assumed that where undesirable characters occur in several generations we are concerned with heredity. This is no doubt true of the blindness in pedigree I, and highly probable in some other pedigrees. On the other hand, the frequent mention of venereal disease makes it clear that a good deal of the blindness, mental defect and insanity was due to this environmental cause. We find various defects among children brought up in Poor Law institutions and in conditions of great poverty. In view of the known effects of diet upon mental and physical health, it would be more possible to assess the part played by heredity in the causation of these defects if a few typical dietaries were given. For example, it would be interesting to know how much milk was drunk per week in 1900 by a five-year-old child in a typical family of this group. The author makes no suggestion that malnutrition may have played any part in determining the defects with which he deals.

The term 'social problem group' is applied to a small group who under pre-War conditions were chronically unemployed. Since 1921, this phrase has been out of date. Our main social problem to-day is the unemployment of persons able and willing to work, and the social problem group to-day is the group responsible for this fact. Some economists blame the owners of unused bank balances, others the technicians whose inventions have displaced labour; whoever else is to blame, the subjects of this book are not.

In spite of his disclaimer, quoted above, the author has been guilty of the most startling generalisations. Of the irregular unions common among his subjects he writes: "Such conditions may exist in other sections of the community, but if so they are unknown to the writer". A study of divorce decrees might convince him that unions of this type are frequent among certain sections of the rich. Again, Mr. Lidbetter believes in "the impossibility of considering biological problems upon an examination of pedigrees consisting only of two or even three generations". Yet our knowledge of the inheritance of blood group membership and taste-blindness is entirely built on such pedigrees. For such reasons as these, we must question the author's deductions from the data presented.

Even if the pedigrees show inheritance, it is not clear what is inherited in most cases. The people concerned were ill-adapted to life in East London. But one who (p. 87) had "spent most of his life in the workhouse, or in prison" rose to commissioned rank in the army, and ceased to be a burden on the rates; that is to say, he was a success in a different environment. Unless the

author contemplates the permanency of the East London environment, he has no more right to describe most of his subjects as socially inadequate because they failed there, than to describe a Jersey cow as agriculturally inadequate because she fails on the South African veldt. Unfortunately, such considerations will not occur to all the readers of this book.

The statement on pp. 19–20 that the socially inadequate are endowed at the expense of the self-supporting community could be used for any sort of propaganda, for example, against capitalism or the drink trade. It is here applied to the chronic pauper, with the further suggestion that the inadequacy is congenital. This is as legitimate as most other political propaganda, but it seems very unfortunate that it should be carried out with funds supplied by such bodies as the Medical Research Council and the Royal Society. Moreover, the obvious political bias displayed is likely to have the opposite effect to that intended. Some members of the 'social problem group' almost certainly bear genes which would lower their efficiency in any environment, and thus present a real problem for the eugenist. Readers who disagree with Mr. Lidbetter's opinions on politics and economics will be likely to overlook this fact.

Undoubtedly many readers will disagree with the reviewer, and regard this work as an important contribution to human biology. It is unquestionably a storehouse of valuable facts, but they would have been more impressive to the reviewer had the political opinions of their collector been less obvious. Is it too late to hope that, in the promised second volume of this work, a serious attempt will be made to assess the relative importance of nature and nurture in determining the characteristics of the men and women here described ? J. B. S. H.

The Human Outlook in Botany

Everyday Botany. By L. J. F. Brimble. Pp. viii+589. (London : Macmillan and Co., Ltd., 1934.) 7*s.* 6*d.*

THERE is no doubt that the study of botany is less commonly regarded as of general importance than is that of chemistry and physics, which seem to touch more closely our everyday life with their direct bearings on the chemical industries, on electricity, telephony, wireless and so on. Yet a knowledge of plant life is essential to the development of agriculture, the oldest and most widespread of human occupations, and those countless individuals who cultivate allotments or seek to embellish their surroundings by trim and attractive gardens would be more successful in their pursuits if they had some understanding of the needs of the plants they grow. Unfortunately, their education in this direction has usually been neglected.

It is to be regretted that even in these days, when the importance of science in our national life is beginning to meet with more recognition, the biological sciences are still absent from the curriculum of many boys' schools. Perhaps the ordinary textbooks of botany have not convinced the headmasters of the human interest and the universal importance of the subject. Mr. Brimble has endeavoured to meet this defect in his "Everyday Botany" by including in an elementary book dealing with plant life many features which indicate the utility to man of many important plants and plant products. By emphasising the human side of botany and maintaining a wide outlook on the important practical applications of a study of plants, the author fully justifies the publication of a new textbook, which it is to be hoped will meet with a warm welcome.

It is natural and fitting that the treatment of the subject matter should have a physiological bias, for it is the life of the plant which is of prime importance in considering its cultivation. But a knowledge of its structure is essential too, for structure and function of the various organs go hand in hand. Both aspects are adequately dealt with and the text is clear and readable, continually lightened for the general reader, for whom the book is primarily written, by reference to interesting facts which should be of common knowledge, but unfortunately are not. The treatment remains, however, always scientific, and the scope of the book is sufficiently comprehensive to serve as an adequate preparation for the various School Certificate and Matriculation examinations. One of the features which will attract both pupils and teachers is the wealth of illustrations, a large number being reproductions of excellent drawings by the author.

Having dealt with the plant as a whole, Mr. Brimble devotes a special chapter to the plant and its surroundings, an attractive introduction to the modern branch of botany known as ecology. This is followed by a chapter on evolution and plant-breeding, which fittingly indicates one of the paths of future progress in agriculture and horticulture. In this chapter, as indeed throughout the book, the author indicates by reference to former and present investigators the course of the development of botanical science, and manages to convey to the mind of the reader that botany is a progressive science and that it has its part to play in the progress of human affairs. In this as in other ways the book is stimulating in its effect upon the reader, and it will without doubt be found most useful to all who wish to acquire a knowledge of plant life.

Short Notices

Index Kewensis Plantarum Phanerogamarum. Supplementum Octavum Nomina et Synonyma Omnium Generum et Specierum ab initio Anni MDCCCCXXVI usque ad finem Anni MDCCCCXXX nonnulla etiam antea edita complectens. Ductu et consilio A. W. Hill. Confecerunt Herbarii Horti Regii Botanici Kewensis Curatores. Pp. iii+256. (Oxford: Clarendon Press; London: Oxford University Press, 1933.) 75*s.* net.

THERE is always a welcome for a new supplement of the "Index Kewensis", which supplies the botanist with a list of the names of genera and species published during a five-year period, and thanks are due to Miss Green and Dr. Sprague of the Kew Herbarium for the skilled and careful labour involved in its compilation. A useful innovation in this eighth supplement is the inclusion as an appendix of an alphabetical list of new or previously overlooked generic names under their respective families.

In the "Index" the name of the genus is followed by an indication of the family to which it belongs; new specific epithets are followed by the name which, in the opinion of the author, it should replace. Hybrids are also indicated. Appreciation of the rule that requires a Latin diagnosis to ensure validity of a new name is expressed, as in the case of the various Kew floras, by the additional reference which renders it valid. There is a fair sprinkling of *nomina nuda*—mere ghosts without body—and as botanists have agreed to neglect these it seems unnecessary to index them. A bad case is found under *Mentha*—of 60 entries 39 are *nomina nuda*.

It would be of interest to estimate the proportion of novelties represented by the new names but this varies widely from page to page. A small proportion only of those of genera represent plants new to science; mainly are they expressions of new views, to a large extent individual and sometimes conflicting, as to the limitations of genera; the long lists under the families Ficoidaceae and Leguminosae are striking examples. These alterations are responsible for correspondingly long lists of new combinations in the index of species. For number of entries *Hieracium* (hawkweeds) takes the prize, filling eighteen columns of 'novelties' nearly all from Norway and Sweden. We extend our sympathy to the Scandinavian botanists.

It is no faint praise to say that the new "Index" is as interesting reading as is a dictionary. It mirrors present tendencies of views on taxonomy as well as records the progress of monographic work and the botanical exploration of less-known parts of the world. A. B. R.

Exploring the Unconscious: Further Exercises in Applied Analytical Psychology. By Dr. Georg Groddeck. Pp. 224. (London: The C. W. Daniel Co., 1933.) 7*s.* 6*d.* net.

THIS excellently translated provocative book consists of a selection from the writings of Dr. Groddeck. For him, life is greater than its manifestations and the human being than his symptoms. While his profession as physician provides his problems and so far determines their expression, it does not limit his outlook. To him all human activities are the work of some unknown, called by him the 'It' as the most impersonal word available, and if we would understand illness, mental or physical, literature, art and music we must learn the language by means of which this unknown expresses itself, frequently a difficult cipher for which we have no ready-to-hand key. The physician trying to interpret bodily symptoms is advised not to overlook the unconscious factors and he is shown that the very method that will help him in this will also illumine the problems of Faust, Peer Gynt and the "Ring", as well as some vexed riddles of philology, of music and art.

Some of the symbolism among which Dr. Groddeck moves with ease will be beyond many readers, but will provoke others to test it for themselves. He emphasises to a much greater extent than most psycho-therapists the importance of synthesising as well as analysing, and the rôle of repression is far more adequately dealt with than elsewhere. The ideas to some will seem fantastic, to others alluring: to all whose work demands an interest in human beings his general conceptions are worthy of consideration, at least, as hypotheses to be tried out.

An interesting and attractive personality reveals itself in this unusual book, and the translation is so good that one is not aware that it is not in its original form.

Plane and Geodetic Surveying: for Engineers. By David Clark. (Glasgow Text Books of Civil Engineering.) Vol. 2: *Higher Surveying.* Second edition, revised and enlarged. Pp. xii+312. (London: Constable and Co., Ltd., 1934.) 25*s.* net.

THIS work is already well known as a standard book on the subject of geodetic surveying; and the new edition should go far to uphold the reputation of the old. The diagrams and photographs are clearly reproduced, and the subject matter is set out in a readable manner. The problems set at the end of each section are extremely useful, and possess the advantage of having the answers appended to them. It would perhaps have been preferable to use letters on the illustrations of such instruments as the theodolite in order to show the constituent parts more clearly; no description of the application of aerial photography to modern surveying is included, and the section dealing with map projections seems to be somewhat condensed. The difficult question of the rapid adjustment of errors in triangulation surveys is admirably dealt with, especially by the method of conditioned quantities.

Altogether, this work can be described as well suited to the needs of students reading for pass and honours degrees in engineering, and for those who desire more detailed knowledge of advanced surveying than is given in the usual textbooks. B. H. K.

Polarimetric Methods in Chemistry*

By PROF. T. M. LOWRY, C.B.E., F.R.S.

MUTAROTATION

NEARLY forty years ago, as a student of organic chemistry under Prof. H. E. Armstrong, I undertook my first research, on the stereochemistry of the α-derivatives of camphor. The earliest experiments showed that the bromination of α-chlorocamphor and the chlorination of α-bromocamphor both gave an isomorphous mixture of stereoisomeric αα′- and α′α-chlorobromocamphors. It was then natural to extend the research to the nitro-derivatives. For this purpose it was necessary not only to nitrate bromocamphor, but also to brominate nitrocamphor. In this way I first encountered the nitrocompound, $C_{10}H_{15}O.NO_2$, which has already provided a material basis for two extensive series of researches, and has not yet exhausted its utility or interest.

The first of a series of happy chances was a measurement of the optical rotatory power of a solution of nitrocamphor in the morning, followed by a confirmatory reading in the afternoon. During the luncheon interval the rotatory power of the solution had become quite different, and I was thus presented with a novel example of the phenomenon of change of rotatory power with time, which Dubrunfaut had first observed in 1846 in a freshly prepared aqueous solution of glucose. This property of the reducing sugars had been variously described as birotation, multirotation, and paucirotation, according as the ratio of the initial to the final rotation was 2 : 1, greater than 1 or less than 1 ; but, since in certain solvents the *sign* as well as the magnitude of the rotation of nitrocamphor was changed, I suggested in 1899 that the phenomenon should be described as *mutarotation* ; and this name has been in general use ever since.

The chemical basis of the phenomenon was disclosed by another happy accident. Wishing to know whether the change of rotatory power could be repeated when the nitrocamphor had been recovered from solution, I left a solution in benzene to evaporate on the water bath. Later in the day I examined the residue and found that it was now almost entirely insoluble in benzene. It had in fact been converted into a new compound, an anhydride formed from nitrocamphor by the loss of half a molecular proportion of water. An anhydride of this type could not be formed directly from nitrocamphor itself, but it could be derived easily enough from an isomeric hydroxylic form of the substance, such as that from which the salts of nitrocamphor were presumably derived. This conclusion was confirmed by the fact that the anhydride of lævorotatory nitrocamphor was, like the salts, strongly dextrorotatory. The mutarotation of nitrocamphor, always from left towards right, could therefore be attributed to a partial conversion in solution of lævorotatory nitrocamphor into a dextrorotatory isomeride, containing an acidic hydroxyl group, which was capable of forming an anhydride as well as a series of salts.

At this stage, Prof. Kipping very generously gave me a quantity of the π-bromo-derivative of α-bromonitrocamphor, from which I was able to prepare a stock of π-bromonitrocamphor. Lapworth and Kipping had described this compound as trimorphous, and had recorded the crystal constants and published drawings of two of the forms. The orthorhombic form, melting at 142°, proved to be strongly dextrorotatory when dissolved in benzene, but it became lævorotatory after a few hours. The tetragonal form, melting at 108° (which is formed as a by-product, alongside the more stable form, by rapid evaporation of a solution in chloroform), was found to be lævorotatory, but like nitrocamphor it exhibited a relatively small mutarotation from left towards right. This labile form was therefore analogous with ordinary nitrocamphor, whilst the more stable form was analogous with the still unknown pseudo-nitrocamphor, the relative stability of the two isomers having been reversed by the introduction of a halogen. The third form, for which no crystal measurements had been published, was evidently a mere mixture of these two isomers.

The mutarotation of the sugars in aqueous solutions had been attributed to several causes ; but, when Emil Fischer observed the same phenomenon during the reversible hydrolysis of the sugar lactones, he concluded that these changes of rotatory power were due to reversible hydration, and this conclusion was very widely accepted. This explanation can obviously be applied to any aqueous solution in which reversible hydrolysis can take place ; but it was not applicable to nitrocamphor, which exhibited mutarotation in a large range of anhydrous solvents, but was too insoluble to be examined in aqueous solutions. Since interaction with the solvent was thus excluded, the mutarotation of nitrocamphor could only be attributed to *dissociation* or to *isomeric or polymeric change*.

* From the presidential address entitled "Physical Methods in Chemistry" to Section B (Chemistry) of the British Association, delivered at Aberdeen on September 6.

At that date, certain sugars had already been prepared in two isomeric forms, which exhibited mutarotation in opposite directions; but these changes were attributed to the complete conversion of the two sugars into a third isomeride. In the case of π-bromonitrocamphor, however, the product of mutarotation of the normal and pseudo forms was obviously an equilibrium mixture of these two substances, and not a third isomeride, since, on evaporation of the solution, crystals of the normal and pseudo forms were deposited side by side. Mutarotation was therefore attributed to the *reversible isomeric change* of two isomers; and this interpretation was regarded as generally applicable to mutarotations in which interaction with the solvent could be excluded.

Dynamic Isomerism

The phenomenon of reversible isomeric change had been studied, and its essential characteristics had been fully elucidated, twenty-two years before by Butlerow in 1877. He had shown that two isomeric forms of the unsaturated hydrocarbon, *iso*dibutylene, C_8H_{16}, could be brought into equilibrium by the reversible addition of sulphuric acid, since a molecule of sulphuric acid could be removed from the acid sulphate in two different ways. Simultaneously, two *iso*dibutyl alcohols of the formula $C_8H_{18}O$, in the form of their acid sulphates, were brought into equilibrium by the reversible elimination of sulphuric acid, since the resulting olefine could add on sulphuric acid in two different ways:

$$C_8H_{16} + H_2SO_4 \rightleftharpoons C_8H_{17}O.SO_2.OH$$

Butlerow also recognised that, although sulphuric acid was required to bring the isomeric olefines and alcohols into equilibrium, the introduction of a catalyst might not be required in other cases. In particular, he suggested that prussic acid might be regarded as an equilibrium mixture of the two acids, HCN and HNC, from which the cyanides and *iso*cyanides $CH_3.CN$ and $CH_3.NC$ are derived:

$$CH_3.CN \leftarrow HCN \rightleftharpoons HNC \rightarrow CH_3.NC$$

Methyl cyanide. Prussic acid. Methyl *iso*cyanide.

Butlerow's paper did not receive the attention that it deserved, perhaps because it was published under the too modest title "On Isodibutylene". Much more interest was aroused by the publication, eight years later, by Laar, of a speculative paper "On the Possibility of Several Structural Formulæ for the Same Chemical Compound". Laar assumed that the dual reactivity of certain substances, of which ethyl acetoacetate is now the most familiar example, might be due to the incessant wandering of a hydrogen atom between two alternative positions in the molecule. In order to make his theory more precise, he compared these internal migrations with the vibrations which give rise to radiation in incandescent gases. To this phenomenon he gave the name of *tautomerism*, and in order to emphasise the contrast with Butlerow's phenomenon of reversible isomeric change, he stated categorically that the substances represented by the two alternative structural formulæ were "not isomeric but identical".

Since two isomeric forms of π-bromonitrocamphor had been isolated in the crystalline state, and their slow progress towards equilibrium in solution had been followed by observations of mutarotation, it would have been absurd to describe them as identical, or, in terms of Laar's definition, as tautomeric. These well-defined compounds, however, provided an excellent illustration of Butlerow's phenomenon of "equilibrium between isomers". I therefore ventured to describe this phenomenon in very obvious terms as *dynamic isomerism*, in contrast to the more usual condition of static isomerism, in which each isomer preserves its individuality and is not in process of conversion into any other substance of similar composition.

(*To be continued.*)

The Metamorphosis of Paper

ONE of the results of the application of scientific methods to the cellulose industries, and in particular to paper, has been a realisation of the considerable inherent strength of the unit fibre. One would, of course, hesitate to select paper for any purpose for which great strength is essential, but at the same time it must be remembered that, when paper is broken, it is usually the bonds connecting the fibres, and not the fibres themselves, which are ruptured. Reliable figures are necessarily difficult to obtain, but actual measurements indicate that, weight for weight, the tensile strengths of certain cellulose fibres and of wires made from light metals are of the same order (cf. NATURE, 131, 553, April 15, 1933).

It is not unnatural, therefore, that many attempts have been made to produce paper products having the equivalent in strength and durability of more resistant materials such as cloth, leather, wood and even metal, and in such cases attention has usually been concentrated on strengthening the bonds between the fibres both laterally and longitudinally, on the reasonable assumption that the individual fibres can take care of themselves. By selecting the strongest of

fibres and treating them mechanically in the paper-mill beater, it is possible to split the ends of the fibres into smaller fibrillæ which intertwine on the paper-machine and develop considerable strength, but there is obviously a limit to the extent to which this can be carried, and this limit precludes paper completely as a competitor even to a woven fabric.

The most promising results have been obtained by processes of impregnation, in which the fibres are held together by addition of an independent consolidating material. Thus, if paper is passed through zinc chloride or sulphuric acid under controlled conditions of concentration and temperature, the cellulose is modified in such a way as to form a hard impervious surface layer. This so-called 'vulcanising' process not only imparts a certain amount of strength and solidity to the sheet, but also, if a laminated product is made by pressing sheets into intimate contact before the hardening process is complete, a hard material having many of the properties of wood is obtained. Materials of this type, for example, fibrous plasters, mixtures of paper and glue, and laminated paper products made by impregnation with synthetic resins, have been available for many years, but have not hitherto been obtainable in the form of a strong flexible sheet.

The methods suggested for strengthening fibres by simple immersion in a bath occupy a share of the patent literature far out of proportion with the value of the material they produce. There are, however, several outstanding exceptions, one of which is rubber. Absorbent paper containing more than 90 per cent of α-cellulose can be heavily impregnated with rubber either as a latex suspension or dissolved in a solvent, and the resulting product, when suitably coloured, finished and embossed is an excellent imitation of leather or cloth, from the point of view not only of appearance but also of strength and durability.

Another very successful product, but of a rather different character, is "Linson", which is described as a cellulose fabric. This gives a partial clue to its identity, although the base material is manilla, which is one of the strongest vegetable fibres known. The great strength of Linson is indicated by the fact that the folding-resistance is almost ten times that of an ordinary bookbinding cloth. The difficulty of producing a high-glazed, water-repellent finish without brittleness seems to have been overcome, and not only is it possible to scour or polish the surface without damage or removal of colour, but also the resistance to oil and petrol gives it a considerable advantage over the numerous cellulose lacquers at present available for waterproofing. Resistance to water is usually and for obvious reasons incompatible with suitability for work with adhesives, but Linson must be ranked with the few products of its kind which fulfil both requirements satisfactorily. Apart from alkalis, fairly strong acids and certain organic solvents (which may be regarded as unfairly stringent tests) we have found only one medium which it will not resist without change, and that is hot water ; the effects of storage and weathering have, however, yet to be tested.

Numerous uses for this class of material at once suggest themselves, but mention may be made here of all kinds of substitutes for the poorer and thinner varieties of leather, for bookbinding material, motor-car roofings, desk-tops and (since it can be sewn, washed, ironed and blocked) even for clothes. J. G.

Recent Aeronautical Research

THE annual report for 1933–34 of the Aeronautical Research Committee covers the work of the first year under the new chairmanship of Mr. H. T. Tizard.* It summarises the position to-day with regard to actual flight that "flying may now be regarded as a safe means of transport. This is due on the one hand to the steadily increasing reliability of aircraft engines, and on the other to the satisfactory development of rules of design." The Committee suggests that the relative immunity from accidents has been largely attained by the age-long process of trial and error, which has not been without its cost in loss of life. It is probable, however, that there is no other industry in applied science that has had quite so much scientific thought given to both its fundamentals and the elucidation of its errors in application of them. Hence the relatively rapid progress in both of the outlooks that the Committee considers has led towards safety is in itself due, in no small degree, to its own work.

Paradoxically, the report then discusses a series of accidents that have been happening to one particular type of aircraft, and admits that the trouble is not yet completely solved. Experiments on a model with specially made wings of the correct proportional elasticity are now in progress as an attempt to reproduce the apparent conditions under which these failures occurred. Such accidents cannot be entirely disassociated from existing weather conditions, and work has been undertaken in an attempt to measure such

* Aeronautical Research Committee. Report for the Year 1933–34. Pp. iv+89+4 plates. (London: H.M. Stationery Office, 1934.) 1s. 6d. net.

conditions in flight. The net result of the observations made suggests that only during one flight in 10,000 in western Europe is an aircraft likely to encounter disturbances in the air that would have an effect equal to meeting an upward gust with a velocity of 30 ft. per second. All aeroplanes as at present designed are strong enough to meet such a gust. This throws a sidelight upon the proportionate risk that is attendant upon flying. It would be interesting to compare it with the number of trips made by, say, a London motor bus, or a train on a British railway, per structural breakdown.

In a similar connexion, a reference is made to a report by the Director of the Meteorological Office on the effects of lightning on aircraft. In no instance has there been a fatality occurring as the result of a British aeroplane being struck by lightning, while damage to the structure is usually slight. This paper has been published by the Meteorological Office (Professional Notes, No. 66 : Lightning and Aircraft. By G. C. Simpson. London : H.M. Stationery Office, 1934. 4*d*. net. See NATURE, Oct. 20, p. 618).

The spinning of aeroplanes has resulted in a number of accidents in previous years. Various ways of avoiding the dangers of a flat spin which sometimes arises during a normal spin, and from which it is difficult to recover, are mentioned in some detail. The new free spinning tunnel at the Royal Aircraft Establishment has been of considerable assistance in these investigations. In this tunnel, in which the air flows vertically upwards, a model can be left to spin freely and its behaviour observed. It is now considered that the problem is sufficiently understood to justify giving further experiments a lower priority than formerly.

A curious contradiction has arisen with regard to safety during landing and take-off. The increase in the wing loading and the general improvement in stream-lining of aeroplanes has increased the difficulties associated with these two manœuvres. It is possible under certain conditions to propel the aeroplane into the air by its own momentum before it is aerodynamically supported. The complete understanding of this problem and many others relative to control calls for a very thorough knowledge of the flow of air over wings in the stalled condition. This has been investigated principally at Cambridge. A picture of the air flow has been obtained by watching the behaviour of tufts of wool attached to the surface. When the flow is steady the tufts lie out along the wing, but when turbulent they wave about in a violent manner. This technique is proving useful for the study of air flow in many different ways.

Investigation into the properties of the autogiro has also been carried out during the past year. The new type, which is wingless and has no rudder or elevators, is considered to be a great advance on previous designs, especially from the point of view of safety in flight. It can not only land, but also take off in a very small space, and is particularly simple to control. Its minimum flying speed is about half that of a conventional type of aeroplane, and it is quite stable. For commercial purposes it may not be so efficient as the aeroplane. The Committee states that it is now examining the theory of the autogiro in more detail in order to find out whether there are any unusual conditions of flight when it may become unstable and dangerous.

The Committee has also considered proposals for the construction of cyclogiros or paddle-wheel aeroplanes. The outstanding problems on these aircraft are, in its opinion, that of difficulty of construction with reasonable weight rather than aerodynamics.

With regard to the work on aero-engines, the most promising lines of advance seem to be in single-sleeve valve engines ; an illustration in the report shows the remarkable decrease in the number of parts to a sleeve valve cylinder of a radial air-cooled engine compared with the more normal design with a poppet valve cylinder. Work is proceeding also on compression ignition engines of the sleeve valve type. Consideration is being paid to possible replacement of carburettors in petrol engines by injection pumps, although there does not appear to be any fundamental advantage in the latter.

Lubrication is also mentioned, although with no very definite proposals up to the present. The difficulties of laying down a specification for a good lubricating medium are appreciated, not the least of these being to find out exactly what functions the engine user demands of the lubricant. Experiments have shown that the use of 'inhibitors' will delay the formation of gum on cylinders and pistons, and it is hoped to prevent the formation of sludge by similar means.

Certain progress is mentioned in the metallurgy of those metals of interest to the aeronautical engineer. The subjects investigated include elasticity and fatigue, the use of beryllium, magnesium alloys, corrosion prevention, etc.

A supplement of about seventy pages gives details of the year's work in aeronautical research under individual sub-headings as follows :—(i) Aerodynamics ; (ii) fluid motion ; (iii) stability and control ; (iv) servo controls ; (v) spinning ; (vi) seaplanes ; (vii) atmospheric turbulence and meteorology ; (viii) structures ; (ix) aircraft noise ; (x) engines ; (xi) elasticity and fatigue ; (xii) alloys.

Obituary

PROF. WILLEM DE SITTER

ASTRONOMY has suffered a heavy loss by the death of Willem de Sitter, director of Leyden Observatory. In the development of astronomical research in the present century, Holland has taken a conspicuous part; and, since the death of J. C. Kapteyn, de Sitter has been the leading astronomer of his nation. He is most widely known as the propounder of the 'de Sitter universe', a recondite development of the theory of relativity which is the basis of our present idea of an expanding universe. But that reveals only one side of his versatility. The great research, which occupied him for thirty years, was in classical celestial mechanics; and in 1931 the Royal Astronomical Society awarded him its gold medal "for his theoretical investigations on the orbits of the satellites of Jupiter, and for his contributions to the Theory of Relativity". It is a strange chance that, of his most conspicuous contributions, one should relate to the Jovian system—first-fruits of the invention of the telescope—and the other to the remotest systems that the telescope has yet revealed. But, setting aside his personal research, astronomers more usually think of him as the energetic head of a flourishing observatory, who by his sound practical judgment, his wide experience, and his single-minded character, has had a far-reaching influence on the general advance of astronomy.

Willem de Sitter was born at Sneek in Friesland on May 6, 1872. He was educated at the Gymnasium at Arnhem, where his father was a judge, and at the University of Groningen. Though primarily a mathematician, he was captured by Prof. Kapteyn's enthusiasm and began to work in the Astronomical Laboratory at Groningen. It was, however, Sir David Gill who finally converted him into an astronomer. Visiting Groningen in 1896, Gill made his acquaintance, and eventually invited him to the Cape to assist in the discussion of the heliometer observations of Jupiter's satellites. De Sitter found the Jovian system a subject after his own heart; it gave scope both to his mathematical training in celestial mechanics and to his later interests in the practical side of astronomy. He worked at it more or less continuously until 1929, when at last he felt satisfied to publish his definitive values of the orbital elements and masses of the four satellites.

After two years at the Cape Observatory, de Sitter returned to Groningen and became an assistant in the Astronomical Laboratory. In 1908 he succeeded H. G. van de Sande Bakhuyzen as professor of astronomy in Leyden. On the death of E. F. van de Sande Bakhuyzen in 1918, he was appointed director of the Leyden Observatory. This was an important and arduous post, for the Dutch Government had decided on a great enlargement and reorganisation. Leyden is one of the oldest observatories; its third centenary was celebrated last year; but for many years it had ceased to be an important institution. De Sitter applied himself to the reorganisation with energy and far-sightedness, and sacrificed his personal work to the responsibilities of his office. Surrounding himself with a well-chosen staff, he rapidly made the Observatory one of the most important in Europe. This success was fittingly recognised when he was made president of the International Astronomical Union for the period 1925–28.

One interesting innovation was the alliance which de Sitter formed in 1923 with the Union Observatory at Johannesburg, providing for regular visits of members of the Leyden Observatory to gather observational material in the favourable climate of South Africa. Leyden will shortly have its own instrument installed at the Union Observatory, namely an equatorial with twin photographic telescopes of 16-inch aperture having Cooke triplet objectives. The instrument is now ready for testing, and de Sitter was planning just before his death a visit to England to inspect it.

In 1916–17, de Sitter published a series of three papers in the *Monthly Notices of the Royal Astronomical Society* "On Einstein's Theory of Gravitation and its Astronomical Consequences". These were the first papers in English on the new theory. Einstein's original paper was almost inaccessible here, owing to the interruption of international communication; probably the only copy in England was one which de Sitter kindly sent to the present writer about this time. There were already a number of developments to be added. De Sitter's papers included an admirable up-to-date exposition of the mathematical theory; and they have greatly influenced the form in which the general theory of relativity has come to be understood in England. In the second paper, he investigated the effect of the new law of gravitation on the motion of the moon, and found that it would cause an advance of the perigee and node amounting to nearly 2″ per century; this is at present just outside the limits of practical detection. The analysis in the paper is very arduous, and shows how fully de Sitter had entered into the methods of the new theory. A simpler way of handling the problem has since been discovered, but it confirms de Sitter's conclusion.

It is in the third of these papers that the 'de Sitter universe' appears as a suggested alternative to the 'Einstein universe'. It is perhaps necessary to explain how these ideas arose. It has become the regular procedure in mathematical physics to express the laws of Nature by differential equations. But in classical physics at least the differential equation is not the whole of the law; boundary conditions are also prescribed. Thus it is not sufficient to say that Newton's law of gravitation is $\nabla^2\varphi = -4\pi G\rho$; there is the further condition that that solution of the differential equation must be taken which makes φ zero at infinity. Tested by the principle of relativity, the Newtonian equation failed; Einstein had to substitute another differential equation, and so reached his famous theory. But what is sauce for the goose is sauce for the gander, and the boundary values at

infinity should also be tested by the same principle. Unfortunately, they did not satisfy the test. In particular, the familiar solution giving the gravitational field of the sun (which affords the chief observational tests of the theory) gives values at infinity which are open to this criticism. Einstein was the first to recognise this inconsistency, and proposed a remedy. De Sitter pointed out that there was an alternative which in some ways appeared less artificial. He entered into a full discussion of the astronomical phenomena which might be used to discriminate between them. Both theories lead to a closed spherical space, and de Sitter's paper contains estimates of upper or lower limits to the size of the universe on either hypothesis. It is a reminder of our progress in the last seventeen years that none of these estimates is large enough to include some of the nebulæ the distances of which have recently been measured.

De Sitter pointed out that the most definite test would be provided by the velocities of the spiral nebulæ. In his cosmology, but not in Einstein's, the velocities should increase with increasing distance. He does not seem to have noticed that the velocities should all be recessive, though this is almost immediately evident from his formulæ. It is true that he predicted a systematic displacement of spectral lines to the red, due not to genuine motion but to a 'slowing down of time' at great distances from us. This is now recognised to be only a second order effect, and is submerged in genuine increase of receding velocity with distance. We need not here trace in detail how the present version of the expanding universe differs from de Sitter's original account; the differences are such as naturally arise in the course of development of a highly original idea. Confronted for the first time with the topsy-turvy conceptions to which his pioneer work had led, de Sitter was amazingly far-sighted on some points and amusingly blind on others. He appreciated as much as anyone the joke that some of the most surprising properties of his universe arose from the fact that he had forgotten to put any matter into it.

The de Sitter universe attracted the attention of geometers as well as physicists, and became a favourite theme of study. De Sitter took little part in this himself. By the time the radial velocities of spiral nebulæ had been determined in sufficient numbers, he was heavily occupied in reorganising Leyden Observatory. For at least ten years he was "the man who discovered a universe and forgot about it". But in 1930, having at last completed his work on the Jovian system, he returned to the subject. Learning later of Lemaître's development of the theory, he accepted it with enthusiasm and published a number of papers on the problems raised. An interesting summary of his later views is given in the last chapter of his book "Kosmos", which contains the Lowell lectures delivered by him at Boston in 1931.

Astrophysics, as ordinarily defined, was outside de Sitter's range; but he took care to secure in his observatory a strong astrophysical department directed by Prof. Hertzsprung. His activities included most other branches of astronomy—dynamical, statistical, instrumental. He did much work on the fundamental constants of the solar system. His work on Jupiter's satellites led him to contribute to the examination of the secular retardation and irregularities of the earth's rotation, using the early observations of these satellites to check the earth's performance as a time-keeper.

Both for his ability and his character, de Sitter was highly esteemed by his colleagues. He was a frequent and welcome visitor to England. He attended and took part in several meetings of the British Association, including the two meetings held at the Cape. He was far from robust, having suffered a long and severe pulmonary illness about 1921 which left him with a damaged lung; but he did not spare himself in activity. He looked older than his years. Outside astronomy he was much interested in art and literature; but his greatest joy was in his home life with his children and grandchildren. He had two sons and two daughters, all married.

On November 9 of this year he became seriously ill with pneumonia, at the same time with two other members of his family—a son and grand-daughter who had just returned from the Dutch Indies. The child died on November 16, but it was hoped that de Sitter would recover. On November 18, complications set in and he grew rapidly weaker. He died on November 19. A. S. E.

THE REV. A. H. COOKE

ALFRED HANDS COOKE was born at Enfield in 1854. He was a colleger at Eton and proceeded as a scholar to King's College, Cambridge. Here he crowned a classical career of unusual brilliance by being Senior Classic in 1878. The following year he was elected a fellow of King's, where he remained as dean and tutor until 1900.

Cooke's scientific work was almost exclusively confined to the study of the Mollusca, and in this branch of zoology he soon attained a position of widely recognised authority. He was University curator of zoology from 1881 until 1890 and in 1895 published his best-known book—the entirely charming volume on Mollusca in the Cambridge Natural History. But he did much other work of a more technical nature and the value of his many papers on conchology was acknowledged by the degree of Sc.D. conferred on him by the University in 1914. He was president of the Malacological Society in 1913–15 and of the Conchological Society in 1919–20. His large collection of shells, many of them taken by himself in foreign travel, he had recently presented to the British Museum. This collection includes a very long series of the whelk, *Purpura lapillus*, from all parts of the world. It shows the extreme variations of the species and contains a sinistral variant, a Hungarian specimen and one of the four or five recorded examples.

For twenty years after leaving Cambridge, Cooke was headmaster of Aldenham, where he produced a steady stream of fine classical scholars of his own training, and continually encouraged and extended

the teaching of science. He was an impressive preacher and an exceptionally fine lecturer, and to many generations of his boys the memory of his personality will ever remain one of the most powerful influences of their lives.

Cooke was, indeed, one of the really great men who touched nothing that he did not adorn. He had no mean reputation as a classical scholar and his dual record—Senior Classic and Doctor of Science of Cambridge—must be unique. In 1920 he retired to the Eton living of Mapledurham, where, attracted to the study of archæology, he quickly mastered a new subject and produced, in 1925, his fascinating book, "The Early History of Mapledurham". It was here that he died on November 28. T. H. S.

WE regret to announce the following deaths:

Dr. Aristarch Belopolsky, vice-director of the Central Astronomical Observatory, Pulkovo, U.S.S.R., on May 16, aged eighty years.

Prof. O. D. Chwolson, formerly professor of mathematical physics in the University, Leningrad, on May 11, aged eighty-two years.

Dr. J. W. Leather, agricultural chemist to the Government of India in 1892–1916, on November 14, aged seventy-three years.

Dr. Theobald Smith, For.Mem.R.S., formerly director of the Department of Animal Pathology of the Rockefeller Institute of Medical Research, New Jersey, aged seventy-five years.

News and Views

Charles Augustus Young (1834–1908)

AMONG the many eminent American astronomers of last century, few were better known than Charles Augustus Young, the centenary of whose birth occurs on December 15. As a pioneer of solar spectroscopy, he was second to none, while his great gifts as a writer and teacher gained for him a world-wide reputation. Born at Hanover, New Hampshire, where both his father and grandfather had held chairs in Dartmouth College, he graduated in 1853, and then after a tour in Europe with his father, for a few years taught classics and theology. At twenty-three years of age he was made professor of mathematics in Western Reserve College, Ohio, and from that time onwards devoted himself to astronomy. The Civil War for a short time interrupted his work, but in 1866 he succeeded his father in the chair of astronomy at Dartmouth College, and eleven years later succeeded Alexander as professor of astronomy at Princeton, a position he held until his retirement in 1905. Although he made investigations of the spectra of the planets, comets, stars and nebulæ, his main interest was in solar investigations. He observed total solar eclipses at Burlington, Iowa, in 1869, at Tenez de Frontena, Spain, in 1870, at Denver in 1878, in Russia in 1887 and in North Carolina in 1900. It was in connexion with the eclipse of 1870 that he made his striking discovery of the so-called 'reversing layer'. He observed the transit of Venus of 1874 at Peking and that of 1882 at Princeton. His well-known book "The Sun" appeared first in 1881, while later he published his "General Astronomy", 1889, "Elements of Astronomy", 1891 and "Manual of Astronomy", 1902. His book on "The Sun" passed through many editions and was translated into several languages. Honours came to him from England, Germany, Italy and France, and in 1891 he was awarded the Janssen Medal of the Paris Academy of Sciences. In 1882 he served as president of the American Association for the Advancement of Science. He died at Hanover, New Hampshire, on January 3, 1908, at the age of seventy-three years.

Present-day Scientific Research

SIR JAMES IRVINE, principal of the University of St. Andrews, in replying to the toast of the profession of chemistry at the Ramsay Chemical Dinner held in Glasgow on December 7, gave his views on some aspects of modern research. Sir James reviewed the changes which have taken place in chemical industry since the beginning of the century and referred particularly to Scotland. He said that a country which produced men like Neilson, Young, Tennant, Townsend and Watt appeared to have nothing to fear from changes in industrial conditions. But the new conditions have formed themselves too quickly, and their impact on a disorganised world has been too swift for readjustment to be entirely satisfactory or even possible. In regard to scientific training, Sir James finds himself at variance with the spirit of the times because he cannot resist the thought that scientific training in Great Britain is already over regimented. He did not refer particularly to undergraduate instruction but more to the extreme specialisation and almost mechanical quality of much of the work termed research. The ladder of research was once difficult of access and steep to climb. Only the zealots made the attempt, impelled by a force they could not control, and only the strongest survived. To-day no training is reckoned complete on first graduation, and in consequence research students, sometimes singly, more often in teams, work towards the goal of a higher degree.

SUCH a form of research is a costly business: it is time-consuming, and the penalties fall on those who ought to be spared. Advances in science are certainly made, but Sir James is concerned chiefly with the effect of such work on the individual and the stultification it begets in his power to think. Many students at present engaged in research would be infinitely better employed in supplementing their academic knowledge by a training in the methods whereby science is operated in industry and in the conduct of the practical affairs of life. Many professors, too, would be better professors and capable of greater

service to the world if they were allowed the leisure and peace of mind to prosecute their researches unhampered by the care and training of research collaborators. The methods of the solitary philosopher, the methods of Davy and Faraday, can scarcely be excelled. Research in the academic sense has become a fashion; it will soon become a trade and then farewell to the hopes that Great Britain will again produce the few particular men who, in a flash of genius, have turned discovery into invention and invention into industry. Scotland has given to the world such pioneers, and is not lacking in the qualities which are needful.

Reduction of Working Hours in Industry

THE uncompromising attitude of certain sections of British industry to proposals for the reduction of working hours might be regarded with some amusement but for the serious results which it is likely to precipitate. The portentous arguments set forth, for example, by the National Federation of Employers Organisations against the forty-four hour week recapitulate in unmistakably the same accents those advanced with equal plausibility in previous generations against Factory Acts, the abolition of child labour and the limitation by law of the hours of work by women and children. There are, however, important firms such as Imperial Chemical Industries, Ltd., in its Billingham Works, and Boots Pure Drug Co., at Nottingham, which have had the courage and wisdom to determine the possibilities of the forty-hour or five-day week by direct experiment. The experiment carried out at Nottingham is of the greater interest in that its results have been made generally available in an important report by Sir Richard Redmayne, who was nominated by the Ministry of Labour, at the firm's request, to conduct an exhaustive inquiry as to whether the permanent adoption of the five-day week in all its works is possible ("A Review of the Experimental Working of the Five Days Week by Boots Pure Drug Company at Nottingham." By Sir Richard A. S. Redmayne. Pp. 70. Nottingham: Boots Pure Drug Co., 1934. 1*s*.). The publication of the full details of this investigation in itself constitutes a noteworthy break with the tradition of secrecy which has hampered the pooling of experience in matters of industrial safety, hygiene, labour policy, etc.

SIR RICHARD REDMAYNE concludes that the working of the five days working week inaugurated on April 30, 1934, and terminating on September 29, has proved an unqualified success both from the business point of view and from that of the employees. He is satisfied that the cost in the aggregate has not been enhanced and the efficiency of the employees has been increased. Marked improvements in health, contentment, regularity of attendance at work and diminution of absenteeism have been observed since the start of the experiment, and the employees themselves would view with dismay any return to the five and a half day week. Had the working hours per week not been reduced, it would have been necessary to discharge a number of workers, and from this point of view alone the experiment has already been of real benefit to the community itself. Sir Richard Redmayne is satisfied that equally satisfactory results would be obtained if the experiment was continued over the winter months. It is, of course, difficult to say how far the experiment can be applied to other concerns with equal prospects of success. The intimate relation of production and distribution in this particular concern has probably contributed largely to its success, but Sir Richard Redmayne considers that there are many works at which the five day week might be tried with equal prospects of success. Messrs. Boots have set an example in scientific experiment on a most important social-industrial question, and scientific workers should not be slow in pointing out to the community the possibility of obtaining similar decisions in these matters in other industries or concerns.

Rare Books on Magic

AN exhibition of old and rare works dealing with magic, witchcraft, legerdemain and kindred subjects was opened on December 6 and was on view until December 14 at the University of London Council of Psychical Investigation, 13D Roland Gardens, South Kensington, London, S.W.7. Five hundred items had been selected for exhibition out of the 12,000 volumes collected by Mr. Harry Price, the honorary secretary of the Council, forming what is probably the largest and most important assemblage of printed works relating to occult subjects available for the student. The books exhibited ranged in date from about 1490 to the present day, though, curiously enough, the "Malleus Maleficarum" (1488), the first printed work on witchcraft, and the Bible of the witch finder, was not represented by a copy earlier than 1576. Works dealing with magic and the witch, ghosts and spiritual manifestations generally, of the sixteenth, seventeenth and early eighteenth centuries are becoming increasingly rare and expensive, and many of them in a few years' time will be unobtainable. A specialised library of the size of that of the Council for Psychical Investigation is, therefore, of great importance for the psychologist and the social historian. In looking through any extensive range of books such as this, it is significant to note how slow has been the growth in appreciation of the nature of evidence when any element of the supernatural has been implicated in an investigation. Although early works, such as Lavater's "Ghostes and Spirites Walking by nyghte . . ." (1572) and Scot's "The Discoverie of Witchcraft" are thoroughly sceptical, it was not until 1668, in the work of the Rev. Joseph Glanville, fellow of the Royal Society and virtually the father of psychical research, that anything in the nature of a systematic setting out of evidence was attempted.

THE recent haunting at Saragossa, in which voices in a chimney have been explained as due to the "unconscious ventriloquism" of a serving maid—an explanation almost as mysterious as the phenomena it explains—adds interest to the accounts in this

exhibition of remarkable manifestations associated with the youth of both sexes from time to time. Eventually they have, as a rule, been attributed to imposture. Among the best known is the Cock Lane Ghost in the middle of the eighteenth century, which inspired one of Andrew Lang's more intellectually agile efforts and is represented in the exhibition by an anonymous pamphlet attributed to Oliver Goldsmith. Another case, equally famous, if more materialistic in its supposed manifestation, was that of Mary Toft (1726) who gave birth to 27 rabbits, but failed to be equally prolific when removed from Guildford to Leicester Fields. In tracing back the history of the investigation of spirits, and of trials for witchcraft, it is remarkable what degree of credence was given to the evidence of juvenile neuropaths, and how frequently it was accepted as adequate, often without corroboration, to ensure condemnation of the accused to prison and death, while at the close of the sixteenth century the case of one Somers discussed in "A Discovery of the Fraudulent Practices of John Darrel . . ." by Samuel Harsnett, an eminent divine and later Archbishop of York, was near to causing a schism in the Church.

Exhibition of Antiquities from Colchester

A SPECIAL exhibition of antiquities from Colchester opened at the British Museum on December 10. The objects exhibited illustrate the results of the five years' exploration carried out on the British and Roman site at Colchester by the Colchester Excavation Committee, which was formed in 1930 by the British Museum and the Essex and Colchester Museum jointly. The exhibits, which consist of objects obtained by excavation, and plans, drawings and photographs, while giving a general view of the results, serve particularly to illustrate three aspects of the information which five years' work has made it possible to piece together. The first of these is the history of the site, beginning with its first foundation as a British city, then in its period of greatest prosperity under Cunobelinus (A.D. 5), its conquest at the time of the invasion of Claudius (A.D. 43), and its eclipse on the rise of the Roman city seven years later. Apparently the diminished British city shared the fate of the Roman city when the latter was burned by Boudicca in A.D. 61. The photographs of the structural remains discovered and their plans, as well as the series of coins and material remains, are an index of the vicissitudes of the site. The second aspect is the character of native culture at Camulodunum; and the third, the effect of the impact of Roman culture on that of the native. To some, this last will appeal as of the greatest interest of all. Many new facts, indeed, have been brought to light at Colchester, not the least important being the data bearing upon the manufacture of Romano-British pottery. The remarkable discovery of the now famous kiln demonstrated that not only did the Romano-British potters make jugs, mortars, etc. in buff ware, slip coated fabric, castor ware, etc., but they also made the well-known Samian or 'terra sigillata' of which the manufacture had previously been thought to be confined to Gaul.

Archæological Investigations in Ireland

DR. O'NEILL HENCKEN, director of the Harvard Archæological Mission to Ireland, before leaving for a brief vacation in America, has given an account of the results achieved in the recently completed third year of the Mission's work, which appears in the *Observer* of December 9. Excavations at Cushenden, Co. Antrim, would seem to have confirmed fully the view of the importance of this site for the elucidation of the origin and affinities of the stone age industries of north-east Ireland, which is held by Mr. C. Blake Whelan, with whom the Mission has been in co-operation. Mr. Whelan has recently pointed out the probability that further systematic investigation of stone age sites in this area would provide evidence of stratification, which is lacking for certain of the comparable European industries of the mesolithic and earlier phases of the neolithic ages (see NATURE, Nov. 4, p. 702). From Dr. Hencken's statement, it now seems that this evidence is likely to be forthcoming from Cushenden, when certain comparative studies now in progress have been completed. He states that all the phases of the Irish stone age have been found at Cushenden in conditions, geological and other, which should provide the necessary data for the discussion of the origin of these cultures and their affinities with comparable material from sites in Britain and on the Continent.

DR. HENCKEN also referred to the Mission's investigations on the crannog site of Lagore, Co. Meath, known from the annals to have been the residence of Irish kings in the eighth, ninth and tenth centuries. The excavations have shown that the site was occupied from much earlier times and have brought to light a wealth of material illustrating Irish culture in earlier centuries. The crannog is 150 ft. in diameter and 11 ft. thick. It was surrounded by an oaken palisade. The lake in which it stood has now disappeared. The inhabitants were pastoralists, but practised occasional hunting. Few, if any, traces were found of agricultural activity. Ornaments of bone and objects of leather, predominating in number, bear this out. Other materials in use were bronze, iron, glass (beads), enamel, wood, stone and pottery. The Mission has received generous assistance from the Irish Government.

Medical Uses of Radium

A REPORT bearing the above title has been issued by the Medical Research Council summarising the results of research work during 1933 in the treatment of cancer and other conditions (Spec. Rep. Series, No. 197. H.M. Stationery Office. 9*d*. net). The radium is lent by the Council to selected centres throughout Great Britain, and these furnish reports to the Radiology Committee. In cancer of the mouth, radium has proved a successful agent in the treatment of primary growths of the tongue, but when the glands are involved they are much less amenable.

With breast cancer, operation is generally successful in early cases, but when the axilla is involved, much less so. For the latter, radium therapy has been extensively tried with questionable success, and X-rays are probably a more suitable agent. In uterine cancer, frankly operable cases are treated as successfully by radium as by surgery, but with a smaller operation mortality, and surgically inoperable cases treated by radiation yield a by no means negligible percentage of clinical cures. Certain non-malignant conditions also respond well to radium treatment, for example, uterine hæmorrhage. Several important experimental researches are also included in the report.

IT is estimated that the total quantity of radium available for treatment in Great Britain is now about 70 gm. Of this amount, the Radium Commission controls 23 gm., which includes 20 gm. placed at its disposal by the Radium Trust, and three 1 gm. units, the property of the King Edward's Hospital Fund (Fifth Annual Reports of the National Radium Trust and Radium Commission 1933–1934. H.M. Stationery Office. 9*d*. net). The radium is distributed for use for experimental work and treatment between the Medical Research Council and the National Physical Laboratory, certain London hospitals and institutions, and thirteen national radium centres and five regional radium centres. In addition, allocations have been made by certain organisations, such as the British Empire Cancer Campaign, and a considerable amount of radium is privately owned.

National Medical Statistics

THE Registrar-General's Statistical Review of England and Wales for the Year 1933 (Tables, Part 1: Medical), pp. iv+406, has recently been published (London: H.M. Stationery Office. 6*s*. net). It appears that the number of births registered in 1933 was 580,413, giving a rate of 14·4 per 1,000 persons living. This rate is 0·9 below that for 1932, and constitutes a new low record. The death-rate was 12·3 per 1,000 persons living, 0·3 above the rate for 1932 (the same as that for 1931) but 0·9 above that for 1930. The deaths of children under one year of age numbered 64 per 1,000 live births against 65 in 1932, 66 in 1931 and 60 in 1930. Cancer showed a death-rate of 1,526 per million persons living against 1,510 in 1932. If, however, allowance is made for differences in the age constitution of the population, the comparative mortality from cancer shows a slight decrease. Tuberculosis again furnished a new low record of 824 per million living. Puerperal sepsis caused the deaths of 1·75 women per 1,000 live and still births, 0·20 more than the rate for 1932 but 0·09 less than 1930. The death rate from suicide was 140 per million persons living, a decrease of 3 per million on the record high rate of 1932. A slow increase in this rate had been continuous for a number of years. Road accidents due to mechanical vehicles were responsible for 5,934 deaths. The figures for the last five years were 5,196, 5,752, 6,342, 5,892 and 5,671 respectively.

Exhibition of Microscopes

THE second annual exhibition of microscopes and appliances, conducted by Messrs. W. Watson and Sons, Ltd., 313 High Holborn, London, W.C., which has been open all this week at the Central Hall, Westminster, attracted numerous visitors. A number of mounted specimens were shown on a series of microscopes ranged round the Hall, comprising diatoms, pollens, histological and pathological specimens, and crystals with polarised light. Members of the Quekett Microscopical Club arranged an interesting exhibit of living pond-life, including some beautiful specimens of *Volvox* and *Vorticella*. The use and value of the microscope in industry were demonstrated by exhibits illustrating the differences in microscopic structure of various qualities of leather, the size of sugar crystals, cocoa particles and entangled air bubbles as influencing the quality of sweets in confectionery, and the microscopic flora in cheese and in vinegar fermentation. A side-show of considerable interest was a demonstration of the making of the glass discs and their shaping, grinding and polishing so as to form the constituent lenses for microscope objectives. Other exhibits illustrated the detection of forgery and of crime weapons, and formed the subjects of two of the lantern lectures, by Mr. T. J. Ward and Major G. Burrard respectively, which have been a feature of the exhibition. Other lantern lectures included "A Naturalist on the Amazon" (Mr. Robins), "An Amateur among the Stars" (Mr. Offord), and "How Lenses are Made" (Mr. Watson Baker), together with several cinematograph displays by the Kodak Company.

Sound and Noise

A RESEARCH and Development Lecture on "Sound and Noise" was given at the Royal Institution on December 12, under the auspices of the Institution and the British Science Guild, by Dr. G. W. C. Kaye, Superintendent of the Physics Department at the National Physical Laboratory. Mr. Hore Belisha, the Minister of Transport, was in the chair. Man has developed very many and ingenious ways of making sounds and noises. In some everyday events the noise is only a small by-product; for example, only about a thousandth part of the energy of a dropped weight or of a hand-clap appears in the form of noise. This figure was increased to a few per cent in the case of motor horns and loud speakers, and even up to 30 per cent or more for the loud speakers used for talking pictures. By comparison with many sounds, the human voice is very weak, and even during shouting the output was only about 0·001 watt. Suitably equipped, an orchestra of 75 has a normal acoustic output of about 0·5 watt, which in strident passages may be increased 100-fold—quite enough, if it could be so applied, to light an average electric lamp.

FOR the purposes of the measurement of the loudness of noise, a reference standard of sound has been chosen, which consists of a pure note of a frequency of 1,000 cycles per second. The adjustable

intensity of the standard note is measured on a scale of decibels above an arbitrary zero near the threshold of hearing; the corresponding loudness is then expressed on a numerically identical scale of phons. The various subjective noise meters on the market determine the equivalent loudness of noises in phons by matching them by ear against the standard note. The objective meters, on the other hand, depend on the physical measurement of the intensity by a microphone; they can, however, be made to stimulate the ear and so compare the loudnesses of similar noises. The new acoustics laboratory at the National Physical Laboratory has greatly facilitated investigatory work on the steps required to reduce sources of noise, on the noise proofing of walls and on the noise absorption of building and other materials. The last line of defence against noise in a building is the use of surface absorbents. Ordinary hard plaster is a better reflector of sound than a mirror is of light, so that in modern rooms designedly free from curtains, upholstery and carpets, the noise level can become uncomfortably high unless one of the commercially available acoustic absorbents is applied to the walls or ceilings.

Experimental Hand-Rearing of Game Birds

ORNITHOLOGISTS and students of game birds have become increasingly interested in experiments in hand-rearing and introducing game birds to new areas, and what is believed to be the first ptarmigan (*Lagopus leucurus*) to hatch in captivity was from one of eighteen eggs collected by Dr. A. A. Allen, of the Department of Ornithology of Cornell University, near Churchill, Hudson Bay, and put under bantams at Ithaca (*Scientific American*, Nov. 1934). Science Service, of Washington, D.C., reports that a second batch of twenty ptarmigan eggs has been obtained from Canada and put under bantams, though several eggs have been broken by the foster mothers. During the present year, the first introduction, and hatching, of English pheasants (*Phasianus colchicus*) in Uganda was accomplished by the Agricultural Department at Kamala (T. W. Chorley, *Field*, Aug. 4, 1934). The eggs were obtained by Mr. T. W. Chorley, of the Agricultural Department in Uganda, from the Silverdale Game Farm, Lancashire, and arrived by air mail on May 3. Next day they were put under two native fowls, and three chicks hatched on May 27, and the remainder on May 28, 85 per cent of the imported pheasant eggs hatching. Unfortunately, two heavy storms broke out in the first three weeks, and several birds died, but the remainder did well.

Electricity on Board Ship

THE paper read by C. W. Saunders, H. W. Wilson and Dr. R. G. Jakeman to the Institution of Electrical Engineers on November 22 on the generation, distribution and use of electricity on board ship is a timely one. Although electricity was used in the British Navy for various purposes so far back as 1874, it is only since the advent of the Diesel engine that it has been largely used. To-day, almost all auxiliary machinery—from the windlass in the bows, through the engine room and hull, to the steering gear in the stern—is electrically operated in important ships. In a 20,000 ton turbo-electric passenger liner, the propelling machinery, usually two turbo alternators, would be about 20,000 horse power and there would be usually four motors to which they send the power. In addition, there would be four main generators each of a 1,000 h.p. The steering gear requires 84 h.p., the capstan machines 536 h.p. and the boat davits 120 h.p. For the fans 500 h.p. is required and for the refrigeration 290 h.p. Compared with these numbers, the 31·5 h.p. required for the passenger lifts seems small. A modern liner is really a large floating hotel, and when at sea the travelling public demands a standard of comfort as high as that obtainable on the best hotels ashore. Consequently the most modern types of lighting, heating and cooking equipment are installed. The galley alone at times of maximum load may require 900 h.p. In the *Queen of Bermuda*, for example, there is one 450-line telephone board, 250 electric signs, 2,250 bell pushes, 400 electric radiators, 650 electric fans for cabins, 410 miles of conductors in cables and wires and 20,000 electric lamps. For very large ships it is generally agreed that turbo-electric drive is the most suitable at the present time.

De la Beche's "Researches in Theoretical Geology"

PUBLISHED in 1834, unpretentious in size and style (12mo.), De la Beche's work was especially welcome to the younger geologists of the time as a philosophical treatise, comprehensive and helpful in design. This little volume had an interesting preface explaining the author's position. It ran as follows:—"Although the theory of central heat and the former igneous fluidity of our planet have been much dwelt upon in the following pages, the author trusts that he will not be considered so attached to these views as not to be ready to reject them and embrace others which may afford a better explanation of an equal number of unobserved facts. . . . It can only be amid a thousand errors, and by a determination to abandon our preconceived opinions, when shown to be untenable, not by pertinaciously adhering to them . . . that we can approximate towards the truth. By strictly advocating a particular theory, prominently displaying those facts only which may appear to afford it support, we are in perpetual danger of deceiving ourselves and others." Finally—"We may conclude that whatever changes our planet may suffer, either from external or internal causes, and the necessary conditions exist, life will be created to suit those conditions; even after man, and the terrestrial animals and plants contemporaneous with him, may have ceased to live on the surface of the earth."

Proceedings of the Fifth Pacific Science Congress

IT is hoped to publish very shortly the complete *Proceedings* of the Fifth Pacific Science Congress which was held at Victoria and Vancouver, Canada, in June 1933. The publication will be in five volumes:

(1) general and Congress symposia; (2) astronomy, geodesy and geography, geology and mineral resources; (3) meteorology and terrestrial magnetism, oceanography, radio, seismology and volcanology; (4) agriculture, anthropology, animal diseases and botany; (5) entomology, fisheries, forestry and zoology. The *Proceedings* will be published by the University of Toronto Press, Toronto, Ont., Canada, price 20 dollars.

Journal of Applied Mechanics

THE Applied Mechanics Division of the American Society of Mechanical Engineers will publish a *Journal of Applied Mechanics* beginning on March 1935. The technical editor will be J. M. Lessells, Swarthmore, Pa., U.S.A., who will have the assistance of several distinguished authorities on applied mechanics. The *Journal* will appear four times each year in issues containing about eighty pages each. It will consist of original papers in general mechanics, elasticity, hydrodynamics, aerodynamics, strength of materials and thermodynamics, similar to those published during the last few years in the *Transactions* of the Applied Mechanics Division of the Society. The price will be five dollars for non-members of the Society for annual subscription, to be sent to A.S.M.E., Applied Mechanics Journal Fund, 29 West 39th Street, New York, N.Y., U.S.A.

The Physical Society's Exhibition

THE twenty-fifth annual exhibition of scientific instruments and apparatus, arranged by the Physical Society, will be held on January 1–3 at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, S.W.7. The leading manufacturers of scientific instruments will be exhibiting their latest products in the Trade Section. The Research and Experimental Section will contain contributions from most of the important research laboratories in Great Britain, and there will be a special sub-section devoted to experiments of educational interest. In addition, the work submitted for the craftsmanship competition by apprentices and learners will be on view. Discourses will be delivered each day at 8 p.m. as follows: January 1, Dr. B. Wheeler Robinson, "The Architecture of Molecules"; January 2, Dr. C. V. Drysdale, "The Problem of Ether Drift"; January 3, Dr. H. Spencer Jones, M.A., "Giant Telescopes". Members of institutions and scientific societies may obtain tickets from their secretaries; tickets may also be obtained direct from the Exhibition Secretary, 1, Lowther Gardens, Exhibition Road, S.W.7. No tickets will be required on January 3.

Announcements

MR. MERVYN O'GORMAN will read a paper entitled "Bringing Science into the Road Traffic Problem" before the British Science Guild at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on December 19, at 5 p.m. The paper will be followed by a discussion.

THE following appointments have recently been made by the Secretary of State for the Colonies: C. B. Gibbins, to be agricultural assistant, Coffee Experimental Station, Moshi, Tanganyika; S. G. Wilson, to be veterinary officer, Nyasaland; A. C. Shill, marketing officer, fruit and vegetable trades of the Leeward and Windward Islands, to be adviser in agricultural marketing and controller of agricultural exports, Malta; T. H. C. Taylor, late entomologist, Coconut Committee, Fiji, to be assistant entomologist, Agricultural Department, Uganda.

THE Royal Academy Exhibition of British Art in Industry will be opened on January 5 and will close early in March. In connexion with the Exhibition, a panel of lecturers has been organised who are prepared to visit schools, works, etc., to lecture on cognate subjects. Further information can be obtained from the Secretary, Royal Academy of Arts, Piccadilly, London, W.1.

IN the list of British representatives present at the opening of the Maison de Chimie in Paris (NATURE, Dec. 8, p. 868) it should have been stated that Mr. Edwin Thompson was present in his capacity as president of the Society of Chemical Industry.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A lecturer in botany in the University of Western Australia—The Agent-General for Western Australia, Savoy House, Strand, London (Dec. 18). An assistant in the M.B. classes and in dental metallurgy at Guy's Hospital Medical School—Prof. C. S. Gibson, Guy's Hospital Medical School, London, S.E.1 (Dec. 19). A technical assistant in the War Department Establishment—The Superintendent, Signals Experimental Establishment, Woolwich Common, S.E.18 (Dec. 19). A teacher of metallurgy at the Municipal Technical College, Coventry—The Director of Education, Council House, Coventry (Dec. 21). Two agricultural advisory officers to the Norfolk County Council—The Clerk, The Shirehouse, Norwich (Dec. 22). A lecturer in electrical engineering at West Ham Municipal College, Romford Road, E.15—The Principal (Dec. 31). A demonstrator in chemistry at King's College, Strand, London, W.C.2—The Secretary (Jan. 1). A professor of electrical engineering at the College of Engineering, Guindy, Madras—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (Jan. 4). A University lecturer in zoology at the University of Cambridge—F. T. Brooks, Botany School, Cambridge (Jan. 7). A director of forestry in the Irish Free State—The Secretary, Irish Land Commission (Forestry), 24, Upper Merrion Street, Dublin (Jan. 31). An investigator for metallurgical research at Cambridge—Prof. R. S. Hutton, University Metallurgy Laboratories, Pembroke Street, Cambridge. A professor of hydraulic engineering and a professor of mechanical engineering at the National Chekiang University, Hangchow—Universities China Committee, 91, Gower Street, London, W.C.1. A junior investigator at the British Non-Ferrous Metals Research Association—The Secretary, B.N.F.M.R.A., Regnart Buildings, Euston Street, N.W.1.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 938.

A New Potato Epidemic in Great Britain

EARLY blight (*Alternaria solani*) of the potato has been observed in Great Britain in the field only but very rarely, and its attacks have not been known hitherto to assume epidemic proportions in Great Britain. In the autumn of 1932 several sporadic cases were noted in the experimental plots at Cambridge, whilst somewhat earlier a few of our plants in the glasshouse had been thought to be suffering from the same disease. At that time examination of the lesions had failed to demonstrate the distinctive spores. In 1933, the disease was considerably more common at Cambridge, and in the autumn of that year, Dr. Dillon Weston very kindly examined specimens and recovered from them an *Alternaria* in pure culture. Sub-cultures were submitted to Prof. Westerdijk of Baarn and to Mr. Wiltshire of the Imperial Mycological Institute, both of whom identified the species as *A. solani*.

FIG. 1. Leaflet showing the rounded lesions and the concentric rings—the fusion of individual flecks is commencing. —Photo by infra-red light.

FIG. 2. An entire leaf of a Kerr's Pink plant representing the average condition of the disease in this variety in north-west Scotland towards the end of September 1934.

During 1934 we have succeeded in infecting a large number of seedlings, as well as several adult plants of established varieties both in the glasshouse and the field, and have had no difficulty in finding the spores on the lesions.

One of us had occasion to spend the month of September examining potato crops in the Outer Hebrides, the north-west coastlands, and in the great potato-growing areas of Ross, Cromarty and Aberdeen, and found that the disease—often in an advanced stage—was present throughout the whole area on every plant examined of the widely grown variety Kerr's Pink. Plants of the variety Edzell Blue were less heavily infected, whilst those of the variety Golden Wonder seemed to have escaped attack. A similarly widespread and intensive field infection was found in the late autumn in Cambridge on the varieties Majestic and King Edward.

In the United States, tuber damage is a common feature of the disease, but we have no evidence so far that the tubers have been affected in the field in Great Britain. It may be that the epidemic spread is correlated with the occurrence of the last two abnormally dry seasons, but against this it must be remembered that we first observed the disease in the field in the summer of 1932.

Apart from loss due to direct damage to the tuber, it is almost certain that a disease which destroys about 25 per cent of the green leaf area of the plant must cause a sensible reduction in crop, if only as a result of the loss of photosynthetic tissue.

It is obvious that we are now confronted in Great Britain with early blight in an epidemic form. This disease has long been a serious source of loss in various parts of the Continent, including Holland, and is regarded as one of the major potato diseases in the United States, where it is responsible in some years for a loss due to tuber infection in the neighbourhood of 25 per cent of the crop. On the Continent, in the United States, India and South Africa, the ravages of this disease have been held in check fairly satisfactorily by use of the Bordeaux spray or copper-lime dust.

REDCLIFFE N. SALAMAN.
CECILIA O'CONNOR.
Potato Virus Research Station,
Cambridge.

Longevity of Seeds

THE question of the longevity of buried seeds is always recurring, as witness the recent revival of the fable of 'mummy wheat'. There is abundant evidence that the embryo of the wheat grain perishes relatively soon, in ten years or less under ordinary conditions. Respiration goes on until the substance of the embryo is burnt away; extreme desiccation may prolong the process. Other seeds, however, do retain their vitality for much longer periods when dry, and when buried in earth germination may be indefinitely delayed. Possibly the tension of carbon dioxide in the soil gases slows down the respiration process; again, we have found that humus, particularly of deep-seated peat, contains substances inhibiting germination, even when the conditions of moisture, aeration and temperature are optimum.

This raises the fundamental question of whether the life of an organism can be suspended and pass into a static condition, to be resumed when the environment becomes favourable again. So far as our experimental knowledge goes, seeds are always respiring, considerably at first when they are drying off after ripening, but then more slowly, the machine just 'ticking over' as long as life remains.

If the essence of life resides in change, can there be a stop and a later resumption? On the basis of some continuing change, however minute, being necessary,

how are we to account for the long dormant life of some organisms that possess a very small reserve of respirable material, as for example the spores of bacteria which in the dry state have a very long recorded life? Some refined experiment seems to be needed to try whether in such cases respiration, however infinitesimal, is not still going on.

This is not the only unsolved question that the dormancy of seeds presents. Every farmer and gardener is familiar with the growth of certain weeds, notably charlock, which follows the ploughing up of land which may have been in grass twenty or thirty years. But why in an ordinary arable field, subject to charlock, do we get a rush of growth in one year and few or no seedlings in another? Why do other rare plants suddenly spring up in unexpected places? In Dr. Brenchley's experiments on the germination of seeds contained in soils taken at different depths from the old Rothamsted plots, the soil samples are exposed to optimum conditions of aeration, moisture and temperature, but years elapse before all the seeds germinate.

In the past abnormal season many unexpected 'weeds' have appeared in the John Innes gardens. Some are comparatively uncommon plants, that as far as is known have never been grown here; for example, *Datura sp.*, *Ambrosia artemisiaefolia*, *Physalis edulis*, etc. It may be supposed the seed had been introduced in manure, but considering the rarity of the plants, that only shifts the locality of the problem. One piece of land here, after it had been cleared from sweet peas, has covered itself with *Nicotiana* seedlings. Nine years earlier the plot had carried *Nicotiana*, but in the intervening period not a seedling had been seen. We know something of the effects of 'vernalisation' and of chilling in stimulating the germination of certain seeds which may otherwise refuse to start, but this dormancy of buried seeds still offers problems for experiment.

A. D. HALL.

John Innes Horticultural Institution,
Merton, S.W.19.

Kinetics of Photosynthesis

I AM grateful to Emerson and Green[1] for directing attention to the fact that the equation expressing the velocity of photosynthesis during the photostationary state[2] was incorrect because it indicated that the temperature coefficient is a function of the external CO_2 concentration. Their alternative formula is open to the same criticism, since it indicates that the temperature coefficient increases with decrease in CO_2 concentration. The error is due to an incomplete definition of the conditions which govern the photostationary state.

There are three processes involved; namely, the primary light reaction in which the chlorophyll in its complex with CO_2 undergoes a change, the Blackman reaction in which this changed chlorophyll is restored to its original state, and the formation of the complex of chlorophyll with CO_2. If the velocities of these three processes be equated to give the expression for the photostationary state, the resulting expression indicates that the rate of photosynthesis in flashing light is independent of the external CO_2 concentration, which is known not to be the case. If, however, the assumption be made that the rate of formation of the complex with CO_2 is very fast in the case of the chlorophyll formed in the Blackman reaction, and that the establishment of the equilibrium between ordinary chlorophyll and CO_2 is slow, the equation for the photostationary state is simplified to

$$y = k_1 I(bA - x) = k_2 x e^{-Q/RT}$$

whence

$$\log \frac{y}{K - y} = \log \frac{k_2}{k_1 I} - \frac{Q'}{T},$$

where A is the total concentration of chlorophyll in the irradiated surface, b is the fraction which exists as the complex, $K = k_1 IbA$ and $Q' = Q/2{\cdot}303R$.

These equations indicate that the temperature coefficient is independent of the CO_2 concentration and that the rate in flashing light is a direct function of the CO_2 concentration, since b is a function of that concentration.

Emerson and Green's equation for the photostationary state

$$y = k_1 Ix = k_2(a - x)Pe^{-Q/RT}$$

appears to be incorrect. Since $k_2(a - x)Pe^{-Q/RT}$ is the velocity of the dark or Blackman reaction, x will be a maximum after a period of darkness. It follows that $k_1 Ix$ will be a maximum the moment irradiation is commenced and will decrease with time until the photostationary state has been established. The above equation, therefore, cannot express the photostationary state.

It is not possible here to discuss the chemistry of the photosynthetic process, but it may be stated that it is not intended to represent the Blackman reaction as being uni-molecular. It is bi-molecular, but since the concentration of the second reactant is assumed to be large and sensibly constant, it is included in the constant k_2. A complete account will be given in a separate communication.

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Nov. 20.

[1] NATURE, 134, 289, August 25, 1934.
[2] NATURE, 133, 414, March 17, 1934.

Inhibitors of Catalase Reaction

IT is well known that the activity of catalase is greatly inhibited by very small concentrations of potassium cyanide, hydrogen sulphide and especially hydroxylamine. To these reagents we can now add sodium azide (NaN_3) which also acts as a strong inhibitor of catalase.

In a recently published note, Sevag and Maiweg[1] have announced the discovery of a new type of catalase poison belonging to the group of oximes. They have found, however, that these compounds when used freshly prepared have no poisoning properties. The inhibitory property of the oxime solution is manifested only after acidifying it with dilute hydrochloric acid, warming for twenty minutes and neutralising with dilute soda. It is interesting to note that this inhibitory property was found by these authors to be proportional to the strength of acid used in their manipulation.

Following the technique described by Sevag and Maiweg, 0·232 gm. of dimethylglyoxime ($CH_3C(NOH).C(NOH).CH_3$) was dissolved in 100 c.c. of water, containing 10 c.c. normal hydrochloric acid, warmed for 20 minutes on a water bath and neutralised with normal caustic soda.

The solution thus prepared, contrary to the

statement made by these authors, was found to contain a large concentration of hydroxylamine. This solution, like hydroxylamine and unlike oxime, on addition of sodium nitroprusside and a little caustic soda, turns red on heating. Like hydroxylamine it oxidises hæmoglobin to methæmoglobin. It precipitates cuprous oxide from an alkaline solution of copper sulphate, and the titration of this solution with Fehling solution reveals the presence of about 87 mgm. of free hydroxylamine. We find therefore that about 66 per cent oxime was decomposed, liberating a corresponding amount of hydroxylamine.

On testing this solution with nickel it was found to contain only 29 per cent of undecomposed dimethylglyoxime, which conforms fairly well with the previous estimation of the free hydroxylamine.

These results show that 0·018 M solution of oxime treated by the method of Sevag and Maiweg gives approximately 0·024 M solution of hydroxylamine. In other words, the molar concentration of hydroxylamine (a well-known catalase inhibitor) in Sevag and Maiweg's solution, at the end of their manipulation, was higher than the initial concentration of the oxime. It is not surprising, therefore, that their solution had such a powerful inhibitory action on catalase.

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[1] Sevag, M. G., and Maiweg, Lore, *Naturwissenschaften*, **22**, 561; 1934.

Passage of Very Fast Protons through Matter

IT is now generally assumed in nuclear theories[1] that the interaction between a neutron and a proton is of the form

$$-J(r)\,S \qquad (1)$$

where $J(r)$ is some function of the distance r between them, and S is the operator which interchanges the space co-ordinates but not the spin of the two particles. Such an interaction has some important consequences in the passage of very fast protons through matter.

We consider a collision in which the neutron is initially at rest, and the proton moving with a large momentum such that the wave-length is small compared to the effective radius of the interaction $J(r)$. Then, as Wick[2] has pointed out, with an exchange interaction of the type (1), most of the *neutrons* are thrown in the forward direction. (With a non-exchange interaction, most of the protons would be scattered in the forward direction.) To calculate the magnitude of the collision cross section we must make some assumption about the form of $J(r)$, of which we know very little. Assuming $J(r)$ to be of the form

$$J(r) = a\,e^{-br} \qquad (2)$$

the effective cross section, calculated by the Born approximation, for the scattering of the neutron in the solid angle $d\omega$ making an angle θ with the original direction of the proton is

$$\frac{256\pi^4}{h^4}\,\frac{a^2b^2}{\left\{b^2+\frac{4\pi^2}{h^2}\left|\underline{p}_1-\underline{p}_0\right|^2\right\}^4}\times \frac{p_1^3\,E_0\,E_1}{p_0\left\{p_1+\frac{E_1}{E_0+Mc^2-E_1}\,(p_1-p_0\cos\theta)\right\}^2c^4}\,d\omega \qquad (3)$$

where $p_0 = Mv/\sqrt{(1-v^2/c^2)}$ is the initial momentum of the proton, v its velocity, M the mass of the proton or neutron assumed equal, and $E_0 = c\sqrt{(p_0^2 + M^2c^2)}$ the initial energy of the proton. E_1, p_1 are the energy and momentum of the neutron given by the conservation of energy and momentum for a particle scattered at an angle θ. The effective cross section for the scattering of the neutron in any angle less than θ is

$$q(\theta)=\frac{64\pi^3}{3}\,\frac{{E_0}^2}{c^2{p_0}^2}\cdot\frac{a^2b^2}{h^2c^2}\left[\frac{1}{b^6}-\frac{1}{\left\{b^2+\left(\frac{2\pi p_0}{h}\right)^2\sin^2\theta\right\}^3}\right] \qquad (4)$$

where we have neglected terms of the order $(hb/2\pi Mc)^2$. When $2\pi p_0/h \gg b$, (3) has a very strong maximum in the forward direction, and in this case the mean angle $\bar{\theta}$ at which the neutrons are ejected is

$$\bar{\theta} = \frac{1}{\sqrt{2}}\cdot\frac{hb}{2\pi p_0}, \qquad (5)$$

and the neutron has on the average an energy less than the original energy of the proton by an amount δ, where

$$\delta = \frac{1}{16\pi^2}\cdot\frac{h^2b^2}{M}. \qquad (6)$$

Taking $a = 1{\cdot}4 \times 10^{-4}$ erg, $b = 6{\cdot}8 \times 10^{12}$ cm.$^{-1}$, being the values determined by Wick[3] from the stability of oxygen, the total cross section for an encounter q, got by neglecting the last term in square brackets in (4), is $0{\cdot}16 \times 10^{-24}$ cm.^{2}, $\bar{\theta} = 1{\cdot}1°$, and $\delta \approxeq 0{\cdot}47 \times 10^6$ e.v., for a proton with $E_0 = 5 \times 10^9$ e.v. $\approxeq 5{\cdot}4\,Mc^2$, such as might possibly occur in cosmic radiation.

Thus, such a proton in its passage through matter will go on until it collides with a neutron and gives nearly all its energy to the neutron. The neutron will travel until it collides with a proton in the material as given by (4), (5), (6), and the proton which is thus ejected will have very nearly the same energy as the original proton, and travel in very nearly the same direction. Further, for protons of such high energies we should expect to be able to treat the neutrons in nuclei as free, so that, using the cross section given above, the mean 'range' of a proton in lead is about 1·5 cm., and that of the neutron about 2·3 cm., as the lead nucleus contains 82 protons and about 125 neutrons. Therefore in going through a metre of lead there will be roughly twenty-five changes from proton to neutron and back, and the total energy loss due to ionisation of the emerging proton will be about half that to be expected theoretically since more than half the distance will be travelled by neutrons.

We may remark, that with the values of a and b assumed above, an accurate calculation[3] of the cross section for the collision of neutrons of energy roughly $3{\cdot}8 \times 10^6$ e.v. with protons gives a result which is nearly four times larger than the cross section found by Chadwick. Our results may therefore be too large by a factor four.

The above expressions are further inaccurate inasmuch as (*a*) there is no relativistic wave equation for the proton, and (*b*) the interaction energy (1) can be represented by a potential $J(r)$ probably only in non-relativistic approximation. One might hope that the correct relativistic treatment would reduce the total cross section given above.

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Gonville and Caius College,
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[1] W. Heisenberg, *Z. Phys.*, **80**, 587; 1933. E. Majorana, *Z. Phys.*, **82**, 137; 1933.
[2] G. C. Wick, *Z. Phys.*, **84**, 799; 1933.
[3] G. C. Wick, *Nuovo Cimento*, **11**, 235; 1934.

An Equation for the Kinetics of Activated Adsorption

FOR an understanding of the nature of so-called activated adsorption, the kinetic characteristics of these types of processes are of the greatest importance. From the first conception of Taylor one might expect to find kinetic equations, based on the molecular kinetic theory of Langmuir, taking into account the low condensation coefficient increasing with the temperature. But, as I have shown in a lecture on activated adsorption given in Moscow (1932) at the IX Physical-Chemical Conference[1], of all cases of activated adsorption known at this time, not one obeys these equations. The well-known diffusion kinetics equations also cannot be applied to these systems.

Somewhat later, in our laboratory, J. Zeldowitsh showed that for the chemosorption of carbon monoxide on manganese dioxide, the velocity of the process can be well expressed by the following simple equation:

$$\frac{dq}{dt} = V_0 e^{-\alpha q}\,; \quad V_0 = be^{-E/RT} \qquad (1)$$

where q is the quantity of gas adsorbed during the time t, α and b are constants, characteristic for the given system[2]. On account of the high value of α, the velocity of adsorption diminishes several tenfold before saturation is half reached.

At first we did not assign fundamental significance to this empirical equation, but an analysis of the literature has shown that the kinetics of most of the known cases of activated adsorption, differing widely in their chemical nature and temperature range, follow an analogous law. Thus, for example, this equation written in a more convenient form:

$$q = \frac{1}{\alpha} \ln (t + t_0) + C \qquad (2)$$

where $t_0 = \frac{1}{\alpha . V_0}$ and $C = \frac{1}{\alpha} \ln \alpha V_0$

is satisfied by the data of Emett and Brunauer[3] on the sorption of nitrogen in iron, those of Benton and Drake[4] for oxygen on silver, those of Taylor and Sickman[5] for hydrogen on zinc oxide, etc.

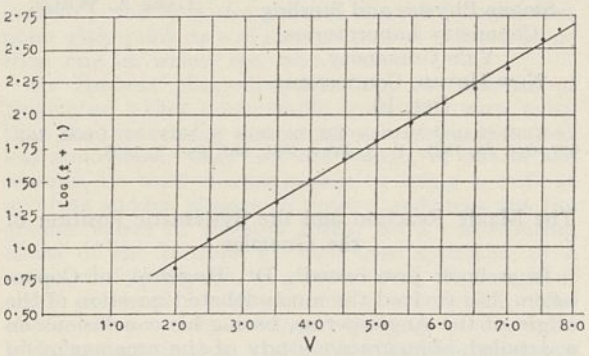

FIG. 1.

It is easy to show that the adsorption of ethylene on nickel in a recent paper of Steacie and Stovel[6] is very well expressed by this equation. The agreement is shown on Fig. 1 which shows the activated sorption as a function of time, for the 142° curve in Fig. 1 of Steacie and Stovel's paper. Thus we may suppose that an equation of type 2) *is a general equation for the kinetics of activated sorption.* It is easy to show that equations (1) and (2) *cannot* be derived from the usual ideas as to the character of activated adsorption, and that they lead to a very peculiar picture of the course of such processes, which at the same time gives an explanation for the appearance of large steric factors (another characteristic of activated adsorption).

We shall return to these equations in a fuller paper to appear soon.

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[1] S. Roginsky, *J. Phys. Chem.* (Russ.), **5**, 175; 1934.
[2] S. Roginsky and J. Zeldowitsh, *Acta phisico-chimica*, **1**, 1934 (in print).
[3] Emmet and Brunauer, *J. Amer. Chem. Soc.*, **56**, 35; 1934.
[4] Benton and Drake, *ibid.*, **56**, 255; 1934.
[5] Taylor and Sickman, *ibid.*, **54**, 602; 1932.
[6] Steacie and Stovel, *J. Chem. Phys.*, **2**, 581; 1934.

Absorption of Light in Gases

CONTINUING an earlier experiment[1], we have measured the absorption of light by cæsium vapour in the presence of helium. We find that the addition of helium greatly reduces the absorption by cæsium, about 3 cm. of helium being sufficient to reduce it to half the value obtained for cæsium in vacuum. Frank[2] and Mrozowski[3] have shown that the continuous molecular absorption of mercury, zinc and cadmium vapours is proportional to P^γ, where P is the vapour pressure and γ is a constant (for one wave-length). For different wave-lengths, γ lies between 1 and 2. Thus the absorption increases less rapidly than the molecular concentration. Their results may perhaps be explained if there is a reduction of absorption, due to collisions between atoms and molecules in the vapour, similar to the effect we have found in cæsium and helium.

Other work[4] has shown that the absorption of light by reacting gas mixtures is not equal to that calculated by summing the absorption of the constituents, the absorption being apparently increased.

Thus it is not possible to assume that in general the absorption of a gas is simply proportional to the concentration of the atom or molecule producing the absorption. It would appear probable that many calculations (particularly in photo-chemistry and stellar physics) may need revision in the light of the above results.

In all experiments where a large pressure effect has been found, the absorption has been due to transitions involving one unquantised state. It is known[5] that the magnitude of the line absorption of atoms (where two quantised states are involved) is not greatly affected by the addition of foreign gases. Further experiments on continuous absorption and molecular band absorption are in progress.

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[1] *Proc. Roy. Soc.*, A, **143**, 472; 1934.
[2] *Phys. Z. Sowjet Union*, **4**, 637; 1933.
[3] *Z. Phys.*, **91**, 600; 1934.
[4] NATURE, **134**, 848, Dec. 1, 1934.
[5] Fuchtbauer, Joos and Dinkelacker, *Ann. Phys.*, **71**, 204; 1923.

Gyromagnetic Effect for a Ferromagnetic Substance above its Curie Point

UP to the present, no satisfactory explanation has been given for the magnitudes of the magnetic moment per atom of ferromagnetic substances as deduced from the saturation intensities at low temperatures. Furthermore, these data do not admit of correlation with the magnetic moment per atom (or ion) obtained from susceptibility measurements of the ferromagnetics above the Curie point. Hence it is advisable to measure the gyromagnetic ratio for a ferromagnetic substance above its Curie point in order to find the origin of the paramagnetism in this region.

Experimental difficulties preclude measurements at temperatures above room temperature, and so it is necessary to choose an alloy the critical point of which is in the neighbourhood of 0° C., or lower. A suitable alloy is found in the nickel-copper series, which possesses the additional advantage that the magnetic moment per nickel atom in the paramagnetic state is independent of the concentration in the range of alloys concerned; that is, it is the same as in pure nickel. The experimental difficulties are considerably greater than those encountered in the case of normal paramagnetic substances which I have investigated, being further complicated by hysteresis and permanent magnetic moment as additional sources of error. However, results were obtained on three different alloys (nickel content $\sim$ 56·5 per cent) the Curie points of which were $-14°$, $-9°$ and $-2°$ C., the mass susceptibilities ranging from 98 to 180×10^{-6}. The mean result for g is 1·9 with an estimated accuracy of 10 per cent. Thus the g value of 2·0 is within experimental error, indicating that the paramagnetism of the nickel is due to spin alone, as in the case for the ferromagnetic state.

Opportunity was taken to make a systematic test of the contention made by Barnett that my results on the gyromagnetic effect for paramagnetic substances, as well as earlier work on ferromagnetics, are vitiated by unsuspected sources of error peculiar to English physicists[1]. Conditions were particularly favourable to such tests as the disturbing effects are particularly large for the alloys investigated above. In no case, however, was any error detected in the technique previously employed. A full account of the work will appear elsewhere.

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[1] Barnett, *Phys. Z.*, **35**, 203; 1933. For discussion, see also Bates, NATURE, **134**, 50, July 14, 1934.

Humidity-Resistance Relations in Carbon-Coated Hygroscopic Materials

RECENT notes[1] on paper hygrometry recalled to me some earlier observations by myself on the decrease in electrical resistance with drying of a paper coated with a glue-lampblack mixture, and have led to further experiments with carbon-coated hygroscopic materials. This decrease in resistance is attributed to the closer and more numerous carbon contacts as the paper shrinks.

Data for the paper mentioned above, for 'Cellophane' with indian ink lines, and for human hair coated with indian ink appear in Fig. 1. For the paper and the 'Cellophane', the resistances are the equilibrium values attained in fanned air after standing over either calcium chloride or a saturated solution of potassium chloride (86 per cent relative humidity). The hair was studied only in quiet atmospheres of various humidities provided by salt solutions. The temperatures were those of the room.

Both the paper and the 'Cellophane' were 'conditioned'. They were exposed, alternately, to dry and to moist atmospheres until their resistances approached nearly constant lower values at given humidities. Half a dozen wet-dry cycles were sufficient. The hair was not so conditioned. All data obtained with it appear in Fig. 1.

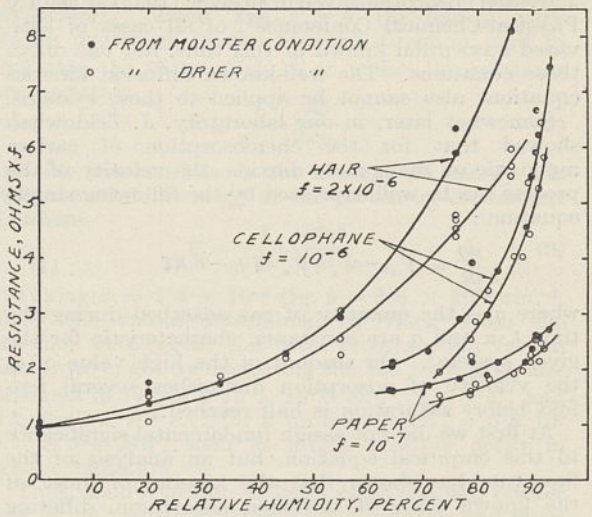

FIG. 1.

In nearly saturated atmospheres, the electrolytic conduction in the paper predominated over the conduction by carbon. As a consequence, its resistance passed through a maximum when the atmosphere changed to or from saturation. Corresponding experiments with 'Cellophane' and hair were not made.

The paper and 'Cellophane' resistors were 20 cm. $\times$ 1·25 cm., with ends dipping 1 cm. into mercury wells. The hair resistor consisted of 27 segments in parallel, each 2·5 cm. long. The hair had been boiled in ethyl ether. Resistances were computed from the currents given by a 1·5 volt dry cell.

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[1] K. Mellanby, NATURE, **132**, 66, July 8, 1933. J. Grant, *ibid.*, 677, Oct. 28, 1933. P. H. Prior, *ibid.*, 857, Dec. 2, 1933.

The Maüle Reaction and the Systematic Position of the Gnetales

IN a book just issued[1], Dr. Hagerup, of Copenhagen, has revived the much-debated question of the origin of the Angiosperms, basing his conclusions on a detailed, comparative study of the organogeny of the floral structures in a series of representative species of the Gnetales, Piperaceæ and Juglandaceæ. From this investigation he derives support for the belief in the close relationship of the Piperaceæ and the Gnetales, the differences between them being, in his view, of minor importance morphologically; so that either the Gnetales should be added to the Angiosperms, as Lignier contended, or the Piperaceæ should be regarded as having arisen directly from

gymnospermic ancestors through the Gnetales, as the author himself maintains.

These conclusions have been based upon observations, admirably extensive, but along organographical lines only, and they have been opposed, in review, on that ground. It is therefore worth while directing attention to supporting evidence from an entirely different side.

The long-neglected Maüle reaction[2] consists in the chlorination of lignin by treatment with potassium permanganate and strong hydrochloric acid (the original procedure) or directly with chlorine water, followed by ammonia, which may be replaced by an alkali or an organic base. The result is a bright red colour of unknown chemical nature which appears to be an indicator, colourless in the acid form and with red salts, with a C = O chromophore group in the molecule.

This reaction was claimed by Maüle as specific for Angiosperm wood, and an extensive test by us in 1932–33, covering forty-three families of Angiosperms, supports this claim, with the outstanding exception that the colour is also given by the wood of all three genera of Gnetales and by them alone among non-Angiosperms, except in the sclerenchyma (not the xylem) of two species of *Stangeria* and possibly also one species of *Podocarpus*, which gives a weak reaction according to Crocker[3].

The Gnetales stand out conspicuously in sharing this distinctively angiospermic element of constitution.

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[1] Hagerup, "Zur Abstammung einiger Angiospermen durch Gnetales und Coniferae". Copenhagen, 1934.
[2] Maüle, *Bei. Wiss. Bot.*, **4**, 166; 1901.
[3] Crocker, *Bot. Gaz.*, 95, 168; 1933.

Traffic Noise

Now that so much is being done in order to find means of reducing street and other noises, it may be worth while considering whether there are not more factors than intensity and character of the noise to be taken into account. It is fairly probable that any noise is more objectionable when it is intermittent; and it is also possible that an intermittent noise with quick rate of change is more objectionable than one in which the rate is slow.

Sir Herbert Maxwell points out in NATURE of November 3 that horse traffic used to be more noisy than the present-day motors; but it certainly caused less annoyance. May not the reason, or one of the reasons, be that changing gear or using a cut-out involves sudden change in noise; and may not the greater speed of modern traffic be a contributing cause of the trouble, in that fast approach of a noisy vehicle results in greater rate of change of noise as heard by anyone at a standstill? The clatter of a two-horse dray rumbling over granite setts was continuous, and became audible gradually to anyone who was not on the move; but the noises created by a motor cycle without silencer, or by a bus changing gear after getting under way involve quick rate of change. I am sure that rate of change must be taken into account in deciding whether a given noise is objectionable or not.

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Corrections to the Refractive Indices of Quartz in the Infra-Red

IN the region 3–4 μ, the dispersive power of crystalline quartz (ordinary ray) is about four times that of fluorite and thirteen to fourteen times that of rock-salt, but, because of strong absorption beyond 3·6 μ and also between 2·8 μ and 3·1 μ, quartz has been neglected as a prism material in this part of the spectrum. The high dispersive power does, nevertheless, more than compensate for the loss due to absorption, and better resolution is obtainable than with fluorite.

When prisms of quartz and fluorite were used in a recent research, it was found that wave-length discrepancies occurred between the results obtained with the two prisms, and these were traceable to the relatively inaccurate data for the refractive indices of quartz. The figures available for quartz in this region are due to Rubens[1], who measured the refractive indices of both quartz and fluorite by the method of coincidences, using a wire grating; later he corrected his results to be in accordance with Paschen's more accurate values for fluorite[2]. Paschen[3] has since given still more accurate data for fluorite, and Rubens' values for quartz are no longer correlated with these. Moreover, the dispersion curve for quartz up to 3 μ is accurately known[4] and is smooth, while Rubens' curve, in addition to showing two rather abrupt bends, does not join up well with this but intersects it at a small angle at 3 μ.

From the comparison of the results lately obtained with quartz and fluorite prisms, values for the refractive indices of quartz have been estimated for several wave-lengths between 3 μ and 3·8 μ, and these, when plotted, are found to lie on a smooth continuation of the curve up to 3 μ. These corrected refractive indices of quartz are given in the accompanying table, and should be regarded as provisional values, suitable for adoption until direct determinations of greater accuracy become available, whilst not in any way obviating the need for the latter. The corrections proposed, it will be seen, are of quite appreciable magnitude.

λ	*n* (Rubens)	*n* (Corrected)	Difference
3·03 μ	1·4987	1·4987	0
3·18	1·4944	1·4947	+ 0·0003
3·40	1·4879	1·4885	+ 0·0006
3·63	1·4799	1·4809	+ 0·0010
3·80	1·4740	1·4746	+ 0·0006
3·87	(1·4715)*	1·4715	0

* Interpolated value.

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[1] Rubens, *Ann. Phys.*, **53**, 273; 1894.
[2] Paschen, *Ann. Phys.*, **53**, 325; 1894.
[3] Paschen, *Ann. Phys.*, **4**, 299; 1901. **41**, 670; 1913.
[4] Paschen, *Ann. Phys.*, **35**, 1005; 1911. Carvallo, *C.R.*, **126**, 728; 1898. Coblentz, *Sci. Pap. Bur. Stan.*, **16**, 701; 1920.

Spectrum of Acrolein

IN connexion with measurements on the photochemical decomposition of acrolein we have measured (Hilger E 315 spectrograph) its ultra-violet absorption spectrum. There are two distinct regions of absorption, one consisting of bands with no overlapping continuum, extending from *c.* 4000 A. to 2800 A.; the other of continuous absorption beginning at

c. 2300 A. and extending towards higher frequencies. The first region becomes continuous at pressures above *c.* 60 mm. These results agree essentially with the earlier work of Lüthy[1]. The first region corresponds to absorption by the carbonyl group. Saturated ketones have also been found to give banded absorption below *c.* 2100 A., so that the second region found here might also involve absorption by the carbonyl group. On the other hand, some facts suggest that the continuous absorption is really to be attributed to a primary excitation of the C = C link. In consequence of the conjugated grouping this may be displaced towards the red as compared with that usually found.

The main feature of the first absorption region is a series of relatively intense pairs of narrow bands. The intervals between the intense pairs are each *c.* 1260 cm.$^{-1}$, and this is also true of the weaker pairs. This frequency is probably to be associated with a vibration of the molecule

$$\begin{matrix} R \\ H \end{matrix} \diagdown\!\diagup C \rightarrow \leftarrow O$$

agreeing with the values found for other aldehydes. At lower pressures the bands at the long-wave end are fairly sharp but become less sharp at wavelengths shorter than *c.* 3500 A.; the point at which the diffuseness begins to be noticed varies with the pressure. At the long-wave end some of the bands show under higher dispersion (Hilger E 1 spectrograph) a distinct fine structure, the nature and magnitude of which is such that it may imply a rotation of the hydrogen atoms and the oxygen atom around an axis close to that of the C–C–C chain. These bands appear to have been analysed by Snow and Eastwood under still higher dispersion[2].

The illumination of acrolein vapour at room temperatures with light of frequencies corresponding to the first region of absorption leads predominantly to a polymerisation, which may imply a long life of the excited state and a much delayed dissociation. The experiments are being extended to propiolic aldehyde, the spectrum of which may show certain simplifications.

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[1] *Z. phys. Chem.*, **107**, 285; 1923.
[2] NATURE, **133**, 908, June 16, 1934.

Points from Foregoing Letters

THE widespread infestation of potato leaves, especially of the Kerr's Pink variety, with early blight, is indicated by Dr. R. N. Salaman and Miss O'Connor, who describe its occurrence and dangers and indicate methods of checking its ravages.

The chemical combination of the carbon dioxide obtained from the air, with water, in order to form finally sugar, starch and other carbohydrates, occurs in green plants in several stages. Prof. E. C. C. Baly invokes three steps: (1) reaction of chlorophyll with carbon dioxide; (2) further reaction in presence of light to form carbohydrate; (3) Blackman reaction in darkness when chlorophyll goes back to original state.

Sevag and Maiweg's claim to have found a new substance, belonging to the oxime-group, which poisons the enzyme catalase (which increases the rate of liberation of oxygen from peroxides) is disputed by Prof. Keilin and Mr. E. F. Hartree, who find that the oxime solution of Sevag and Maiweg contains hydroxylamine, an already known poison for catalase.

Certain gases are adsorbed by given metals or metallic oxides and are thereby rendered more active in specific chemical reactions (activated adsorption). Prof. S. Roginsky discusses the rate at which such adsorption takes place and maintains that it does not agree with Taylor's theory of the phenomenon.

Prof. Dhar and others have shown that reacting gases absorb more light than the same gases separately. Prof. R. W. Ditchburn and Dr. H. J. J. Braddick find that the simple admixture of two non-reacting gases affects their light-absorbing power. Certain photochemical and astrophysical calculations may need revision in view of these results.

Dr. W. Sucksmith has measured the angle through which certain nickel alloys turn when submitted to varying magnetic fields (gyromagnetic effect). Nickel-copper alloys were chosen, the magnetic susceptibility of which at temperatures above − 14°, − 9° and − 2° C. varies inversely as the absolute temperature (that is, they are paramagnetic). Below these temperatures (Curie points) their susceptibility varies irregularly (that is, they become ferromagnetic). From his measurements Dr. Sucksmith infers that the paramagnetic behaviour of nickel alloys, like the behaviour of ferromagnetic substances in general, is due solely to the spin of the electrons and not to their orbital motion.

The increase in electrical conductivity shown upon drying, which he has measured in certain carbon-coated organic materials, is explained by Dr. Lars A. Welo as being due to the closer contact of the carbon particles when the materials shrink.

The bright-red colour which the wood of flowering plants gives upon chlorination (Maüle reaction) can be used as additional evidence that the family of Gnetales (of which the species *Ephedra*, growing on the sand-dunes of the Mediterranean, is the chief European representative), really belongs to the flowering plants, in spite of their cone-like flowers that have led botanists to include them among the non-flowering cone-bearing plants (Gymnosperms). Prof. R. C. McLean and Miss Myfanwy Evans find, in fact, that all three known genera of Gnetales give the Maüle reaction.

Dr. H. W. Thompson and Mr. J. W. Linnett have measured the light absorption of acrolein in the visible and ultra-violet and discuss the relation of the two absorption bands observed to the molecular structure of that compound. They find that illumination of acrolein vapour with light corresponding to one of the absorption bands leads to molecular aggregation (polymerisation).

Research Items

Iron Age Site, Kilpauk, Madras. A preliminary report on the excavation of what promises to be an important site in the prehistory of southern India has been published by Messrs. M. D. Raghavan and T. G. Aravamuthan (*Current Sci.*, 3, No. 3). The prehistoric cemetery of Kilpauk, Madras, situated in the garden of a bungalow belonging to Mr. E. R. Prudhomme, has been known for about twelve years, and a number of specimens of pottery and a small sarcophagus had been found in the course of laying out the garden. No attempt had been made to explore the site systematically until August last, when operations were begun on behalf of the Madras Government Museum. Up to the date of writing, the authors had extracted a quantity of black-tipped ware, in which the rim and inside are black and the rest red, all-black ware, a figurine of black pottery of high finish, apparently representing a bird, and half of a fine pottery head. Two iron objects were found, of which one was a small hoe blade of a very primitive type with a slightly curved cutting edge and a narrow butt, and the other a stick of iron, about six inches long. The most important find, however, was a sarcophagus about six feet in length, standing on six pairs of short legs, closely resembling specimens found at Pallavaram and Perumbair. It was filled with sand and bits of pottery. A fragment of a human tibia was found nearby. The sarcophagus had been badly damaged by a mango tree root and could not be removed whole. The site has certain distinctive features which mark it off from other prehistoric sites, such as the occurrence of both urn burials and sarcophagus burials, and the abundance of fine pottery. The all-black vessels distinguish Kilpauk from both Perumbair and Adichanallur. Beyond an attribution to the iron age of Southern India, it is as yet too early to attempt any precision in chronological classification.

Pawnee Ritual Games. The Pawnee ghost dance hand game has been made the subject of a study in cultural change by Dr. Alexander Lesser, based in part on field-work among the Pawnee Indians under a project supported by the Columbia Council for Research in the Social Sciences (Columbia Univ. Cont. to Anthropology, No. 16). The Pawnee first came under the United States Government with the purchase of the Louisiana territory in 1803. Their native economy of buffalo hunting accompanied by a digging-stick cultivation of corn and squash broke down with the coming of white settlement, and in 1874–76 they were moved from Nebraska to reservation land in Oklahoma. By 1892, when the Ghost Dance appeared among them, their culture had completely broken down, owing to a great extent to the efforts of the Government to substitute individual agricultural holdings for their village system. Their ceremonies had become functionless and extinct, while their arts, which had centred on the buffalo, had disappeared. They had nothing to look forward to and nothing to live by. The Ghost Dance gave them a new aspiration. In the form of the ritual among the Pawnee the hand game, a gambling game, which under the traditional culture had been associated with hunting and warfare, played an important part. Though there were no longer material stakes, there was still a feeling about winning and losing. In place of the opposing sides being based upon tribal divisions, they were constituted by such distinctions as 'visionaries' against 'innocents', men and women and the like. The incorporation of the hand game in the ghost dance ceremonial seems to have reached the Pawnee from the Arapaho. Only four other tribes appear to have developed the game in this manner. Not only did these games satisfy the desire for creative effort, but the ceremonies were the occasion of social gatherings on a large scale, which lasted over four days, meeting a real need when the tribe had been scattered over allotments.

Bionomics of the Tsetse Fly on the Gold Coast. The species of tsetse fly, *Glossina longipalpis*, Wied., is of great importance as a vector of human and animal trypanosomiasis in West Africa. Of the common tsetse flies, *G. longipalpis* appears to have been the least investigated. The bionomics of this insect in the country around the Gold Coast port of Takoradi forms the subject of a recent paper by Mr. K. R. S. Morris (*Bull. Ent. Res.*, 25, part 3, Sept. 1934). It appears that the main food hosts of this species were bushbuck and duiker. When these small game animals were driven out of a specific fly-belt by farming and wood-cutting, the insect quickly and completely disappeared. Its distribution is dependent more upon humidity than upon temperature. The main vegetational types frequented by the insect are transition forest, inland savannah forest and coastal savannah, where the range of humidities is between 50 and 80 per cent (relative humidity) and the temperature between 75° and 85° F. It does not occur in the rain forest, where the relative humidity is above 80 per cent, or in the northern savannah, where it is as low as 30 per cent in the dry season. By statistical methods, coefficients of correlation were determined for the fly's density-activity and various climatic factors of the fly-belt. The main policy for control should lie in improving and directing the native's methods of bush cultivation. Farms should be as close to villages as possible, contiguous and kept under permanent cultivation. Clearings should be made at least 100 yards wide around bush villages and at least 200 yards wide around important towns. Small clearings and isolated farms are regarded as a danger.

Habits of *Aequideus latifrons*. The Cichlid fishes are always favourites in aquaria and have peculiar breeding habits, either attaching their eggs to some solid support and guarding them, or carrying them in the mouth until hatched. Mr. C. M. Breder, Jr., of the New York Aquarium, in "An Experimental Study of the Reproductive Habits and Life History of the Cichlid Fish *Aequideus latifrons* (Steindachner)" (*Zoologica. Sci. Contrib. New York Zoo. Soc.*, 18, No. 1, 1934) studies a species which deposits its eggs on a substratum. The fishes were the aquarium-bred offspring of specimens collected in 1931 by Mr. A. Eisinger at Barranquilla, Columbia, and were brought to the New York Aquarium when still very small. Their behaviour appeared quite normal and like those studied under field conditions. Eggs may be laid every twenty-five days at a temperature of about 25° C., and hatch in two or three days. They are fanned by the parents' fins during the whole of the

incubation period, and the young are protected until another lot of eggs is ready to be laid. The parental care is strikingly shown in the way that both eggs and young are guarded in the aquarium, for they have many enemies and are eagerly eaten by the non-breeding adults present. If the fishes are disturbed they may remove the eggs altogether, taking them carefully one by one to some sandy hollow and incubating them there. The experiments devised in this research are ingenious, and the sketches and photographs which accompany the paper are very interesting.

Resistance of Mice to Irradiation. Jerome Davis (*Amer. Nat.*, **68**, Sept.-Oct. 1934) discusses the results which he has obtained on the effect of ultra-violet light on mice. Six generations of hairless mice were subjected to ultra-violet light, and a control group was maintained which did not receive this treatment. Three animals from two litters of the sixth irradiated generation, and two controls of the same age were irradiated together. Slight peeling began on the controls after one exposure, but in the experimental animals not until after the fourth exposure. At the end of fifteen exposures, the controls were severely burned, whereas the experimental animals were only slightly so. In the experimental group the burns disappeared within six days, leaving the animals quite normal. The controls, on the other hand, developed hard callouses due to hyperplasia of the epithelium. Davis tentatively suggests that the difference in response to irradiation between the irradiated and control mice may be due to the inheritance of acquired resistance to irradiation. The author, acknowledging that the results are inconclusive, suggests that they may incite others to repeat and extend his work. But it is to be hoped that he will stage a Mendelian experiment with his own stock. It should be a simple matter to show that the tolerance is, or is not, indeed inherited.

Evolution in the Agarics. A long paper by Mr. E. J. H. Corner of Singapore, "An Evolutionary Study in Agarics; *Collybia apalosarca* and the Veils", has appeared (*Trans. Brit. Mycol. Soc.*, **19**, 39–88, Oct. 1934). The account traces the formation and anatomy of the fruit body of *C. apalosarca*, a toadstool-like fungus found growing on wood in Malaya. Characters of the species are given in detail, whilst a new form, *radicans*, and a new variety, *perstipitata*, are also described. The structure of the mature fruit body has been investigated microscopically, and times of spore shedding are correlated with size of the fructification. *C. apalosarca* forms an evolutionary link between *C. radicata* and *Armillaria mucida*, and several interesting comparisons are drawn. For example, the 'root' of *C. radicata* is represented by the lower half of the stem in *C. apalosarca* and by the stem and persistent ring of *A. mucida*. *C. radicata* is supposed to have developed from a naked ancestor; *C. apalosarca* and *A. mucida* from a similar veiled ancestor, whilst the newly-described form and variety mentioned above are intermediates which uphold the hypothesis.

Oxidising Agents as Fertilisers. Iyer, Rajagopalna and Subrahmanyan (*Proc. Indian Acad. Sci.*, **1**, No. 2, p. 106) describe interesting effects of various oxidising agents on crop yield and certain chemical and biological transformations in the soil. Some remarkable increases in yield are recorded, up to 100 per cent, for example, with tomato plants on soil treated with manganese dioxide. Certain other crops responded better to potassium permanganate. Ammonification, with organic manures, was slightly favoured by oxidising agents, and increased oxidation of organic matter was demonstrated by the increased production of carbon dioxide corresponding to the loss of carbon. The treatment also resulted in a temporary increase in the numbers of bacteria and Actinomyces, whilst in some cases depression of fungi occurred. It appears that the results are due more to the facility with which the added substances part with their oxygen than to the effect of the metallic ion, hydrogen peroxide producing effects similar to those of manganese dioxide. Increased formation of bacterial food and consequent increased activity may be involved as well as direct oxidation of organic matter to simpler substances and carbon dioxide.

Deformations of the Crust around Sakura-jima (Japan). Until 1914, Sakura-jima was a volcanic island at the northern end of Kagoshima Bay. After the great eruption on January 12 of that year, it was joined by a stream of lava to the mainland. Series of precise levellings were carried round the head of the bay in 1891–98, 1914, 1915, 1919 and 1932. Prof. C. Tsuboi (*Earthq. Res. Inst. Bull.*, **7**, 103–114; 1929) examined the changes during the first two intervals. The graphs are similar in form; each consists of segments of straight lines, and the ends of segments lie on the same abscissæ, which, according to Tsuboi, correspond with the boundaries of six crust-blocks round the head of the bay. In three of these blocks, the amounts of tilting were 9″, 10″ and 12″, and the directions converge towards a point a short distance to the north of the crater. Prof. N. Miyabe has continued the work for the last two intervals (*Bull.*, **12**, 471–481; 1934). In both, the vertical displacement was reversed in direction, the recovery being at first somewhat rapid. In one crust-block (west of the volcano), the tilting occurred in the same direction as before. In the other two (to the east), the direction of tilting was almost exactly reversed, though less in amount.

Meteorology of the West Indies. The "Handbuch der Klimatologie" of W. Köppen and R. Geiger when complete will be in five volumes (Berlin: Gebrüder Borntraeger, 1934). A number of different parts of this work have already appeared as each has been completed, of which the most recent (Band 2, Teil 1) is entitled "Climatology of the West Indies". The text of this was written in 1927 by the late Prof. R. de C. Ward, formerly professor of climatology at Harvard University, who compiled his account largely on the basis of summaries by W. W. Reed that had appeared a year earlier in the *Monthly Weather Review*. Prof. C. F. Brooks, director of Blue Hill Observatory, with the help of Miss E. M. Fitton and others, extended the tables and summaries; finally Prof. Ward revised the whole work shortly before his death. European meteorologists hear of these regions chiefly in connexion with tropical hurricanes, but the introductory part of this work shows that there are other aspects of their meteorology of almost equal interest. The West Indies show great uniformity of temperature, such as is to be expected of islands of which the greater number lie just within the tropics, but those nearest to the mainland of Central America feel to some extent the effect of the winter cold waves of North America, resulting from south-

ward incursions of polar air ; the more easterly and southerly members of the group escape these effects and have a correspondingly small annual range (2° C. only at Barbados). While temperature changes are unexciting and the simple régime of the north-east trade winds is only rarely disturbed by a hurricane, rainfall shows great variability both in the amount experienced in different years at one place and in the normal amount received at places no great distance apart. At Silver Hill, Jamaica, the total fall in three days, November 5–7, 1909, was 2,159 mm. (85 in.) and in the seven days to November 11, it was 3,428 mm. (135 in.). In the same island, two places only 30 miles apart and differing in elevation by only 189 metres have normal annual totals of 735 and 5,638 mm. respectively. The numerous detailed tables in this work repay study, for example, Table 12, which shows thunderstorm frequency. Some of the islands have only about the same number as the English Midlands, but at Port au Prince (Haiti) the annual frequency is about 107.

The Energies of the Positrons in Induced Radioactivity. Y. Nishira, R. Sagane, M. Takeuchi and R. Tomita (*Sci. Pap. Inst. Phys. Chem. Res., Tokyo*, Sept. 1934) have investigated the energy distribution spectrum of the positrons emitted for radio phosphorus ($_{15}P^{30}$) obtained by activating aluminium by bombardment with α-particles. The activated metal was brought up to a Wilson cloud chamber arranged in a solenoid. The positrons passed through a thin aluminium window into the chamber. The energy distribution is apparently continuous, with a maximum intensity about $0{\cdot}8 \times 10^6$ e.v., and the upper limit of energy is probably in the neighbourhood of 4×10^6 e.v. The results are compared with those obtained by Curie-Joliot, Meitner, Alichanow and others, and by Ellis and Henderson, and published in recent papers. Most of these authors find a rather lower value for the energy at the upper limit. It is suspected that there are other peaks in the energy distribution, but these may well be due simply to statistical fluctuations.

Fast Mercury Ions and the Excitation of X-Rays. D. H. Sloan and W. M. Coates have recently described the further development of the Laurence-Sloan apparatus for accelerating heavy ions in stages to energies of the order 3 million volts (*Phys. Rev.*, Oct. 1). The ions travel through a series of copper tubes which are connected alternately to opposite poles of a high-frequency circuit, and the length of the accelerators is so arranged that an ion once accelerated into the first cylinder passes from one to another always at the right time to receive an acceleration. Detail improvements in the accelerators and their connexions enable higher voltages to be employed than formerly. The maximum voltage applied is 79,000 volts at about 10 megacycles, and about 10 kw. is supplied to the oscillator. About 10^{-8} amp. of mercury ions were obtained at $2{\cdot}8 \times 10^6$ volts. A second paper by W. M. Coates describes the production of X-rays by mercury ions having energies up to 2·4 million electron volts. The X-rays were definitely produced by the ions since they were unaffected by the use of electric and magnetic fields sufficient to eliminate cathode rays from the beam striking the target, while they were stopped by a foil which stopped the positive ions but would be transparent to X-rays produced in other parts of the tube. No radiation was observed from targets of lithium, boron, oxygen, sodium, nickel or copper. X-rays were detected and the absorption coefficients measured in aluminium and air, for the target elements aluminium, sulphur (probably *K*-radiation), bromine (probably *L*-radiation), molybdenum, silver, tin and lead (radiation not identified with certainty). The radiation was in all cases too weak to measure below 300 kv., and increased rapidly with increasing energy of the ions. It is suggested that these rays are produced by the bombarding ion and the target atom approaching sufficiently close to form a quasi-molecule with the two *M* shells (say) overlapping. When the 'molecule' breaks up, one of the atoms loses one of its inner electrons and the subsequent rearrangement gives rise to characteristic radiation. The observed threshold value for the energy of the exciting ion gives a distance of approach of the two nuclei which agrees roughly with this hypothesis.

Tidal Friction and Planetary Motion. Much time and labour were devoted by the late Sir G. H. Darwin to a step-by-step investigation of the cumulative effects of tidal friction upon the motion of the earth and moon. Lord Kelvin suggested that a more general and less laborious treatment could be obtained by considering the energy and angular momentum. In recent times the problem has been taken up again, by the aid of general theorems in Hamiltonian dynamics. T. Levi-Civita, who has himself worked on the subject, gives (*Amer. Math. Mon.*, **41**, 1934) an account of the methods used by G. Krall, which are remarkable in that they enable one to describe the behaviour of a planetary system after an indefinitely great time without calculating the intermediate stages. The conclusions are that everything tends towards a state of uniformity, in which all the bodies will describe circular orbits about their common centre of mass with equal angular velocities. Moreover, each axis of rotation will be perpendicular to the orbital plane, and the period about this axis will be the same for all. In other words, on each planet the length of the year will be the same, and also the length of the day, and there will be no distinction between summer and winter. The above results are for systems which have kinetic energy of rotation comparable with that of translation. A case which has not yet been worked out is that in which the resultant angular momentum is zero. The ultimate fate of such a planetary system would be a catastrophe in which all the bodies collided.

Sunspot Numbers. Tables of monthly and annual sunspot numbers from 1749 to 1933, as determined at Zurich, are given in the September issue of *Terrestrial Magnetism and Atmospheric Electricity*, and are accompanied by a similar table, for the years 1917–33, of the sunspot numbers derived from the central zone of the sun, and a table of monthly intensity of ultra-violet solar radiation at Mount Wilson for the period 1924–33. Diagrams for 1923–33 of the central-zone *daily* sunspot numbers, and of the international daily magnetic character figures, arranged in 27-day sequences, are given by J. Bartels, and illustrate again the fact that strong and long-lived active regions occur on the sun, which affect the earth's magnetic state, even throughout periods in which the sun is practically spotless. The same issue contains two articles, by H. W. Wells and L. V. Berkner, on measurements of the *E* and *F* ionised layers of the atmosphere above Huancayo, in Peru, at latitude 12° S.

The British Institute of Radiology

Annual Congress and Exhibition

THE eighth Annual Congress of the British Institute of Radiology, and an exhibition of radiological apparatus organised by the X-ray industry were held at the Central Hall, Westminster, on December 5–7. The morning of December 6 was devoted to the reading of physical and technical papers, contributions being made by Prof. F. L. Hopwood, Dr. A. Müller, Dr. R. E. Clay and Mr. A. G. Warren.

Prof. Hopwood, giving a demonstration of induced radioactivity, traced briefly the history of the subject starting with the work of M. and Mme. Joliot (1933), who by bombardment with α-particles, induced radioactivity in various substances of atomic number less than that of potassium. He referred to the work of Cockroft and Walton, who produced similar effects with high-speed α-particles, and also to the various results obtained with neutrons, stating that Fermi has excited fifty elements. Prof. Hopwood and his colleagues at St. Bartholomew's Hospital have found that induced radioactivity can be brought about by neutrons emitted from beryllium irradiated by γ-rays. Following on this work, they endeavoured to induce radioactivity by means of high-voltage X-rays. No effect could be detected as a result of irradiation by X-rays excited at 200 kv. or at 400 kv., but the desired effect was produced by X-rays produced at much higher voltages. Bromoform was used for the purpose, and after irradiation in Germany, the sample was brought to London by air and the radioactive bromine separated by chemical means (see NATURE, Dec. 8, p. 880). Bromine apparently gives rise to two radioactive forms, one having a half-value time of about 6 hours, and the other having a half-value time of 30 minutes. It was stated that radioactivity has now been induced in all the elements found in the human body except calcium and hydrogen.

For the purpose of demonstration, Prof. Hopwood showed, by means of a Geiger counter, the induced radioactivity in aluminium (slightly active) and in silver (strongly active). The latter case was of particular interest, as the half-value period of the silver is about 3 minutes, and the decay could readily be detected. Induced radioactivity in a piece of ivory was also demonstrated.

Dr. A. Müller and Dr. R. E. Clay gave a paper on the "X-ray Plant at the Davy-Faraday Laboratory". The simplest apparatus, a small induction coil with a Wehnelt interrupter operating an X-ray tube of the gas type, was demonstrated, and typical crystal photographs were made and developed in the course of the lecture. The authors then pointed out that the principal difficulty in designing high-powered X-ray equipment lies in dissipating the heat generated at the target, and showed mathematically that the maximum permissible loading of a tube depends on the square root of the area of the focus. If the focus is to be kept small and the power increased, recourse is had to a tube employing a rotating anode, and a tube, capable of withstanding a continuous loading of 16 kw. (450 ma. at 35 kv.), has been made and found satisfactory. This tube embodies a target about 20 in. in diameter, rotating at a speed of 2,000 rev. per minute. Using a high-powered X-ray tube of this type, it is possible to work with crystal-film distances of 3 metres, and so obtain a very high resolving power.

The authors are considering the design of a tube capable of handling 50 kw. but are of the opinion that it would not be possible to go to much higher powers, since the maximum permissible loading of a tube having a rotating anode varies only as the square root of the peripheral velocity. Tubes of power much greater than 50 kw. would therefore have to be very large and to rotate at high speeds, and the mechanical stresses would approach the ultimate strength of steel.

Mr. A. G. Warren, in a paper on "The Detection of Small Flaws in Metals by Radiography", discussed in considerable detail the detection of cracks and 'flakes' particularly in steel. He showed that the possibility of detecting cracks radiographically depends partly on their dimensions and partly on their obliquity to the X-rays, and that over a wide range of dimensions a criterion could be found from consideration of the area of cross-section of the flaws. The minimum cross-section of a detectable flaw can be found by ascertaining the cross-sectional area of the finest wire, laid above the specimen, which could be detected on the radiograph. As an example of the minimum size detectable, Mr. Warren showed that, in steel 1 in. thick, a crack of width 0·004 in. and a depth exceeding 0·02 in. can be detected with certainty.

The fifteenth Mackenzie Davidson Memorial Lecture was given on December 7 by Sir William Bragg, on "X-rays and the Coarse Structure of Materials". After explaining briefly the rudiments of the subject, he described recent work carried out on organic ring compounds, and showed that by X-ray means it is possible to make a kind of 'contour map' giving the distribution of electron density in the crystals, which reveals a structure agreeing closely with that arrived at from considerations of the chemistry of the substances. The energetics of substances can be studied by chemical means and also by consideration of the electrical forces holding the atoms together, and the two methods give similar results, but indicate tensile strengths much higher than those usually observed. The discrepancy is attributed to surface defects, which have the effect of weakening the structure, and recent experiments have shown that if the experimental conditions are arranged so that the weaker parts of the sample are not stressed, values for tensile strengths agreeing with those calculated are obtained.

Higher values for tensile strengths are obtained in a vacuum than in air—a result attributed to the effect of water vapour absorbed in interstices, which has the effect of reducing the electrical forces. A piece of mica cleaved in a vacuum will recover when the surfaces are put into contact again, although in air the cleavage is permanent. This effect may be explained on the assumption that water vapour absorbed from the air disturbs the electrical field and prevents cohesion taking place, while in a vacuum the electric field is stable and cohesion readily occurs.

A new apparatus of interest to physicists shown at the exhibition was a high-voltage rectifier of the copper oxide type capable of withstanding an inverse voltage of 200 kv. and passing a current of 30 ma. The complete rectifier is built of smaller units arranged in series, mounted in oil in a metal case and provided with suitable insulators for operation at high potentials to earth.

Centenary of the University of Brussels

THE Université Libre de Bruxelles was founded on November 20, 1834, by Theodore Verhaegen (1796–1892) and a group of friends, a few days after the opening on November 4 of the Catholic University at Louvain. It was housed at first in the buildings now occupied by the Musée Moderne, but was removed in 1842 to the site in the rue des Sols which it occupied until recently. After the War, mainly through the generosity of the "Commission for Relief in Belgium" and the Rockefeller Foundation, a new Cité Universitaire was created at Solbosch, adjoining the Bois de la Cambre. These buildings include a very fine hall and library with appropriate buildings for the faculties of arts and law, whilst the faculties of science are housed in a capacious but more utilitarian building behind the main frontage. A large hostel has also been provided for men and women students, with generous accommodation for non-residents.

The centenary celebrations extended over three days, November 18–20. On the evening of November 18, a reception was given by the Collège des bourgmestres et échevins at the Hotel de Ville, where the guests were received by Bourgmestre Max. The principal function took place in the hall of the University in the presence of H.M. the King of the Belgians. This session was presided over by Bourgmestre Max, and addressed by M. Paul Hymans (Foreign Minister), M. Maistriau (the retiring Minister of Public Instruction), and representatives of past and present students. The Rector, M. Bogaert, announced the names of some twenty-five new doctors *honoris causa*, of whom the first was the King himself. In addition to those associated with the faculties of philosophy and of law, the faculty of medicine had nominated Sir Henry Dale, director of the National Institute for Medical Research in Great Britain, Prof. van den Bergh of the University of Utrecht, and Sir Frederick Gowland Hopkins, president of the Royal Society. The faculty of pure science had nominated Profs. Cayeux, Cotton and Hadamard, members of the Institut de France, Prof. Krismer, emeritus Professor of the École Militaire at Brussels, and Prof. T. M. Lowry of the University of Cambridge. The faculty of applied science had nominated M. Pelseneer, permanent secretary of the Académie Royale de Belgique, Prof. Swarts of the University of Ghent, Prof. Debye of the University of Leipzig (at present visiting professor at Liège on the Francqui Foundation) and Prof. Janet, honorary professor of the University of Paris. At the conclusion of the ceremony, the past and present honorary doctors were received by the King in person.

Public lectures on legal and philosophical subjects were given in the afternoon, and in the evening of November 19 the guests were entertained at dinner by M. Hymans at the Fondation Universitaire. The celebrations were continued on Tuesday, November 20, and concluded with a banquet in the University hall, which was attended by 826 guests.

The celebrations were marked by much enthusiasm and were of an extremely hospitable character. There can be no doubt that in its new quarters the University has every prospect of a brilliant and successful future.

Archæological Excavations in Shetland

MR. A. O. CURLE gave an interesting account to Section H (Anthropology) at the Aberdeen meeting of the British Association on the excavation conducted by him during the past four years in Shetland. A low promontory projecting into the Voe which lies sheltered behind the lofty promontory of Sumburgh Head, the most southerly point of Shetland, bears on its crest the ruin of a late sixteenth century dwelling house, to which Sir Walter Scott in "The Pirate" gave the name of "Jarlshof". Beneath and all around this ruin lie numerous remains of ancient dwellings, ranging from before the Bronze Age reached Shetland in the latest phase of that culture, through the period of the brochs and their secondary buildings, to the coming of the Norsemen in the ninth or tenth century and even later, for relics found in the vicinity of foundations exposed last summer indicated for them a fifteenth or sixteenth century date.

A storm some thirty years ago exposed a range of buildings on the sea front, which were at that date excavated by the proprietor. These consisted of the remains of a broch and a series of later buildings extending probably well into the Christian era. The Office of Works, having accepted guardianship of these remains, resolved to explore the ground in the immediate vicinity, and invited Mr. Curle to direct the operations on its behalf. The work has now been in progress for a short period each year since 1931. A group of prehistoric dwellings five in number, all lying practically contiguous to one another, have been explored and apparently exhausted. A dwelling, excavated during the past summer, was found to consist of an open court some 20 ft. long and 10 ft. broad, rounded at the inner end, with lateral chambers on the sides. The paving suggested the presence of cattle inside the house, a practice followed in much later days. This was confirmed by the discovery of a whale's vertebra, fixed into a wall to furnish a loop for a tether. This dwelling had been partially broken down and then extended by further constructions in front of the original entrance. From this later building a drain had been carried towards lower ground to the south-east. Evidence of a still later period was the closing of that drain by a stairway leading to another dwelling. This second dwelling was obviously of much later construction than the first. In its turn it had had three periods of occupancy, the earliest of which was seemingly contemporary with the latest occupation of the first house. The third occupation of the second house was remarkable for evidence of the advent of artificers in bronze, who cast swords and axes in clay moulds. These dwellers closed the original entrance, which lay at the foot of the stair above referred to, and opened a new entrance at the opposite end of the house. The bronze workers used clay moulds, and, to release their castings, broke the moulds and threw the fragments over the closed entrance and into disused chambers beyond, where they lay, not on the floor level, but in the

soil which overlay them. While using bronze, the people were also employing artefacts of stone and of slate. They also cultivated grain, using a species of barley. In their mode of life they were pastoral, and seem to have drawn little from the sea except shell-fish. Adjacent to the second dwelling lies a third, which in its turn had been subjected to three different occupations. The first and the second of these occurred during the final phase of the Bronze Age in Shetland, and the last after bronze had given place to iron.

This past season, while it saw, seemingly, the termination of the excavation of the prehistoric site, witnessed the opening of a fresh epoch in the exploration of a settlement of the early Norse invaders. A house has been uncovered measuring nearly 100 ft. in length, 12 ft. in breadth at either end, and 17 ft. 6 in. in the centre, the walls of which in part still stand to a height of 3 ft.—probably not much below the original elevation, as the superstructure would be of wood and turf with a roof of timber, partially supported on posts.

Numerous relics have been found, including combs and pins of bone, pins of bronze and a remarkable collection of pieces of slate bearing lines and devices in graffito. One of these, a tablet 7 in. × 2 in., shows a Viking galley with high prow and stern, with mast and steering oar, and the crew indicated by strokes rising from the deck.

Evidence of other buildings of the Norse period has been discovered, and further exploration should produce interesting results.

Technical Aspects of Emulsions

A SYMPOSIUM on the technical aspects of emulsions, organised by the British Section of the International Society of Leather Trades' Chemists, was held on December 7 at University College, Gower Street, Prof. F. G. Donnan being in the chair, and the attendance numbering more than two hundred.

Dr. W. Clayton dealt with the subject of emulsions from the point of view of the patent literature, particular mention being made of the modern idea of 'balanced' emulsifying agents with lipophile-hydrophile groups, and several patent specifications claiming the use of a preformed emulsion as an emulsifying agent of unusual virtue. Dr. R. M. Woodman discussed the problem associated with the preparation of emulsions for horticultural spraying. The formation of opposite type emulsions with one pair of liquids and the same emulsifier, the stability to ageing and to subsequent mechanical treatment of the two types in dual systems near the common phase volume ratio, and the danger to plants arising from the use of these dual emulsion systems were some of the main points discussed.

Emulsions and emulsification in the wool textile industry were the subjects of the contribution by Dr. J. B. Speakman and Dr. N. H. Chamberlain, and it was shown that the ease of removal of thin films of oil from textile fabrics is determined by adhesion phenomena as well as by the magnitude of the oil-water interface. Dr. J. W. Corran raised some interesting points in connexion with the manufacture of mayonnaise, a typical food emulsion. Egg yolk, due to the lecithin present, is the most effective edible substance in the preparation of the emulsion, but another substance, cholesterol, antagonises this action. The superiority of fresh egg as compared with preserved yolk is due not only to hydrolytic changes in the lecithin on keeping, but also to the increased relatively unfavourable influence of the cholesterol. The mustard used in manufacture confers an added margin of stability on the product. The influence of the method of mixing, etc. was discussed at some length.

Mr. R. I. Johnson described various types of agitators, colloid mills and homogenisers used in the production of industrial emulsions. The chief factors influencing the design of homogeniser pump systems and the homogenising valve were considered and reference was made to two-stage homogenisation. Mr. R. Dorey detailed some work on the effect of the mode of preparation on the dispertion of soap-stabilised emulsions, taking as examples emulsions of (*a*) olive oil with sodium oleate and (*b*) arachis oil and potassium oleate. The results given in the form of size frequency analyses indicate that the dispersion of this type of soap-stabilised emulsion is improved if the soap is allowed to be formed *in situ* during the emulsification process.

The mechanism of emulsification was dealt with by Prof. H. Freundlich. The stabilising influence of gases on emulsions produced by ultrasonic waves is most likely a secondary effect, thin layers of gas on the surface preventing or retarding the coalescence of the droplets. Ultrasonic waves acting upon an emulsion (or a coarse suspension) in a thick-walled capillary tube cause striations owing to stationary longitudinal waves in the liquid. In the nodes of these striations large drops are formed, presumably owing to an orthokinetic coagulation of the droplets when travelling from the antinodes to the nodes. It is probable that the facts which are instrumental in the formation and destruction of emulsions by ultrasonic waves are of general importance when producing emulsions by any mechanical means.

Dr. L. A. Jordan discussed the stability of emulsions in thin films with special reference to emulsion paints of the oil-in-water type. The emulsifying agent is absorbed upon the oil-water interface, and the conditions of formation of the interfacial layer determine the ageing effects produced on emulsions. One necessary condition is adsorption in one phase and solution in the other of the emulsifying agent forming the interface, while stability is dependent upon the formation of a tightly packed orientated stable monomolecular layer.

L. G. Gabriel detailed the methods of preparing asphaltic bitumen emulsions. He mentioned that it has been established that high viscosity emulsions prepared from some bitumens are due to the presence in the bitumen of finely divided water-soluble substances which serve to produce an osmotic equilibrium between the solutions, which they form inside the dispersed bitumen particles, and the bulk aqueous phase without. This work has led to a means of varying the viscosity of such emulsions without changing the bitumen content. Emulsions in the leather industry was the subject of the contribution by W. R. Atkin and F. C. Thompson. The process of fat-liquoring consists of two stages, first the absorption of oil from the dilute emulsion, and the electrical

discharge of oil droplets, and secondly the breaking of the absorbed emulsion by acid and by basic chromium compounds in the interior of the leather.

A valuable application of emulsions to medical science was afforded by a paper by V. G. Walsh and A. C. Fraser on the use of highly dispersed emulsions in the treatment of toxæmic conditions. It dealt in the main with the practical application of the observation that if very large doses of toxin are incubated at body temperature for half an hour with olive oil-soap emulsion, they are rendered non-toxic when injected intravenously. This has been made the basis for the treatment of toxæmic conditions, and more particularly of lobar pneumonia. Other points discussed were the selective adsorption of toxin by emulsion and the administration of vaccines and certain drugs in combination with emulsion, which enabled larger doses to be given without the usual effects of overdose, etc.

H. B. Stevens and W. H. Stevens dealt with the question of rubber latex, and pointed out that much scientific investigation is still required to elucidate the facts underlying all the commonly used processes for coagulating rubber latex.

University and Educational Intelligence

BIRMINGHAM.—With the object of creating a memorial to the late Sir Bertram Windle, first professor of anatomy and first dean of the faculty of medicine in the University, Sir Charles Hyde has given £5,000 towards the cost of the new dissecting room to be built at the new medical school on the understanding that it shall be called the "Bertram Windle Dissecting Room". Sir Charles has also given £300 to found a 'Windle prize' to be competed for by students in the Department of Anatomy. In his letter to the Pro-Chancellor, Sir Charles writes: "I am glad to offer these donations as I realise that they will not only carry out the object I have in mind but will also to some extent assist in the finance of the new Medical School which is naturally causing some anxiety to the Council and to yourself."

CAMBRIDGE.—W. S. Mansfield, Emmanuel College, has been appointed director of the University Farm.

Dr. W. B. Lewis has been elected to an unofficial (Drosier) fellowship for research in physics at Gonville and Caius College.

UNEMPLOYMENT among teachers is serious throughout the United States. In a recent report by the New York City Board of Education examiners, it is stated that applicants now on the eligible list have waited so long and are presumably so rusty that new examination should be required before they are appointed. The report adds that their attitude toward education, toward society, toward life itself is unquestionably antagonistic and many have embraced a radical social and political philosophy. Among the teachers there is a prevalent opinion that the fundamental industries of providing food, clothing, warmth and shelter should be divorced from profit and be conducted solely for the general welfare, as are lighthouses, highways, parks and schools. Not only so, but their National Education Association proposes they should teach this doctrine in the schools.

Science News a Century Ago

Resources and Statistics of Nations

"Under the above title," said the *Times* on December 17, 1834, "the first part of a work which promises to be a very useful one has just made its appearance. It is the undertaking of John M'Gregor Esq. F.S.S. . . . This new work on statistics confines itself to facts, and presents to its readers a collection of tables of the physical aspect, area, civil and natural divisions of countries, population, produce of mines, of agriculture, of forests, etc.; of manufactories and fisheries etc.; military and naval forces, seaports, colonies, roads, bridges, canals and, in short, of everything connected with the science of political economy, of every nation on the globe; which tables are the result of much personal observation and of the most authentic public and private documents which are furnished by the Governments of the different countries, and by the most accurate writers by whom the science has been illustrated. . . . The work which is about to be translated into the French and German languages . . . is at once concise, perspicuous and comprehensible."

John Macgregor, the author of this work, was born in 1797 and died in 1857. He spent many years in America, in 1840 became joint-secretary of the Board of Trade in London, and in 1847 was elected M.P. for Glasgow.

Dublin and Kingstown Railway

The last railway to be brought into operation in 1834 was that from Dublin to Kingstown. The official opening took place on December 17, and on that day the *Times* correspondent wrote: "This day our Kingstown Railroad opened, under very favourable auspices, crowds thronged the offices at Westland-row and every hour a full train of carriages started 'at high pressure'. Everyone engaged in the works seems in excellent spirits at the satisfactory state of the road, engines, carriages, etc. All the machinery works well as yet, except in one particular: the springs are not sufficiently elastic to prevent sudden shocks when the carriages stop. Three or four gentlemen had on one occasion to-day their heads knocked against each other and the carriage doors, and severe contusions were the consequence. A county of Kildare gentleman's head was laid open. The majority had, however, hard Irish heads and did not mind a few knocks. The directors have prepared a splendid entertainment at Kingstown for their friends and the subscribers to the undertaking. The weather is delightful for December, and a few broken heads does not throw much damp on a scene of Irish amusement where everything else goes well."

Elections to the Royal Society

At a meeting on December 18, 1834, Sir Benjamin Brodie in the chair, thirteen additional candidates were elected into the fellowship, making a total of fifty elected in the course of the year. Their names were: the Rev. John Barlow, the Rev. James William Bellamy, William Brockedon, Thomas Galloway, Dr. Bisset Hawkins, Andrew Leith Hay, Francis Kiernan, George Lowe, Richard Owen, Benjamin Phillips, Richard Saumarez, Charles John Tynte, John Gardner Wilkinson.

The list is noteworthy for the inclusion of two candidates who afterwards each achieved the

distinction of the Copley medal, namely, Francis Kiernan (1836) and Richard Owen (1851). In medical science the former made important contributions respecting the structure of and circulation through the liver. He was one of the founders of the University of London. [Sir] Richard Owen, at the time of his election, was assistant conservator, Royal College of Surgeons, and lecturer in comparative anatomy at St. Bartholomew's Hospital. Most of his early papers were read before the Zoological Society; in 1832, however, the Royal Society published (*Phil. Trans.*) his elaborate study entitled, "On the Mammary Glands of the *Ornithorhynchus paradoxus*". Owen became first Hunterian professor (1835); and superintendent of the Natural History Department, British Museum (1856). In the "Life" of Darwin it is recorded that Owen, a strong opponent of Darwin's views, contributed "a bitter and anonymous article on the 'Origin of Species' to the *Edinburgh Review* of 1860".

The *Beagle* Leaves the Chonos Archipelago

On November 10, 1834, the *Beagle* sailed southward from Valparaiso to survey the Chonos Archipelago as far south as the Peninsula of Tres Montes. The survey occupied about a month and on December 18 Darwin wrote: "We stood out to sea. On the 20th we bade farewell to the south, and with a fair wind turned the ship's head northward. From Cape Tres Montes we sailed pleasantly along the lofty weather-beaten coast, which is remarkable for the bold outline of its hills, and the thick covering of forest even on the almost precipitous flanks. The next day a harbour was discovered, which on this dangerous coast might be of great service to a distressed vessel. It can easily be recognised by a hill 1,600 feet high, which is even more perfectly conical than the famous sugar-loaf at Rio de Janeiro. The next day after anchoring, I succeeded in reaching the summit of this hill. It was a laborious undertaking, for the sides were so steep that in some parts it was necessary to use the trees as ladders. There were also several extensive brakes of the Fuchsia, covered with its beautiful drooping flowers, but very difficult to crawl through. In these wild countries it gives much delight to gain the summit of any mountain. There is an indefinite expectation of seeing something very strange, which, however often it may be balked, never failed with me to occur on each successive attempt. Everyone must know the feeling of triumph and pride which a grand view from a height communicates to the mind. In these little frequented countries there is also joined to it some vanity, that you perhaps are the first man who ever stood on this pinnacle or admired this view."

Dundonald's Rotary Steam Engine

The *Mechanics' Magazine* of December 20, 1834, contains an illustrated account of the rotary steam engine invented by the famous naval commander Thomas Cochrane, tenth Earl of Dundonald (1775–1860): "We give a place to the present description of it in our pages," said the *Mechanics' Magazine*, "for two reasons . . . first because of the considerable talk about it owing partly to the celebrity (for other things than machine inventing) of the noble inventor, and partly to his prodigiously confident representations of its amazing capabilities, and secondly because if we are wrong in the opinion we have formed of it . . . it would be a thousand pities that the knowledge of an invention, calculated to confer so much benefit on the mechanical world, and to save so much trouble and mortification to hundreds of ingenious mechanics, who are now occupied with the solution of that problem of *which it is said to furnish the best possible practical solution*, should not be as speedily and as widely diffused as possible." Later on, Dundonald was allowed to fit one of his rotary engines in H.M. Paddle Sloop *Janus*, but it proved a failure and was removed from the ship. This engine formed the subject of one of the many reports which Airy, the Astronomer Royal, from time to time made at the request of the Admiralty.

Societies and Academies

PARIS

Academy of Sciences, November 5 (*C.R.*, 199, 897–988). JEAN TILHO: Two sketches concerning the final capture of the Lagone and its consequences for the Tchad basin. Sketch maps illustrating the author's previous communication on the same subject, and further remarks on the serious consequences which would result in the Tchad area. MARIN MOLLIARD: Heather and mycorrhiza. Results on the culture of *Calluna vulgaris* under aseptic conditions: the views of Rayner as to the necessity of the presence of a mould for normal growth are not confirmed. CHARLES ACHARD, AUGUSTIN BOUTARIC and JEAN BOUCHARD: The action of sera on the fluorescent power of solutions of uranine. The fluorescent power of uranine solutions is unaffected by the addition of normal sera (horse, man), and this is also the case with sera from subjects suffering from various diseases. The blood of cancerous patients, however, causes a marked reduction of fluorescence. JULES HAAG: Self-maintained oscillations. J. CABANNES: Theoretical considerations on the luminescence of the upper layers of the atmosphere. The luminosity of the night sky is regarded as a phosphorescence phenomenon in a gaseous mixture of metastable nitrogen, ozone, oxygen and water vapour. HENRI DEVAUX and JEAN CAYREL: The influence of temperature on the electrical conductivity of cupric sulphide in thin layers. The considerable changes in the conductivity of thin layers of cupric sulphide produced by a rise of temperature are attributed to loss of water. LUCIEN DANIEL: Deficient seeds in the grafted Jerusalem artichoke. E. J. GUMBEL: The paradox of the limit age. DAVID WOLKOWITSCH: A generalisation of a theorem of Monge. ALFRED ROSENBLATT: The application of Picard's method of successive approximations to the study of equations of the second order, elliptical and non-linear, with three independent variables. CORNELIS VISSER: The angular derivative of univalent functions. HENRI CARTAN: Pseudo-conformal transformations of the topological product of two domains. TCHANG TE-LOU: A new method for the study of detonation in the motor. It is not sufficient to measure the maximum pressure produced by the detonation: the variation of dp/dt with the time is a better measure of the shock. An apparatus is described which records the curve dp/dt as a function of time. Reproductions of four of these curves are given, showing the effect of advancing the spark. DANIEL BARBIER: The reality of the correlation observed between the eccentricities and periods of double stars. A discussion of the views

of C. K. Seyfert. From a discussion of additional data, the author can neither confirm nor deny the conclusion of the reality of this relation. RAYMOND LAUTIÉ: The density and molecular constitution of a normal pure liquid. WOJCIECH SWIETOSLAWSKI and JOSEPH SALCEWICZ: The application of Newton's laws of cooling to the measurement of very small thermal effects. The method described has been applied to the determination of the heat produced by a specimen of pitchblende. The temperature change was of the order of 0·0034° per hour. EMILE SEVIN: Waves, spin and numbers. J. SAVARD: The ionisation potentials and energies of formation of some halogen molecules. JEAN SAVORNIN: The influence of the reflective power and sharpness of the edge of a screen on distant refraction. MLLE. C. CHAMIÉ: The supplementary radiations in the recoil of the active deposit of thorium. JULES GUÉRON: The Raman spectrum, constitution and evolution of solutions of stannic chloride. MLLE. MARIE LOUISE DELWAULLE: The system bismuth iodide, potassium iodide, water. PIERRE LOCUTY and PAUL LAFFITTE: The system sulphuric acid, ammonium sulphate, water. PICON: The preparation and properties of ammonium, calcium and quinine aurothiosulphates. A. PERRET and R. PERROT: The reactional aptitude of sodium amide. Study of the reactions of sodium amide with cyanogen, phosgene and sulphuryl chloride. CHARLES DUFRAISSE and MAURICE LOURY: Researches on the dissociable organic oxides. 1, 1-Diphenyl-3, 3-dicarbethoxyrubene. Its dissociable oxide. GEORGES DARZENS and ANDRÉ LÉVY: The fluorine derivatives of butyltoluene and of butyl-*m*-xylene. New fluoro-nitro derivatives smelling of musk. JACQUES FROMAGET: The Trias in the north-west part of the syncline of Sam Neua (Tonkin and Laos). P. ROUGERIE: The harmonic analysis of the diurnal variation of the north-south earth currents recorded at the Parc Saint-Maur Observatory. GEORGES DÉFLANDRE: Microfossils of plankton origin, preserved in the state of organic matter in flints from the chalk. H. COLIN: The starch of the Florideæ. This has properties intermediate between those of true starch and glycogen. PIERRE LESAGE: The heredity of acquired precocity in *Lepidium sativum*. MLLE. JEANNE LÉVY: Experimental alcoholism. The mechanism of growing used to alcohol. From experiments on the rat it is concluded that there is no acceleration in the oxidation of the alcohol: the effect is due to a reduction in the sensibility of the cells of the brain. ANTOINE MAGNAN: Contribution to the study of flight in birds. MARC DE LARAM-BERGUE: Self-fertilisation and cross-fertilisation in *Bullinus contortus*. P. CHEVEY: The vertical distribution of the ichthyological fauna near the eastern coasts of French Indo-China. JACQUES POCHON: The rôle of a cellulolytic bacterium of the stomach, in the transformation of cellulose into glucose, in the interior of the digestive tube of ruminants. It is proved that *Plectridium cellulolyticum* is an important factor in the process of digestion of cellulose in ruminants. GASTON RAMON: Experimental antidiphtheric immunisation by means of living diphtheria bacilli.

CAPE TOWN

Royal Society of South Africa, August 15. R. W. S. CHEETHAM, I. SCHRIRE and H. ZWARENSTEIN: Influence of testicular and of urinary extracts on the creatinine excretion in rabbits. Testicular extract increases the excretion of creatinine transiently in the normal rabbit by approximately 40 per cent. Testicular suspensions decrease the creatinine elimination in the normal rabbit by approximately 40 per cent. This too is a transient effect. Injection of urinary extract of the male sex hormone first decreases the creatinine excretion by 30 per cent and then increases the elimination by 30 per cent approximately. This is a diphasic effect, and passes off within four days of the injection. B. G. SHAPIRO and H. ZWARENSTEIN: Effect of hypophysectomy and castration on muscle creatine in *Xenopus laevis*. The average creatine content of the hamstring muscles of the South African clawed toad is 400 mgm. per 100 gm. Removal of anterior or both lobes of the pituitary produces a steady decline in muscle creatine. Five months after operation the hypophysectomised animals contain an average of 18 per cent less creatine than the captive control animals. Removal of the testes or of the ovaries has no effect up to five months. S. HONIKMAN, H. A. SHAPIRO and H. ZWARENSTEIN: The bio-assay of the gonadokinetic principle of the anterior pituitary. A curve has been constructed relating dosage of an acid extract of anterior pituitary (sheep and goats) to percentage response (ovulation plus oviposition) in *Xenopus laevis* during July (breeding season). Fifty animals were used for each point: they were kept at 18°–20° C.; readings were taken twenty-four hours after injection; laboratory age of animals did not exceed two weeks. The unit is defined as the amount of original tissue required to produce a 50 per cent response. This was found to be 3·8 mgm., that is, 263 units per gram. BENJAMIN FARRINGTON. Vesalius on china-root. Extracts from a letter of Andreas Vesalius to Dominus Joachim Roelants written at Ratisbon, June 13, 1546. At this time China-root (that is, China-smilax, a species of sarsaparilla) had an enormous reputation as a specific for various diseases. Vesalius, in lively and sarcastic style, exposes the inadequacy of the basis on which this reputation rested.

VIENNA

Academy of Sciences, Oct. 25. KARL GROBBEN: Decapod sperm and the position of Eucyphidea in the genealogical tree of the decapod Crustacea. JOSEF HARAND: Critical temperature as a microchemical characteristic. A heating block for the safe and rapid determination of critical temperatures is described. A streaming microscope is used which allows quantities of material as small as 0·1–0·05 mgm. to be employed. Prud'homme's formula for chlorine derivatives of the paraffin series is confirmed, the critical temperature of methane being calculated to be 186·6°. The values for *n*-, *i*-, and commercial butanes are given, and it is shown that a substance gaseous at the ordinary temperature may be identified and its purity determined by means of its critical temperature. Examination of binary systems is also possible. ALFRED PISCHINGER and WILLY HORNIK: Influence of indifferent neutral salts on substantive histological staining. OTTO SCHINDLER: The kidneys of the larvæ of sea fish.

Oct. 31. FRITZ RIEDER: Wilson chamber studies of the ultra-radiation on the Hafelekar (2,300 metres). With the help of Wilson diagrams, a statistics of the electrons liberated by ultra-radiation, as regards their energy and—with some degree of probability—the sign of their charge, is developed. Observations

were made also on heavy corpuscular rays, the liberation of which by ultra-radiation appears established; these have ranges of 0·6 cm. to at least 5·5 cm., calculated to 15° C. and 760 mm. pressure, but their nature and the mode of their formation remain unknown. FRIEDRICH LAUSCHER: Thermal radiation and restriction of horizon. Radiation of basins, valleys and lanes. (1) A general method for deducing the radiation from any surfaces.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Saturday, December 15

BRITISH PSYCHOLOGICAL SOCIETY, at 3. Annual General Meeting.

Sunday, December 16

BRITISH MUSEUM (NATURAL HISTORY), at 3 and 4.30.—M. A. Phillips: "Fossil Mammals".*

Monday, December 17

BRITISH MUSEUM (NATURAL HISTORY), at 11.30.—Dr. W. T. Calman: "The Shipworm".*

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Discussion on "Population Maps" to be opened by Prof. C. B. Fawcett.

Tuesday, December 18

EUGENICS SOCIETY, at 5.15—(at the Linnean Society, Burlington House, W.1).—Dr. Shepherd Dawson: "Disease and Intelligence".

Wednesday, December 19

BRITISH SCIENCE GUILD, at 5 (at the Royal Society of Arts, John Street, Adelphi, London, W.C.2). Col. M. O'Gorman: "Bringing Science into the Road Traffic Problem".

Official Publications Received

GREAT BRITAIN AND IRELAND

Department of Scientific and Industrial Research. Industrial Research Exhibit: a Guide to Stands 6 to 34, Cardiff Engineering Exhibition, 1934, under the auspices of the South Wales Institute of Engineers. Pp. 20. (London: Department of Scientific and Industrial Research.)

Proceedings of the Third International Locust Conference, London, September 18, 1934. (Cmd. 4725.) Pp. 184. (London: H.M. Stationery Office.) 3*s*. 6*d*. net.

Year Book of the University Catholic Societies Federation of Great Britain, 1934–1935. Pp. 96. (Glasgow: Hon. Secretary, 13 Fortrose Street.) 1*s*.

Rothamsted Experimental Station, Harpenden: Lawes Agricultural Trust. Report for 1933. Pp. 200. (Harpenden: Rothamsted Experimental Station.) 2*s*. 6*d*.

Natural Science and Archæology Society, Littlehampton. Reports of Proceedings, 1933. Pp. 22. (Littlehampton.)

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Year ended 31st March 1934; with Report of the Director of Fuel Research. Pp. vii+178. (London: H.M. Stationery Office.) 3*s*. net.

University of Durham. Abstracts of Theses for Doctorates presented by Candidates who have received the Degrees in Convocation during the Academical Year 1933–1934. Pp. 12. (Durham.)

Transactions of the Royal Society of Edinburgh. Vol. 58, Part 1, No. 11: The Early Stages in the Development of the Ferret; Fertilisation to the Formation of the Prochordal Plate. By Dr. William J. Hamilton. Pp. 251–278+7 plates. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 6*s*.

The Royal Technical College, Glasgow. Annual Report on the One Hundred and Thirty-eighth Session adopted at the Annual Meeting of Governors held on the 16th October 1934. Pp. 84. (Glasgow.)

The North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1933–34. Pp. 36. (Aberdeen.)

A Review of the Experimental Working of the Five Days Week by Boots Pure Drug Company at Nottingham. By Sir Richard A. S. Redmayne. Pp. 70. (Nottingham: Boots Pure Drug Co., Ltd.) 1*s*.

The Scientific Proceedings of the Royal Dublin Society. Vol. 21 (N.S.), No. 13: The Measurement of the Current generated by Rectifier Photo-Cells. By H. H. Poole and W. R. G. Atkins. Pp. 133–139. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d*.

OTHER COUNTRIES

Scientific Reports of the Imperial Institute of Agricultural Research, Pusa (including the Reports of the Imperial Dairy Expert, Physiological Chemist and Sugarcane Expert), 1932–33. Pp. v+203+4 plates. (Delhi: Manager of Publications.) 4.12 rupees; 8*s*.

The Indian Forest Records. Vol. 20, Part 11: New Termites from India. By Thomas E. Snyder. Pp. ii+28. (Delhi: Manager of Publications.) 9 annas; 1*s*.

Carnegie Institution of Washington. Publication No. 436: Contributions to American Archæology. Vol. 2, Nos. 5 to 12. Pp. iii+355+38 plates. (Washington, D.C.: Carnegie Institution.)

Advisory Department of the Imperial College of Tropical Agriculture. Report on the Agricultural Department, St. Lucia, 1933. Pp. iv+51. (Castries, St. Lucia: Government Printing Office.) 6*d*.

Publications of the Dominion Observatory, Ottawa. Vol. 12: Bibliography of Seismology. No. 2 (Items 2131–2244): April, May, June, 1934. By Ernest A. Hodgson. Pp. 27–44. (Ottawa: King's Printer.) 25 cents.

U.S. Department of Agriculture. Miscellaneous Publication No. 198: An Annotated Bibliography of the Hessian Fly, *Phytophaga destructor* (Say). By J. S. Wade. Pp. 100. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the California Academy of Sciences, Fourth Series. Vol. 21, No. 17: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 17: The Hepaticæ (chiefly Riccia and Anthocerotaceæ) of the Galapagos Islands and the Coast and Islands of Central America and Mexico. By Marshall A. Howe. Pp. 199–210+plate 7. Vol. 21, No. 18: The Templeton Crocker Expedition of the California Academy of Sciences, 1932. No. 18: Lichens. By David H. Linder. Pp. 211–224+plate 8. (San Francisco.)

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Director of Agriculture for 1933. By Dr. W. Youngman. Pp. 184. (Colombo: Government Record Office.) 2 rupees.

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 3, Part 8: The Cambro-Ordovician Formations and Faunas of South Chosen—Palæontology, Part 1: Middle Ordovician Faunas. By Teiichi Kobayashi. Pp. 329–519+44 plates. 3.50 yen. Vol. 3, Part 9: The Cambro-Ordovician Formations and Faunas of South Chosen—Palæontology, Part 2: Lower Ordovician Faunas. By Teiichi Kobayashi. Pp. 521–585+8 plates. 1.00 yen. (Tokyo: Maruzen Co., Ltd.)

Meddelanden från Lunds Observatorium. Ser. 2, Nr. 67: Catalogue of Auroræ borealis observed in Northern Sweden during the Time August 1932–March 1933. By Axel Corlin. Pp. 51. Ser. 2, Nr. 68: Studies on the Stream Motions of the Stars. By W. Gyllenberg. Pp. 114. 9.00 kr. Ser. 2, Nr. 69: Analytical Theory of Regression. By S. D. Wicksell. Pp. 32. 2.50 kr. Ser. 2, Nr. 70: Studies of the Effective Wave-Lengths of Stars. First Paper: Effective Wave-Lengths of 659 Stars in Messier 37 from Plates taken at Mount Wilson. By Jöran M. Ramberg. Pp. 39. 4.00 kr. (Lund.)

Memoirs of the Commonwealth Solar Observatory. Memoir No. 4: Atmospheric Potential Gradient Observations at the Commonwealth Solar Observatory, Mount Stromlo, Canberra. By C. W. Allen. Pp. 47. (Canberra: Government Printer.)

Journal of the Indian Institute of Science. Vol. 17A, Part 8: Utilisation of Indigenous Tanning Materials, Part 1: Manufacture of Tannin Extract from Avaram Bark (*Cassia auriculata*, Linn.). By Keshaviah Aswath Narain Rao and Shaha L. Janniah. Pp. 95–104. 14 annas. Vol. 17A, Part 9: Estimation of Potassium by the Cobaltinitrite Method. By S. D. Sunawala and K. R. Krishnaswami. Pp. 105–112. 12 annas. (Bangalore.)

The Indian Lac Research Institute. Bulletin No. 19: The Heat Curing of Shellac, Part 2: "Depolymerisation". By M. Rangaswami and R. W. Aldis. Pp. 10. 1 rupee. Bulletin No. 20: Further Notes on the Use of *Schleichera trijuga* (Kusum) in Lac Cultivation. By Dorothy Norris; with an Appendix by P. M. Glover. Pp. 4. 8 annas. Bulletin No. 21: A Check List of the *Chalcidoidea* bred at Nankum from the Lac Insect *Laccifer lacca*, with some Notes as regards their Function, Economic Importance and Control. By P. M. Glover. Pp. 14. 1 rupee. (Bangalore.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 86. Fishes obtained by Mr. H. W. Bell-Marley, chiefly in Natal and Zululand in 1929 to 1932. Pp. 405–514. (Philadelphia.)

National Research Council: Division of Geology and Geography. Report of the Committee on the Measurement of Geologic Time, presented at the Annual Meeting of the Division of Geology and Geography, April 28, 1934. Pp. ii+86. (Washington, D.C.: National Research Council.)

Descriptive Catalogue of the Collection of Microscopes in charge of the Utrecht University Museum, with an Introductory Historical Survey of the Resolving Power of the Microscope, by P. H. Van Cittert. Pp. 110. (Groningen: P. Noordhoff.) 2.90 f.

Bulletin of the American Museum of Natural History. Vol. 67, Article 8: Chalicotheres from Mongolia and China in the American Museum. By Edwin H. Colbert. Pp. 353–387. (New York City.)

Journal of Science of the Hiroshima University, Series B, Div. 2 (Botany). Vol. 2, Article 2: Monographia Hepaticarum Australi-Japonicarum. By Yoshiwo Horikawa. Pp. 101–325+plates 11–21. (Tokyo: Maruzen Co., Ltd.) 2.10 yen.

Canada: Department of Mines: Mines Branch. Investigations in Ore Dressing and Metallurgy (Testing and Research Laboratories), January to June 1933. (No. 743.) Pp. iii+157+4 plates. (Ottawa: Government Printer.)

Carnegie Institution of Washington. Publication No. 415: Contributions to Palæontology—Studies of the Pleistocene Palæobotany of California. Pp. iii+179+31 plates. (Washington, D.C.: Carnegie Institution.)

CATALOGUES

Forced Air Circulation Furnaces. Pp. 12. (London: Wild-Barfield Electric Furnaces, Ltd.)

Catalogue de Livres anciens et modernes rares ou curieux relatifs à l'Orient. (No. 28.) Pp. 62. (Paris: Libr. Adrien-Maisonneuve.)