NATURE

SATURDAY, APRIL 14, 1934

No. 3363 Vol. 133

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Editorial and Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET, LONDON, W.C.2
Telephone Number: WHITEHALL 8831
Telegraphic Address: PHUSIS, LESQUARE, LONDON

Agricultural Marketing Boards in Great Britain

THE marketing of agricultural produce is much more difficult than that of factory produce. The time element dominates production: in spite of all advances in science, a cow still takes nine months to produce a calf, and a ewe takes five months to produce lambs; by no known method can these processes be hastened, and still more months have to elapse before either calf or lamb is of much value as food. Seed time and harvest come much as they did a thousand years ago: wheat is still in the ground some eight or nine months before it is ready for cutting. However, while plants and animals move slowly, prices change rapidly, and it has happened frequently in recent years that farmers have started the production of lamb, milk or bacon on perfectly sound methods fully in accordance with the prevailing level of prices, but, long before the commodity was ready for sale, prices had changed so drastically as to involve the farmers in heavy financial loss. Obviously, science could do nothing to help: the trouble was purely economic.

Further, until recently, farmers produced only one or two commodities on contracts; in the main they produced simply in hope of a favourable market. Only because they happened to be thrifty people trusted by merchants and bank managers has it been possible for them to keep going during the past few years.

Until a few months ago, the agricultural situation had been rapidly getting worse, and even the most stable farmers in Great Britain found themselves in financial difficulties. An agricultural crisis at the present juncture had obviously to be avoided, and the Minister of Agriculture went straight to the heart of the matter and took economic measures to deal with an economic problem. Improvements in marketing were worked out.

Two types of methods have been adopted. For wheat, the farmers of Great Britain are guaranteed a definite share of the home market at a definite price level. The share is called the 'quota', and the difference between the agreed price and the ultimate market price is borne on the general wheat account of the country and not by the Exchequer. Actually there has been no appreciable rise in price of bread, but the quota, while sufficient for agriculture, is only a small part of our total consumption, so that disparities in price between English and imported wheat would scarcely be

likely to have much effect on the price of the final loaf.

For meat, milk and potatoes, other methods were adopted. We already produce something like half our total meat supply, the whole of our liquid milk, and almost the whole of our potatoes. Any increase in price paid to the farmer would therefore be felt sharply by the consumer, to whom the distributor would certainly pass it on. The method adopted has been to set up 'Marketing Boards' to assure that the produce of the British farmer, at any rate up to a specified total, should find a market. The details of working do not concern us here: they have necessarily to vary with the commodity. There is a general disposition among farmers to accept the schemes, with all the restrictions they imply. The farmer is now finding that under these new conditions he cannot produce what he likes and sell how he likes; having accepted the protection of the new Boards he must conform to their regulations. The result is virtually to put agricultural production on to a contract basis, just as most manufacturing production is done, but the farmer is in the somewhat more favourable position that he can, if necessary, produce much of his own raw materials.

It is obviously essential to the success of the scheme that production should be as economical and efficient as possible, and that all wastes and losses should be reduced to a minimum. Power has therefore been given to the Boards to undertake or foster scientific research wherever this is deemed necessary. This provision need not, and should not, cut across existing provision made by the Ministry of Agriculture and financed out of the Development Fund. There are at present some twelve research institutes, at Rothamsted, Cambridge, Oxford, Aberdeen, Reading, Long Ashton, East Malling, and elsewhere, concerned with research into the various aspects of agricultural science and practice: soils, plant nutrition, plant pathology, plant genetics, animal nutrition, animal health, animal genetics, dairying, fruit and others. These institutes exist for the purpose of gaining knowledge, which is then (in principle, at any rate) passed on to the county agricultural staffs to be sorted out by them, so that information of interest to the farmers of any particular region may be given to them. Various methods are adopted by the different institutes for actually effecting the transmission of information, and it is admittedly a difficult business, but it is done.

The powers now conferred upon the Marketing Boards will enable them to keep in touch with the research institutes and ensure the systematic collection and dissemination of existing knowledge, and the completion of work necessary for filling gaps. The Potato Marketing Board, for example, will certainly find that a great deal remains to be discovered about the growth and storage of potatoes. A conference was recently called at Rothamsted, dealing with these very problems, and by a fortunate circumstance its chairman was also chairman of the Potato Marketing Board. But the papers and the discussion revealed many important problems on which existing information is quite inadequate. More will clearly have to be obtained, but the work must be focused on the problems of the potato grower: on the production, the quality, the keeping powers, and the avoidance of diseases and pests of the potato crop.

Two methods will probably need to be adopted by the Boards. The appropriate existing institutes can be strengthened to deal with specific problems: this is not likely to be costly and it will, so far as it goes, be economical and effective. But the second method is at least as important. It is to set up a small experiment station devoted exclusively to the study of the crop concerned and place it in the midst of the chief growing region, so that growers can easily visit it and the staff can keep themselves fully posted in the growers' problems and difficulties.

Three such stations have already been in existence for some time, and their success testifies to the value of the method: the Fruit Research Station at East Malling; the Fruit and Cider Research Station at Long Ashton, Somerset; and the Nursery and Market Garden Research Station at Cheshunt, which devotes itself mainly to tomatoes and cucumbers, the chief products of its district. All these, especially the two former, are larger than would be needed by the Marketing Boards, but the general type would serve well. The Cheshunt Station affords the best model: its committee is appointed partly by the growers and partly by the Rothamsted Experimental Station Committee; its staff is in close touch with Rothamsted and with the Plant Physiology Department of the Imperial College of Science, but at the same time it is so close to the growers that it misses none of their difficulties. It has achieved remarkable success. A Potato Research Station situated in one of the chief potato growing districts, but so organised as to be in close touch with the appropriate research institutes, would

under suitable management be expected to be similarly successful. It is, however, important that the staff should be men of sound scientific training and outlook; the good practical growers already know all that the so-called practical man can teach them, and the only one likely to be of help is the scientific worker experienced enough to show that he can use the tools of science for solving practical problems, and young enough to be able to adapt himself to the conditions of an important industry and to throw himself whole-heartedly into the new work.

Sugar beet is another crop that deserves very serious scientific attention. Happily a research scheme has now been set on foot in which the sugar beet factories are co-operating with Rothamsted, the National Institute of Agricultural Botany, the Oxford Institute of Agricultural Engineering, and the Norfolk Agricultural Station, each of which undertakes a particular group of problems. For the moment the scheme is only on a year-to-year basis and so it loses the efficiency that comes only with a longer time basis; nevertheless, the fact that it is working shows a sound spirit of appreciation of the value of scientific assistance for its growers on the part of those responsible for the factory organisation.

The Endocrine Glands

The Tides of Life: the Endocrine Glands in Bodily Adjustment. By Dr. R. G. Hoskins. Pp. 352+8 plates. (London: Kegan Paul and Co., Ltd., 1933.) 15*s.* net.

THIS little book has been written by the Director of Endocrine Research in the Medical School of Harvard University, and we must congratulate the author on his performance. He has produced an admirably written manual which will be of the greatest service to all desiring the latest information about the structure and functions of the endocrine glands. What especially awakens our admiration is the note of scepticism and caution which colours his language when he is relating the latest extravagances of those endocrinologists who claim to be able to resolve character and personality into endocrine chemistry. This same caution leads him to view with grave doubt the theory of Sir Arthur Keith that the structural differences between human races are due to differences in endocrine development. He points out that, according to this theory, the Negro should exhibit defective sexuality, since Keith attributes this melanism to a defective adrenal development, but it is notorious that the very opposite is the case.

Our chief complaint against the author is that he has a strong tendency to over-estimate the part played by his countrymen in this field of research. The diagnostic feature of an endocrine gland is that it produces a hormone: and it is only on page 300 that we reach a brief account of the foundation research of Bayliss and Starling which initiated this whole province of biological investigation, and it is mentioned quite casually—"indeed the word hormone was first used in connection with this research". Assuredly it was: Bayliss and Starling invented the term and defined what they meant by it.

It seems to us, too, that the author loses his usual caution in his enthusiasm for some very recent results obtained by American workers—as, for example, those of Cannan. When we are told that an animal suffers no inconvenience when its entire chain of sympathetic ganglia is cut out, most of us will become deeply thoughtful—and wait.

The author raises some extremely interesting questions during his discussions, and to two of these we propose to allude briefly. The first of these concerns the constitution of the cells which make up the male and female bodies respectively. On the sex-chromosome theory the tissues of male and female should have different growth capacities, since the nuclear constitution in all the cells of the male body is different from what it is in those of the female. But as the author remarks, this difference must be potential only, for these tissues obstinately refuse to produce the appropriate secondary sexual differences unless they are flooded with the sexual hormones. But he could have gone further and said that grafting experiments proved that the tissues of both males and females with judicial impartiality will produce the secondary sexual organs of *either* sex if exposed to the action of the appropriate hormone, so that the difference in nuclear constitution seems to be without effect.

Another question discussed by the author is the evolutionary origin of the endocrine organs. How did a tiny group of cells, constituting a minute fraction of the substance contained in the body, acquire its tremendous powers? On the 'chance' theory of the origin of variations, how did Nature chance to construct organs of such enormous potency? Now in the case of two of the most important of these organs, comparative embryology

has supplied the answer and has shown that here, as in all properly analysed cases of evolution, development has been slow, functional and continuous.

The thyroid gland of *Amphioxus* begins as a growth, the so-called endostyle, in the mid-ventral line of the pharynx: this groove carries lines of ciliated cells and intervening lines of mucus-producing cells. By their joint aid a cord of mucus is produced which is worked forwards to the mouth, where it is broken up into a network of filaments by the inrushing current of water produced by the cilia lining the gill slits. The tiny organisms, plant and animal, borne in the water are entrapped and the net with its living prey carried back to the intestine and swallowed. The iodine necessary to all animals is thus secured, since the microscopic plants are a potent source of it. (It is curious to find the author describing the endostyle of *Amphioxus* as a "pouch of the gut producing a mucus which probably aids digestion". Such an answer given by an English medical student sitting for his first M.B. examination would get a very black mark from his examiner.) There is nothing mysterious about the thyroid or 'endostyle' of *Amphioxus*. Similar adaptations are found in a number of aquatic invertebrates belonging to quite different classes—such as bivalves and gastropods amongst the Mollusca—and their purpose is the same as that of the endostyle.

In the case of the lamprey, whose larval life is much longer than its adult existence, the endostyle is still present in the larva and functions in the same way as in *Amphioxus*, but now it has become restricted in extent and forms a pouch studded inside with groups of mucus-producing cells, which opens into the pharynx by a narrow opening. In the adult lamprey, the pouch is cut off from the pharynx, and breaks up into a number of mucus-producing vesicles; no longer able to obtain iodine from outside, it must secrete it from the blood.

Here we have the familiar phenomenon of the gradual restriction of powers originally exercised by a wide stretch of tissue to a small portion of it, and the likewise familiar but totally inexplicable phenomenon of Nature learning to produce from the internal resources of an animal something originally obtained from outside. The gas in the air bladder of fish is a case in point. Originally the air bladder was a mere pouch of the pharynx, the use of which was to retain bubbles of air swallowed by the fish when the oxygen tension in the water was becoming low. But it also served to give the fish the power of adjusting its buoyancy, and in the majority of fish the air-bladder is shut off from the throat and the gas contained in it is secreted from the blood. Evans has recently shown that in fresh-water fish in which the connexion with the throat is maintained, only part of the contained air is obtained by swallowing; most of it is secreted by the blood.

The other endocrine organ of which the evolutionary history has been traced is the pituitary body, including both anterior and posterior lobes. This mysterious body has been credited with the production of at least six different hormones. In the ascidian tadpole, however, in which a brain vesicle, distinct from a spinal cord, first makes its appearance, the pituitary appears as a tube connecting the vesicle—not with the digestive system as our author states—but with the stomodæum or ectodermal hall-way to the mouth. At the metamorphosis, the part connected with the mouth becomes cut off from the rest and develops a number of glandular pockets. In a word, the pituitary body was originally nothing more than the anterior neuropore. In the primitive vertebrate, which as we have seen was originally a 'filter-feeder', the current of water drawn in by the cilia of the gills must also have entered the neuropore, and the extreme front end of the nervous system was thus enabled to 'taste' its contents. It thus performed exactly the same function as is exercised by the 'osphradial' ganglia of bivalve Mollusca. Later it derived the substances which it 'tasted' from the blood. Thus the inmost nature of the endocrine organs, as of every other living organ, cannot be elucidated by its structure alone; we must also take into account its evolutionary history. E. W. MacBride.

Scenting the Quarry

Hunting by Scent. By H. M. Budgett. Pp. xi + 122 + 22 plates. (London: Eyre and Spottiswoode, Ltd., 1933.) 25*s*. net.

EVEN a Poet Laureate would find difficulty in expressing the diversity and extent of the influence of fox-hunting. Farmers, breeders, saddlers, tailors, veterinarians, surgeons, painters, sculptors, poets, composers, to name but a few, have been affected in some way or another by Reynard the Fox; and through them, innumerable others are involved. When practical experience in

hunting the fox is blended with a capacity and zest for hunting data, the chase involves the world of science. When, in addition, an ex-Master of the Bicester and Warden Hill Hounds discloses keenness, perseverance, humour, and a great kindliness, the resulting expression is a book which is not merely of scientific interest, but is also endowed with a charm that can only be described by the word English.

The author has succeeded in writing a book "with the object of explaining the fundamental principles of scent in such a manner that they can be grasped by those who have not had the advantage of a scientific training". The scientific fields and coverts surveyed can only be adumbrated here in part: the significance of the sense of smell; conditions under which scent is good or bad; the effects of light, temperature, humidity and wind; inhalation and exhalation by the soil; special experiments and apparatus (for example, the author's electric scent indicator) for determining scent conditions; the nature of trails followed by hounds; the examination of scent trails left by different quarries over various surfaces; the distance over which scent can be detected by various animals; olfactory fatigue; the obliteration and neutralisation of scent tracks; the microscopic examination of the odorous particles forming a track; the bearing of the sense of smell on animal behaviour. Especially to a dog, "smelling is believing", and canines communicate with each other by means of signal posts or "scent-telephones" as described by Seton.

The wealth of subject-matter, whether gleaned from others or from the author's original observations and experiments, is attractively presented and briefly summarised at the end of each chapter. The accompanying photographs and photomicrographs, especially the plates from original drawings by such a distinguished limner of the hunting-field and connoisseur of the fox as is Lionel Edwards, R.I., complete an ensemble forming a quite unique contribution to intellectual and æsthetic enjoyment.

The author has proved beyond all doubt, by means of painstaking experiments, that there must be actual contact between the quarry and the ground, in order to produce a trail which can be hunted by a hound. Thus, a trail of scent of bruised herbage is left when an inodorous weight is dragged along a field, a trail which a bloodhound is able to follow by scent alone after forty-eight hours. "Hunting by Scent" includes many other interesting observations, and also many indications of problems as yet unsolved. The author, artist and publishers have produced an interesting and enjoyable volume. Perhaps not the least contribution to science lies in its stimulation to further exploration of the inexhaustible field of interest of which the sense of smell is the centre.

J. H. K.

"Vulgariser sans abaisser"

The Universe of Light. By Sir William Bragg. Pp. xi+283+26 plates. (London: G. Bell and Sons, Ltd., 1933.) 12*s.* 6*d.* net.

We can, in England, look back on a long list of eminent men of science who, so far from disdaining any attempt to popularise knowledge, have spared no pains to bring home the truths of science to the layman; and the layman has not been inappreciative of these efforts. A series of some half a dozen volumes clothed in red—the Manchester science lectures for the people—tells eloquently of the crowds who thronged to the Hulme Town Hall to hear Roscoe, Clifford, Rucker, Thorpe, Huxley and a score of other famous Victorians elucidate the scientific problems of the time in a way which may seem over-serious to the lighter hearts of to-day, but which, if numbers be any test, was admirably suited to the needs of their hearers. These lectures, born of Roscoe's energy and drive, were a dominating feature in the life of Manchester in the early 'seventies of the last century. In London, Faraday had not long gone from the Royal Institution, Tyndall was at the zenith of his fame, and was irritating the Scots school of physicists by his solemn championship of Mayer. The persistence of force was a phrase still heard; the specific heat of electricity had still some elements of novelty; and the "Descent of Man" was a best-seller. It is all very interesting, and very crinoline-ish; and it is something of a surprise to realise that Boyd Dawkins, doyen of that far away group of Manchester lecturers of the 'seventies, was taking an active part in a British Association meeting some six years ago.

Manchester and London were then two foci of scientific learning. So they are to-day, and we of the nineteen thirties are specially privileged in being able to hear Sir William Bragg's almost magically easy unravelling of the complexities of modern optical science. It was all very well, sixty years since, to explore the field of spectrum analysis, or to argue the question of the formula

of water; the expositor of to-day, faced with an array of photons, neutrons, diplons and positrons, has a different and difficult row to hoe. Sir William accomplishes the feat in a characteristically genial and effortless manner, clinching his appeal to theory by admirably conceived experiments, and stimulating the interest of his hearers (and readers) by illustrations—the laws of perspective, Japanese mirrors, rearlight reflectors, the lustre of sateen, and so forth—which keep us constantly in touch with reality. *Ars est celare artem;* and, as with Boswell's report of the famous dinner episode, it seems very easy until one tries to do it for one's self.

The nature of light, the eye and vision, colour and its origin, the colour of the sky, polarisation, light from the sun and stars, Röntgen radiation, and, finally, the wave and the corpuscle—this outline of the topics treated in the book shows how wide a range is covered by these lectures, which are as delightful to read as they must have been to hear. Reflection at a plane surface in the opening chapter, electron diffraction at the close of the book—it is a long and involved journey which we cover in less than three hundred pages, and there is not a dull moment on the way.

But surely Eros is playing an unaccustomed rôle in astronomy!

Allan Ferguson.

Short Reviews

Proceedings of the American Society for Psychical Research. Vol. 22: *The Margery Mediumship—The "Walter" Hands: a Study of their Dermatoglyphics.* By Brackett K. Thorogood. Pp. xix+228+123 plates. (New York: American Society for Psychical Research, 1933.) n.p.

This volume is a detailed account of certain alleged supernormal phenomena which occur in the presence of the medium 'Margery' (Mrs. L. R. G. Crandon, of Boston, Mass.). They consist mainly in the impressions of thumbs in dental wax, and an account by Dr. R. J. Tillyard of the conditions under which they are produced was printed in Nature for August 18, 1928, pp. 243 ff., where Fig. 6 is a photograph of one of these impressions. In the leading article of the same date it was pointed out how, assuming the accuracy of Dr. Tillyard's observations, we had little reason to deny the medium's power of producing the thumb-prints of anyone either living or dead. Since then the claim has been made that such prints of living persons (for example, Sir Oliver Lodge) have been produced, but the most interesting development is the alleged discovery that the very large number of prints said to have been made by 'Walter' (the deceased brother of the medium and her 'spirit control') are in reality identical with those of a person living in Boston, who formerly attended a number of sittings and first suggested to 'Margery' the use of dental wax as a convenient compound.

In the case of the right thumb-print some forty points of similarity are admitted by both sides: in the case of the left, identity appears to be absolute, although the president of the American Society for Psychical Research now claims that the examples printed previously in the Society's publications were not authentic, being substitutions on the part of one of the leading investigators; through carelessness they were not noticed at the time.

It is clearly impossible here to evaluate the evidence or even to discuss it, since the data on which the various arguments are based are themselves suspect. Indeed, the report illustrates with startling clarity the reasons why the scientific world remains aloof. For from whatever point of view this report may be regarded, it is not only the medium but also the officials themselves who are being denounced as incompetent and guilty of a series of dubious manœuvres.

Encyclopædia of Psychic Science. By Dr. Nandor Fodor. Pp. lv+416. (London: Arthurs Press, Ltd., 1933.) 30*s.* net.

This book, in spite of its somewhat provoking title, is a notable addition to the literature of psychical research. The author, who, it may be said, is clearly inclined to believe far more than the evidence suggests, has nevertheless succeeded in putting together a mass of material which includes many facts pointing to conclusions not in accordance with his own. The impartiality he displays in printing these data is highly commendable, and some good examples of it may be seen in the articles on Eldred and Duguid.

In his preface Dr. Fodor stresses the difficulties of compiling an encyclopædia of this kind, and states that he should have been assisted by an editorial committee. In this we are inclined to agree. Although he is fully capable of presenting his material, he is naturally not quite fully acquainted with it. Thus the article on "ectoplasm" (apart from a few amazing examples of credulity) is an excellent summary; whilst that on the poltergeist is very poor. In the latter article there are several cases from newspapers whereas there is no word of Dibbesdorf, of Stans, or of Oakland, California! Similarly, in the body of the text we find omissions for which it is not easy to account. Among these we would mention Farmer Riley, Abraham Cummings, Nicolai, Staudenmaier and the Gallery of Spirit Art. Although actual mistakes are readily excusable in a work of this size, it is curious that Dr. Fodor should make Patience Worth masculine, Mrs. Abbott and Lulu Hurst

examples of "electric phenomena"; and Imoda an author of a book on psychic photography.

Apart from criticisms of this kind, the book is likely to be of great service to those who wish to gain a general view of some particular aspect of psychical research or to revise a previous acquaintance. The author must certainly be congratulated on the trouble he has taken, although he would be well advised to omit certain of the photographs in any later edition. One of these is instructive. It shows the medium Rudi Schneider when supposed to be controlled by two observers. His right hand is apparently not held in any way. It is a good example of what occurs in 'psychic science'.

A Description of some Trees, Shrubs and Lianes of Southern Rhodesia. By E. C. Steedman. Pp. xxi+191+92 plates. (Gwelo, Southern Rhodesia: Miss E. C. Steedman, Norfolk Farm, 1933.) 7*s.* 6*d.*

MISS STEEDMAN is to be congratulated on having produced a book on the trees, shrubs and lianes of Southern Rhodesia, which should be of great service to residents in the colony and should stimulate an interest in the vegetation of the country and also, it is to be hoped, serve a useful purpose in arresting the destruction of the indigenous timber.

Miss Steedman has worked under considerable difficulties, being away from sources of botanical literature, and, in consequence, some errors in the nomenclature of the plants to which she refers have crept in. This, however, is a minor point which can easily be set right when she has had an opportunity of consulting authorities and literature, should a second edition of the book be called for.

Thanks to the keys and descriptions, it should be possible for anyone interested in plants to be able to identify the native species, and this will be considerably facilitated by the line drawings which are, on the whole, quite useful, though in some cases they have suffered a little in reproduction.

From the purely botanical point of view, some criticisms can be offered, but the main point about the book is its value to residents in Southern Rhodesia. This is enhanced by the inclusion of the native names of the trees and shrubs wherever it has been found possible to assign them to a definite species.

As the work of an amateur with a real love of her subject, the book certainly deserves high commendation.

A Standard Classified Nomenclature of Disease. Compiled by the National Conference on Nomenclature of Disease. Edited by Dr. H. B. Logie. Pp. xvii+701. (New York: The Commonwealth Fund; London: H. K. Lewis and Co., Ltd., 1933.) 21*s.*

THE National Conference (of the United States of America) on Nomenclature of Disease was formed with the object of solving the confusion due to the absence of a standard nomenclature of pathological conditions. It has now produced the system described in this book, a dual method of classifying disease, based on the two features of topography and etiology. The topographical classification gives a code number to every region of the body in which disease can be clinically located; the first numeral indicates the body system, the second the organ, and the third the part of the organ involved. The etiological classification similarly divides all causal factors into groups, which are further subdivided. Any disease or injury has thus a number indicating location hyphened to another indicating cause. The system also allows expression in symbols of obscure, undiagnosed or partially diagnosed conditions.

The book can be strongly recommended to the records departments of hospitals, and as the method advocated requires accurate expression of a diagnosis, its adoption would do immense good in stimulating precise thinking and avoidance of ill-defined terms on the part of clinicians.

A Bibliography of Differential Fertility: in English, French and German. Edited by Eldon Moore on behalf of Commission II of the International Union for the Scientific Investigation of Population Problems. Pp. vi+97. (London: Dr. E. C. Rhodes, London School of Economics, 1933.) 2*s.*

THE compiler of this book is not a biologist but a journalist who, like many other intelligent laymen, has been attracted by the lure of biology and the problems which it involves. For a considerable time he acted as editor of the *Eugenics Review*, the organ of the Eugenics Society. He has produced in this book a most valuable compilation of papers and books dealing with the problems of fertility both in man and animals.

An Elementary Introduction to Physics: Descriptive, Experimental and Historical. By Edgar Booth. Pp. 465+xvi. (Glebe, N. S. W.: Australasian Medical Publishing Co., Ltd.; London: H. K. Lewis and Co., Ltd., 1933.) 5*s.* net.

A BOOK from Australia is to be welcomed, as it is likely to put forward fresh points of view which give hints to teachers of elementary physics in Great Britain. This book is quite elementary in character and practical in type, and the author has avoided the mistake of introducing the ideas of modern physics at this early stage.

Précis d'électricité théorique. Par Dr. Léon Bloch. Deuxième édition, revue et corrigée. Pp. vii+476. (Paris: Gauthier-Villars et Cie., 1933.) 50 francs.

THIS treatise gives an account of classical electrical theory, with modern notation and the use of vector analysis where necessary. It is comprehensive and clear and ends with two important chapters, one on the electrodynamics and the other on the optics of bodies in motion.

Aluminium-surfaced Mirrors

By Dr. H. Spencer Jones, F.R.S.

THE mirrors in astronomical reflecting telescopes were formerly made of speculum metal—a hard alloy of copper and tin capable of taking a fine polish and having a fairly high reflecting power. Speculum metal mirrors have been entirely replaced by glass mirrors, coated on the figured surface with a thin film of silver. The silvered surface, when fresh, has a high reflecting power for wave-lengths greater than 0·375 μ; at this wave-length the reflecting power is 0·80; at 0·400 μ it is 0·85; at 0·450 μ it is 0·90 and at 0·700 μ it is 0·95. On the short wave-length side of 0·375 μ the reflecting power falls off rapidly, owing to selective absorption, to a minimum value at about 0·315 μ of only 0·04. This is a serious disadvantage when observations are required in the ultra-violet region. Thus, for example, at a wave-length of about 0·325 μ the atmospheric transmission is 0·50 but the reflecting power of silver is only 0·12. In a reflecting telescope, the image is normally produced by reflection at two silvered mirrors, so that the loss by the selective absorption of the silver is much greater than the above figures indicate.

These figures refer to a freshly deposited silver film. But the reflecting power steadily falls owing to gradual oxidation or to tarnishing due to the action of sulphur dioxide in the atmosphere. Where such atmospheric contamination is prevalent the reflecting power falls rapidly. At even the most favourable sites, however, there is a gradual fall in reflecting power, so that the mirrors must be periodically dismounted and resilvered. The silver film is easily deposited chemically and though the silvering process itself is not difficult, any satisfactory method of making it unnecessary would be welcomed, for it would imply that the decrease in reflecting power—which necessitates lengthened exposures and is particularly troublesome in some photometric work—had been eliminated. Coating the silver film with a thin film of colourless lacquer has been tried, but the optical perfection of figure is almost inevitably impaired.

The development of a method of coating glass surfaces with a film of aluminium and the unexpected properties of such films are, therefore, of the greatest importance for astronomical observation. For wave-lengths greater than about 0·40 μ, the reflecting power of an aluminium film is somewhat less than that of a freshly deposited silver film. The difference is not, however, very great; at a wave-length of 0·50 μ the reflecting power of the aluminium film is 0·88 as compared with 0·91 for silver; at 0·60 μ, the relative values are 0·89 and 0·93; at 0·70 μ, 0·87 and 0·95. The reflecting power of a silver film after a short period of use would soon fall below that of a freshly deposited aluminium film. To the short wave-length side of 0·40 μ, the aluminium film is greatly superior to the silver film, as it does not show the band due to selective absorption. At 0·35 μ, its reflecting power is 0·85, as contrasted with 0·70 for silver; at 0·30 μ (near the limit of atmospheric transmission), it is 0·83 as compared with 0·08 for silver. For observations in the ultra-violet region, the aluminium film is, therefore, very much superior to the silver film.

The aluminium films have other important advantages. A freshly deposited film on exposure to the air immediately oxidises, and the oxide coating forms a protective layer which prevents the film from tarnishing. It is stated by Dr. J. Strong, who has developed at the California Institute of Technology a technique for the coating of mirrors with aluminium, that concentrated nitric acid can be poured on the mirror with immunity. Nevertheless, the film can be readily dissolved by dilute hydrochloric acid to which a trace of some copper salt has been added. Sulphur dioxide in the atmosphere does not tarnish an aluminium film, or at most at a very slow rate. A small mirror partly coated with silver and partly with aluminium has been exposed at Greenwich, where conditions as regards sulphur in the atmosphere are bad, until the silver film had become completely yellow. The aluminium film was apparently unaffected. Dr. Strong mentions that the mirrors of a telescope aluminised in October 1932 and constantly used since show as yet no signs of tarnish.

Aluminium films are more strongly adherent to glass than silver films. Dr. Strong states that a piece of adhesive tape may be pressed on to the film and then stripped off without loosening the metal from the glass. This tenacity makes it possible to clean the surface of dust or other contamination by washing with soap and water. It is also stated that aluminised mirrors do not scatter light.

The largest mirror yet coated with aluminium is the 36-inch mirror of the Crossley reflector of the Lick Observatory, which was coated in December 1933. When this mirror was coated with silver, a long exposure spectrogram ended at about 0·325 μ. An equal exposure with the aluminised mirror gives a spectrogram extending to about 0·300 μ. An exposure of only 20 seconds on the star ι Orionis, of magnitude 2·9, gave a spectrogram measurable to about 0·310 μ. The atmospheric ozone absorption lines in the ultra-violet can be photographed in a few seconds. Dr. W. H. Wright states that comparison of photographs of the north polar sequence, before and after the aluminising, indicated that the general reflectivity had been stepped up by 50 or 60 per cent; this illustrates the effect of tarnishing of a silver film even under the favourable

atmospheric conditions on the summit of Mount Hamilton.

Aluminium is a difficult metal to sputter by cathode disintegration, and the most effective method of depositing the aluminium films has been found to be by an evaporation process in a high vacuum of the order of 0·0001 mm. of mercury. The aluminium is heated in small tungsten coils arranged opposite the mirror to be coated; the aluminium evaporates and condenses on the face of the mirror. The low pressure enables each atom of aluminium, after evaporation, to travel in a straight path to the mirror with small probability of collision with other atoms. In coating the mirror of the Crossley reflector, twelve helical tungsten coils were arranged round a 36-inch circle at a distance of 18 inches from the mirror. Each coil had 10 turns and to each turn a U-shaped aluminium wire, $\frac{3}{8}$ inch long and $\frac{1}{32}$ inch diameter, was clamped. Each coil was connected in turn to the electrical supply, at a voltage of 20 volts, the entire process of distilling from the twelve coils requiring about three minutes. The mirror was placed on brass bars fastened to a reinforced steel bedplate, one inch in thickness; this arrangement enabled gases underneath the mirror to be pumped out easily. The bell-jar covering the mirror was of $\frac{1}{4}$-inch sheet steel, stiffened at the bottom by a rolled angle iron, and machined to give a perfect plane surface. A lead fuse wire was pressed into a circular groove in the bedplate, at the bottom of the bell-jar; the angle iron was bolted down by 24 bolts exerting a force of 50 tons on the fuse wire gasket, to which atmospheric pressure on exhausting added another 10 tons.

The mirror surface must be absolutely clean for a satisfactory coat. The most satisfactory way of securing the requisite cleanliness with a large mirror was by removing foreign material with an electric discharge from a central electrode. With the arrangements used for the Crossley mirror a very uniform thickness (about $\frac{1}{10}\,\mu$) of coat was obtained.

Dr. Strong finds that it is possible to coat speculum metal gratings with aluminium; the reflectivity is increased about 50 per cent for visible light and by an even greater extent in the ultra-violet. The higher orders of spectrum also become relatively brighter. The definition was found not to be impaired by the coating. The coat can be dissolved by caustic potash, which does not attack the speculum metal. This application of the process should prove of value in the laboratory as well as in astronomical spectroscopy.

It is hoped that apparatus for aluminising telescope mirrors up to a size of 36 inches diameter will be available in Great Britain before long. Some experimental work has been in progress, and a piece of plate-glass coated with aluminium was on view at the meeting of the Royal Astronomical Society on March 9.

The Lyochromes: a New Group of Animal Pigments

By PHILIPP ELLINGER and WALTER KOSCHARA, Düsseldorf

IN the observations of living animal organs by the 'intravital microscope'[1] it was noticed that cells of some organs of the animal not previously treated with fluorescent dyestuffs contained substances which were excited by ultra-violet light to give a characteristic yellow-green fluorescence. Such substances were chiefly found in the liver cells and in the epithelial cells of the first convoluted tubules of the kidney of all the animals examined, including horses, oxen, dogs, cats, rabbits, guinea pigs, rats, mice, frogs, etc. In the liver two other groups of cells could be found which were fluorescent, but far less strongly; the Kuppfer star-cells, shining with a dull orange-yellow fluorescence, and single cells, showing a reddish fluorescence, near to the blood vessels. The two groups last named have no connexion with the pigments with which this article deals. The intensity of the fluorescence of the epithelial cells of the kidney, and also of the liver cells, appeared to be diminished when the animals (rats) were fed on a diet free from nitrogen, and to be augmented after the administration of urea. The suggestion arose that these pigments might have some connexion with the formation or the excretion of urea, because they were found in great quantity just at the sites of the intensive formation and excretion, and therefore of great concentration, of urea. Since it appeared likely that these pigments had great physiological importance, we tried to isolate and identify them.

Animal pigments have been for a long time an object of interest to physiologists and chemists. Especially by the researches of chemists, knowledge of them has been greatly increased during recent decades. The animal pigments hitherto known are nearly all soluble in neutral organic solvents under suitable conditions, and this property was highly important for their isolation and recognition. Only a few of the animal pigments previously known are strongly fluorescent, and their fluorescence differs in colour from that of the pigments now found in the kidney and the liver.

The first attempts at extraction showed that our pigments were completely insoluble in the usual indifferent solvents, such as ether, chloroform, benzol, ligroin, and that, on the other hand, they were soluble in water. As a guide in our attempts at isolation we used the characteristic yellow-green fluorescence, which clearly revealed even extremely small quantities, and which was further characterised by the fact that it was to a high degree dependent on the *p*H, being changed reversibly to a violet fluorescence by both acids

and alkalis. Further, the fluorescence was destroyed by light. The solutions of our pigments are coloured orange-yellow in stronger, yellow in weaker concentrations. The pigments are resistant to acids, but they are destroyed by hot alkalis.

After having determined the solubility of the pigments in water we proceeded, in the first instance, to mince organs fresh from the slaughter-house (livers and kidneys of horses and oxen) or the same organs from recently killed dogs, in which we had determined the presence of the pigments by intravital microscopy, and, after mincing, we extracted such materials with water. The watery extract was freed from albumen, sugar and other contaminating substances and concentrated. It appeared from these attempts that the yield of raw pigments from both organs was very small. We searched therefore for another source of these pigments, promising a better yield, and found it in whey. We convinced ourselves by tests that the pigments of whey correspond to those of the kidney and the liver, in respect of their fluorescence and their reactions to acid, alkali and light. Having found pigments with these properties in many different materials in our first researches, we concluded that we were dealing with a new group of substances of wide distribution, and we named them 'Lyochromes'.

The pigments of whey have been described recently by Bleyer and Callmann[2] and by Gerngross and Schulz[3]. From the work of Bleyer and Callmann the difficulty of isolating such substances is evident. Bleyer and Callmann could, indeed, greatly concentrate these substances, but they were unable to isolate them. They came to the conclusion that the pigment of whey belongs to the oxyproteinic acids; a conclusion which, as we shall see later, cannot be maintained. Whey first became useful as a raw material, when we had found the right adsorbents for concentrating and isolating the pigments. Fuller's earth was found to be the best adsorbent, and the adsorption was most successful from a slightly acid solution, such as that natural to whey, which always has an acid reaction due to lactic acid.

From the adsorption on fuller's earth, which was washed several times with water and alcohol, the pigments were eluted by mixtures of pyridine and water[4]. In this manner we obtained concentrates of pigments, which were purified by precipitation of contaminating substances, and which could be induced to crystallise from watery solution.

We were able to isolate five crystalline coloured substances, which we described as 'Lactoflavins *a*–*e*'[5], and which differ from one another in constitution, crystalline form, solubility and intensity of the colour in solution. It is possible, perhaps even likely, that the chromogen component in all these pigments is identical. By careful removal of impurities we obtained at first three crystalline pigments, lactoflavins *a*, *b* and *c*, which are distinguished by slight solubility in water and in mixtures of concentrated acetic acid and acetone from the other lactoflavins, *d* and *e*. They differ from one another in crystalline form, basicity and percentage composition as follows:—Lactoflavin *b* (small hexagonal tablets; C 35·7; H 3·3; N 32·0), and lactoflavin *c* (needles of the form of a dragon-fly's wings; C 35·7; H 2·6; N 31·3) have a similar composition. On the other hand, lactoflavin *a* (crystals in nodular aggregates; C 33·5; H 4·0; N 21·6), differs from the other two, especially by its lower content of nitrogen. Lactoflavins *b* and *c* have a percentage composition close to that of uric acid (C 35·7; H 2·4; N 33·3), but differ from uric acid in their greater solubility in water, and in the property of not being precipitated by ammonium chloride. Lactoflavins *a*, *b* and *c* have no melting-points. The crystals are coloured orange-red. They dissolve in water to give orange-coloured solutions, yellow when more dilute. The solutions have a yellow-green fluorescence. It was not possible to fix the molecular weights. The watery solutions lose their colour by heating with alkali, with evolution of ammonia. The three pigments give the murexide test.

From 100 litres of whey we obtain, in the most favourable case, perhaps 10 mgm. of each of the three pure lactoflavins *a*, *b* and *c*. Much loss is caused by the purification of the crude crystals, a procedure in which one must avoid temperatures above 60°. For it was evident that on heating the watery solutions of these lactoflavins a decomposition occurred. This decomposition yields a colourless substance, very difficult to dissolve in water, of a purin-character, and a pigment which remains in the solution, and which shows all the qualities of the Lyochromes. The pigment produced by this cleavage, which we call lactoflavin *d*, has been isolated by us from the mother-liquors of the lactoflavins *a*–*c*, as a pigment very much more soluble in water than the Lyochromes hitherto described. It is not strictly proved, as yet, that this pigment from the mother-liquors is identical with that formed by the decomposition of the slightly soluble Purin-Lyochromes.

Lactoflavin *d* crystallises in the form of reddish-yellow needles, which melt at 270°–273° with complete decomposition. The data per cent given by analysis (C 52·69; H 5·84; N 14·38) indicate the formula $C_{16}H_{20}O_6N_4$, or $C_{17}H_{20}O_7N_4$. The reddish-yellow watery solution of lactoflavin *d* fades, on heating with alkali, to a pale yellow colour, without appreciable evolution of ammonia. The murexide test gives a negative result with this pigment.

In isolating lactoflavin *d* we have found a further crystalline pigment, which is precipitated in microscopic aggregates and which is called lactoflavin *e*. Its solubility in water and its content of nitrogen (24 per cent) give it a position between the lactoflavins *a*–*c*, on one hand, and lactoflavin *d* on the other. The lactoflavin *e* gives a positive murexide reaction, but only with chlorate and hydrochloric acid ('forced murexide test').

By a procedure corresponding to that of Warburg and Christian[6], which will be quoted later, a

decomposition product can be obtained from the Lyochromes of whey by irradiation of their alkaline solutions, which differs from the Lyochromes by its solubility in chloroform. This substance crystallises in the form of reddish-yellow, small, woolly needles ; it melts with decomposition at 315°–317°. It is slightly soluble in hot water, also in ammonia, and is easily soluble in dilute sodium hydroxide. The solutions are fluorescent in the same way as the Lyochrome solutions. The results of analysis of this product of photochemical decomposition (C 61·97 ; H 5·19 ; N 20·58 per cent) indicate the formula $C_{14}H_{14}O_2N_4$. Its properties make it likely that it is, at least, very nearly connected, perhaps identical, with the substance formed by light from the Lyochromes of yeast, obtained by Warburg and Christian. If we accept for lactoflavin *d* the formula $C_{17}H_{20}O_7N_4$, and we compare it with the formula of the photochemical cleavage product of lactoflavin *d*, a difference of $C_3H_6O_5$ is found.

In the transformation of lactoflavin *d* by light we must probably reckon with a reaction proceeding in several steps. At first H_2O will be split off, and then a further substance free from nitrogen, and finally a transformation of the nitrogen-containing, coloured molecule will take place. On this assumption, one may divide the difference between the formulæ of lactoflavin *d* and the photochemical cleavage-product, $C_3H_6O_5$, into H_2O (water) and $C_3H_4O_4$ (malonic acid ?). Not only the higher melting point of the cleavage product, but also its behaviour to oxidation with chromic acid, indicate that its molecule is more stable than the molecule of lactoflavin *d*. While by oxidation with chromic acid, 8 mols of carbonic acid are formed from lactoflavin *d* in about one hour and a half, when the reaction comes to an end, by the same treatment of the cleavage product only about two mols of carbonic acid are evolved in the course of six hours, without the formation of carbonic acid being completed. In contrast to the lactoflavin *d*, we can extract with ether, from the oxidation products of the pigments soluble in chloroform, a substance which corresponds completely to the Lyochromes with respect to its colour and fluorescence, but in which nitrogen can no longer be demonstrated by the test of Lassaigne. The search for the constitution of the Lyochromes must start with such decomposition products.

An important property of the Lyochromes, which must be expressed in the constitutional formulæ, is the reversible reduction to a leuco-substance. These leuco-substances are formed, for example, by a biological process if whey is left standing for some time, so that it becomes covered with a film of microbes. The liquid under this film does not show the Lyochrome fluorescence, but the fluorescence can be restored immediately by shaking it with air. Chemically the leuco-substances can be obtained by reduction with hydrosulphite, with hydrogen sulphide in a weakly alkaline solution, and also with titanous chloride. Of other chemical properties of the Lyochromes, in the first place their great stability to oxidising agents must be mentioned. The Lyochromes are not attacked by concentrated nitric acid, bromine water or hydrogen peroxide. Hydrogen peroxide in presence of iron salts and cold permanganate attacks them only slowly, but they are very quickly destroyed by hot permanganate.

Hitherto the existence of Lyochromes has been determined by ourselves in animal organs, in whey and in urine. The wide distribution of this new group of natural pigments is further evident from the papers of Warburg and Christian and also of Kuhn, Györgyi and Wagner-Jauregg[7]. These investigators detected yellow-green fluorescent pigments of Lyochrome character in yeast in very high concentration, in cultures of the lactic acid bacterium, in muscle, in white of egg, and also in vegetable materials. Warburg and Christian found, in the course of their search for the so-called second respiratory ferment, pigments of Lyochrome character, and they were able to show that the combination of a yellow-green fluorescent pigment with a carrier of high molecular weight represents this iron-free respiratory ferment itself. This respiratory ferment is, therefore, not dialysable, in contrast to the Lyochromes of whey. We have found that, in contrast to that of cow's milk, the pigment of human milk is also fixed on a carrier, probably on albumin. Lastly, Kuhn, Györgyi and Wagner-Jauregg have been led to this new sphere of pigment investigation by researches directed to the isolation of the vitamin B_2. Vitamin B_2 appears to belong to the Lyochromes. To this statement we must make the reservation that the crystallised Lyochromes which, in the opinion of these investigators, are the cause of the vitamin effect, require, for the production of their effect on growth, to be supplemented by a substance chemically not yet defined (vitamin B_4). The crystallised pigments, which Kuhn, Györgyi and Wagner-Jauregg were able to isolate first from white of egg, and then from whey, are similar or identical with the lactoflavin *d* isolated by ourselves from whey. The possibility cannot be denied that the different natural Lyochromes may consist of the same pigment component united with different other substances, acting as carriers.

We find accordingly, in whey, Lyochromes of very different molecular dimensions. Including the substances obtained by decomposition of the original Lyochromes, we can at present construct the following series, arranged in order of molecular dimensions :

(1) The pigments united to a non-dialysable carrier (albumin ?), from human milk, corresponding to the second respiratory ferment of Warburg and Christian.

(2) The pigments in combination with purin-substances (lactoflavins *a*–*c*).

(3) A single pigment (lactoflavin *d*) corresponding to the ovoflavin and the lactoflavin of Kuhn, Györgyi and Wagner-Jauregg.

(4) The photochemical cleavage product, that

is, the pigment without H_2O (water) and $C_3H_4O_4$ (malonic acid ?), corresponding to the cleavage product from yeast of Warburg and Christian.

(5) The oxidation product of the photochemical cleavage product, soluble in ether (free from nitrogen ?).

Warburg and Christian have described the evolution of urea from their photochemical cleavage product by treatment with alkali, by which means the remaining substance, $C_9H_{10}O_2N_2$, loses its whole power of fluorescence and all but a small remnant of its colour. It must be accepted that in this treatment an intramolecular transformation of the remaining substance also takes place; for our probably nitrogen-free oxidation product, obtained from the product of photochemical cleavage, still possesses fluorescence and colour to such an extent that the nitrogen content is very unlikely to have any connexion with these properties.

The three starting-points of the researches leading to the discovery of the new group of animal pigments—namely, the functions of the liver and the kidney, the respiratory ferment, and the action of vitamin B_2—together indicate the great physiological importance of this new class of pigments. While the function of the Lyochromes as respiratory ferment is completely explained, their character as vitamin B_2 still requires further investigation, since in the researches so far made their effect as vitamin B_2 was evident only with the addition of chemically unknown substances. The physiological significance of the occurrence of Lyochrome in the kidney and the liver is still quite unknown. On the respiration of normal tissue cells Lyochromes have no effect, as we ourselves, and also Wagner-Jauregg and Ruska[8], have observed. On the other hand, Stern and Greville[9] found that mammalian red blood corpuscles, which have practically no intrinsic respiratory activity, show a significant increase of oxidation in the presence of Lyochrome. It is very probable, however, that the substances used in these experiments as Lyochromes were not of that character; for, according to the investigations of one of us on the Lyochromes of the urine, the Urochrome used by Stern and Greville for their respiration experiments has no Lyochrome properties.

To summarise: The Lyochromes are characterised by the following qualities: (1) solubility in water; (2) red to orange colour of the crystals, and orange to yellow colour of their watery solutions; (3) yellow-green fluorescence; (4) extinction of this fluorescence by acid and alkaline reactions; (5) reversible reduction to leuco-substances; (6) stability against oxidising agents.

The chemical investigation of the group, in spite of the small concentration of the Lyochromes in organic materials, has already advanced so far that in the near future we may expect that their chemical structure will be revealed, and that a knowledge of new relations between chemical constitution and physiological action will be afforded thereby.

[1] The method of 'intravital microscopy' has been described by Ph. Ellinger and A. Hirt in the *Zeitschrift für Anatomie und Entwicklungsgeschichte*, vol. 90, p. 791, 1929, and in "Abderhaldens Handbuch der biologischen Arbeitsmethoden", vol. 5, II_2, p. 1753, 1930. It permits living animal organs to be examined with the strongest microscopical magnifications by injecting the animal with fluorescent dyestuffs. With ultra-violet illumination these dyes provide, by fluorescence in the cells themselves, the light required for visible illumination of the microscopical picture.

[2] Bleyer and Callmann, *Biochem. Z.*, **155**, 54; 1925.

[3] O. Gerngross and M. Schulz, *Milchwirtschaftliche Forschung*, **6**, 567; 1928.

[4] Details of this procedure as well as of further chemical operations are described in our publications: Ph. Ellinger and W. Koschara, *Berichte der Deutschen Chemischen Gesellschaft*, **66**, 315, 808, 1411; 1933.

[5] We had made an agreement with R. Kuhn, P. Györgyi and Th. Wagner-Jauregg, who worked over the same field and who called their substances 'Flavins', to call the whole group 'Lyochromes' and their single specimens 'Flavins', with the addition of the names of the materials of origin, so that the Flavin from milk is called 'Lactoflavin'.

[6] Warburg and Christian, *Biochem. Z.*, **257**, 492; 1933.

[7] R. Kuhn, P. Györgyi and Th. Wagner-Jauregg, *Ber. Deutschen Chem. Gesell.*, **66**, 317, 576, 1034, 1577; 1933.

[8] Th. Wagner-Jauregg and H. Ruska, *Ber. Deutschen Chem. Gesell.*, **66**, 1298; 1933.

[9] K. G. Stern and G. D. Greville, *Naturwissenschaften*, **22**, 720; 1933.

Obituary

Prof. F. Ll. Griffith

FRANCIS LLEWELLYN GRIFFITH, whose death at the age of seventy-one years occurred on March 14, was, like a number of other distinguished Englishmen, the son of a clergyman, the Rev. John Griffith, who was for many years rector of Sandridge, Herts, and a mathematician of some repute. After being educated at Brighton College, Sedbergh and Highgate, he came up to Oxford as a scholar of Queen's College, where, under the influence of Prof. A. H. Sayce, he began those studies which were destined to win him later a world-wide fame. He took his B.A. degree in 1884, and during the winter seasons of that and the three following years he was engaged in excavation and other research work in Egypt under the leadership of Petrie and Naville. For some months of the season 1886–87 he was busy copying the inscriptions in the tombs of the First Intermediate Period and Middle Kingdom at Asyût and Dêr Rîfeh. His publication of these texts ("The Inscriptions of Asyût and Dêr Rîfeh", 1889) not only shows that even at this early date he had acquired a sound knowledge of Middle Egyptian, but already displays that scholarliness and meticulous accuracy which are so characteristic of all his subsequent work.

From 1888 until 1896, Griffith was an assistant in the Department of British and Mediæval Antiquities in the British Museum. In 1892 he was made assistant professor of Egyptology at University College, London, a post which he retained until he was appointed reader of Egyptology at Oxford in 1901. During those years his output was remarkable both for quantity and quality, its crowning achievement being the

publication in two volumes of Petrie's great find of papyri at Kahun and Gurob. Most of these are documents written in the cursive business hieratic of the Middle Kingdom, a script of which there had hitherto been found few, if any, examples. In his mastery of this difficult script and in his interpretation of the contents of the documents, Griffith showed that he possessed that rare gift—real genius. Many years have passed since those two volumes appeared, and there has been a great advance in our knowledge of Middle Egyptian grammar and syntax, but even so, Griffith's translations and transcriptions need comparatively few corrections.

For the next ten years or so Griffith devoted himself primarily to the study of Demotic, and by the end of that period was the foremost Demotic scholar in the world. His "Stories of the High Priests of Memphis" (1900), the "Demotic Magical Papyrus of London and Leyden", which he produced in collaboration with Sir Herbert Thompson (1907–9), and above all his "Catalogue of the Demotic Papyri in the Rylands Library" (1909) placed Demotic studies on a new footing, and gave them an interest which, in the minds of some of us at any rate, they had hitherto seemed to lack.

About the year 1907, Griffith found opportunity for winning laurels in a new field. Excavations in the Sudan and Lower Nubia were producing inscriptions in the Meroitic script hitherto undeciphered, and the finders handed them over to him to investigate. After a few years of intensive study, he could decipher the script and had advanced far towards a complete understanding of the language.

In due course Griffith turned back to Demotic and was actually engaged at the time of his death in the publication of the Demotic inscriptions occurring in the temple of Philae and in the temples of Lower Nubia, a great and most important undertaking.

In the winter season 1910–11, Griffith and his wife conducted excavations on behalf of the University of Oxford in Lower Nubia, and they continued these activities until the winter season 1913–14. In 1922 and 1923 they excavated for the Egypt Exploration Society at El-Amarna. Twice since then they have excavated in the Sudan, the site of their last campaign (1930–31) being Kawa, where they unearthed three temples, one of which had been founded by Tirhaqa. At Kawa, beside several large stelæ bearing inscriptions of great historical interest, they found a number of reliefs and statues and a quantity of other antiquities, some being of considerable artistic merit.

In 1924, in consideration of his services to Egyptology and to the University of Oxford, Griffith was given the status of professor, and, though he resigned the chair in 1932, he acted as deputy professor until the late Prof. Peet was transferred from the University of Liverpool to succeed him in October 1933. Griffith was a D.Litt. of Oxford, an honorary fellow of Queen's College, a fellow of the British Academy and also of the Society of Antiquaries, an honorary LL.D. of the University of Aberdeen and an honorary D.Phil. of the University of Leipzig. He was a corresponding member of the Royal Academy of Sciences at Berlin, and a foreign associate or corresponding member of many other famous learned societies in Europe.

He was twice married, and his second wife, who has rendered him notable assistance in his excavations in Egypt, Lower Nubia and the Sudan, and in the production of many of his publications, survives him.

Griffith was a man of wide interests. Beside a profound knowledge of Egyptology in all its branches, he was well acquainted with the archæology of his own country and of foreign countries other than Egypt. He was very fond of music and was a good naturalist and botanist. He was a delightful companion for a country walk, pointing out and discussing any interesting flower or plant that he observed growing in hedgerow or field; and he knew every bird by its notes. It should here be stated that his great knowledge of the birds, fish and other animals of Egypt is made manifest in many of his books and articles. A charming trait in his character was his love of children, who found in him an ideal companion. He would take them round his garden and talk to them about the birds and plants, and the creatures living in stream or pond. Small children, frightened of strangers in general, took to him immediately and, when next he appeared on the scene, welcomed him with open arms.

His was a full life and he accomplished much. He died, as all would wish to die, in full possession of all his faculties and with his mind occupied to the last in the work he loved.

ALYWARD M. BLACKMAN.

DR. H. S. WASHINGTON

WITH the death of Dr. Henry Stephens Washington on January 7 at the age of sixty-six years, petrology has suffered the loss of one who, for the past forty years, has worked with distinction and has contributed greatly to the advancement of the science.

Henry Stephens Washington was born at Newark, New Jersey, on January 15, 1867, and, after due preparation, he proceeded to Yale where he obtained, in 1886, the degree of B.A. with special honours in natural sciences. After two years of post-graduate work he graduated M.A. in 1888. The next four years were spent in travelling in the West Indies, Europe, Egypt, Algeria and Asia Minor, parts of the four winters and springs being spent in Greece where he became a member of the American School of Classical Studies. In the latter capacity he assisted in and conducted excavations at Plateae, Argos and Phlius.

Between 1891 and 1893, Washington studied petrology under Zirkel at the University of Leipzig and obtained his doctorate with a thesis on "The Volcanoes of the Kula Basin in Lydia". Afterwards he was assistant in mineralogy at Yale for a short time and continued his petrographical researches in Europe and America. From 1906 until 1912 he practised as a consulting mining geologist, and in 1912 he was appointed petrologist to the Geophysical Laboratory in Washington, a position which he still held at the time of his death.

Dr. Washington travelled extensively and the results of his geological, petrological and volcanic studies in Europe, North America, Brazil, Asia Minor and the Hawaiian Islands are incorporated in numerous publications. His devotion to the chemical side of petrology was the ruling factor in his career, and his skill as an analytical chemist and petrographer, together with an unfailing interest in volcanic processes and rocks, have contributed greatly to our present knowledge of modern lavas. At the same time his scientific activities embraced a much wider field, and his investigations ranged from archæological subjects to problems of the earth's interior.

In 1904 he published his "Manual of the Chemical Analysis of Igneous Rocks", the fourth edition of which appeared in 1930. He was joint author with Cross, Iddings and Pirsson of "The Quantitative Classification of Igneous Rocks", published in 1903, and author of the "Chemical Analyses of Igneous Rocks" which was issued by the United States Geological Survey as a Professional Paper in 1903, and in an enlarged edition in 1917. An enormous amount of work is represented in this compilation, of which the importance, from a petrological point of view, cannot be overestimated; it must always remain an admirable memorial to its author.

It is impossible to deal adequately with Washington's scientific publications, which form an imposing list, but among the more important may be mentioned "The Roman Co-Magmatic Region" (1906), "The Deccan Traps and other Plateau Basalts" (1922), "The Petrology of the Hawaiian Islands" (1923–1928) and "The Composition of the Earth's Crust" (1924, in collaboration with Dr. F. W. Clarke).

Dr. Washington's scientific attainments were widely recognised both in the United States and in Europe. He was a foreign member of the Geological and Mineralogical Societies of London; of the Paris Academy of Sciences; and of the Academies of Science of Norway, Turin and Modena, and of the Royal National Academy of the Lincei (Rome).

With his death, geology must mourn the passing of a great figure in the petrological world.

We regret to announce the following deaths:

Prof. J. R. Ainsworth-Davies, formerly principal of the Royal Agricultural College, Cirencester, on April 7, aged seventy-two years.

Prof. A. B. Macallum, F.R.S., formerly professor of biochemistry in the University of Toronto, lately professor of biochemistry in McGill University, on April 5, aged seventy-four years.

Sir Frederick Palmer, K.C.M.G., C.I.E., president of the Institution of Civil Engineers in 1926–27, who was a well-known bridge and harbour engineer, on April 7, aged seventy-two years.

Prof. Sydney H. Vines, F.R.S., formerly Sherardian professor of botany in the University of Oxford, president of the Linnean Society of London in 1900–4, on April 4, aged eighty-four years.

News and Views

"Letters to the Editor"

An explanation is due to our readers for the unusually large proportion of this week's issue of Nature devoted to "Letters to the Editor". In Nature of February 10, we published an enlarged paper to provide accommodation for twenty columns of correspondence; since then, we have printed a dozen or so letters each week, which have occupied altogether a hundred columns of space. In fairness to our correspondents, it should be said that many of them have acted upon our suggestion that communications should be reduced in length, but still it has been difficult to ensure that prompt publication of current work which is now so widely recognised as one of the chief functions of our correspondence columns. In the circumstances, it has been decided once more to publish an extra number of pages of correspondence, in order to reduce the waiting list, and the present issue of Nature therefore contains thirty-two columns under the heading "Letters to the Editor". Of the twenty-nine communications printed, about a half are from centres in Great Britain and Ireland. The remainder come from places so widespread as Copenhagen, Leningrad, Moscow and Warsaw in Europe, Boulder, Chicago, Harvard and Montreal in North America, Sendai in Japan, Cairo, and Kyancutta (South Australia). They provide further evidence, if such be needed, of the wide circulation of this journal and the keen activity with which scientific problems are being attacked in many parts of the world.

Prof. G. H. Lemaître

Prof. G. H. Lemaître, professor of mathematical methodology and the history of mathematical sciences in the University of Louvain, has been awarded the Francqui Prize of the value of 500,000 francs. The Francqui Foundation was created in 1932, and may award this annual prize to the Belgian who has made outstanding contributions to science

and thus enhanced the international prestige of Belgium. This year's prize has been awarded to Prof. Lemaître for his outstanding work on the systems of galaxies and on cosmic theory. His discoveries and theories have had a profound influence on astrophysical and physical thought throughout the world, especially in connexion with the theory of the expanding universe, which he originated. The presentation was made in the presence of the King of the Belgians.

Native Problems in North Australia

THE natives of Arnhem Land in North Australia are presenting an interesting problem to the Commonwealth Government. The methods usually adopted in dealing with disturbances among the natives are the old-time punitive police expedition or special missionary enterprise; quite recently a mixture of the two has been tried. As Prof. F. Wood Jones has pointed out, the former is apt to lead merely to massacre, and the latter must be admitted to have failed to effect any permanent solution of the problem. It is properly soluble only by rigorous segregation of the blacks from settlers, traders and the like (European and Asiatic), and by prolonged intimate study of them by highly trained anthropologists willing and able to live amongst them as members of their tribes. The University of Melbourne has made an admirable and practical move in offering to the Department of the Interior the services of an able and experienced research student to work amongst the Arnhem Land natives. To the great regret of all who are interested in these primitive peoples, the offer has been declined; but the last has not been heard of it. On scientific, no less than humanitarian, grounds a determined effort along sound modern lines should be made to resolve this long-neglected native problem. The establishment of a Commonwealth Department of Native Affairs would be a step in the right direction.

Water Supplies in Great Britain

IN reply to a question in the House of Commons on April 9 as to the present position in regard to water supplies in Great Britain, Mr. Ramsay MacDonald said: "The reserves of many water undertakers have fallen to a low level for this time of the year. The Government have been carefully watching the situation and, because of the continued absence of abundant rains, are satisfied that emergency measures must be taken. Therefore, in view of seriousness of the position, the Government propose to bring legislation before the House immediately." The Water Supplies (Exceptional Shortage Orders) Bill was accordingly presented to the House on April 10, whereby the Minister of Health, and the Secretary of State and the Department of Health for Scotland, would be authorised "to make orders, and to give directions with a view to meeting deficiencies in water supplies due to exceptional shortage of rain, and for purposes connected with the matters aforesaid". It will be remembered that the subject of water supply and regulation was discussed in NATURE of November 11, 1933, p. 725, in an article dealing with a report of a committee of the British Association, when the institution of an inland water survey of Britain was urged as a necessary preliminary to efficient water administration. Reference was also made in that article to the presidential address to the Institution of Mechanical Engineers delivered by Mr. Alan Chorlton, M.P., in which he suggested the construction of a water 'grid' in Great Britain comparable with the electricity 'grid' recently completed.

Pooling of Water Supplies

MR. CHORLTON returned to the subject in a recent paper read before the Royal Society of Arts (*J. Roy. Soc. Arts*, Feb. 23, 1934), in which he directs attention to the policy of Great Britain, which has allowed water supply to remain in the hands of local authorities without any national plan devised in the interests of the population as a whole. As a result, there are 1,100 separate water undertakings in the country with a mosaic of disconnected entities and interlocking boundaries. Urban areas are best served, but many rural areas require adequate provision. A hydrogeological survey is needed before plans on a large scale can be matured. Furthermore, some pooling of supplies is essential because of the vagaries of rainfall within any given year, and lastly, special storage reservoirs should be constructed to serve abnormal demands in dry seasons. These might be in the Thames valley, for the south generally; in south Lincolnshire for the Ouse flood waters; and in the Lake District to serve the industrial areas of Lancashire. Such undertakings would, according to Mr. Chorlton, have many advantages in providing a certainty of good water in all areas, and a possibility of encouraging increased use of water without alarm of shortage, while the expenditure on labour would decrease unemployment for some years to come.

Australian Support for Empire Agricultural Research

SATISFACTION will be felt at the decision of the Commonwealth Government to adopt the recommendation of the Executive Council of the Imperial Agricultural Bureaux that financial support be given to certain research organisations in Great Britain formerly assisted in part by the Empire Marketing Board. It is true that the sum involved is not very considerable: £800 per annum to the Entomological Laboratory at Farnham Royal, £500 to the Station at Slough dealing with insect infestation of stored products, and £4,500 to the Low Temperature Research Station at Cambridge; a total of £5,800 per annum. The point of importance, however, is that the Australian decision is an indication of the growing feeling there that teamwork in agricultural research is not merely desirable in the interests of the various members of the Empire, but also is essential if full advantage is to be taken of the limited total resources available for scientific work. The Empire Marketing Board did much to foster this spirit, the value of which is clearly recognised in the outlying dominions.

Rothamsted Experimental Station

The recent appeal for £30,000 for the purchase of the Rothamsted experimental fields has met with a ready response and already £22,000 has been promised. This is due chiefly to the generosity of Mr. Robert McDougall of Cheadle, who has offered £15,000, and the Sir Halley Stewart Trust, which has offered £5,000, on condition that the remaining £10,000 be secured by May 12, when the option on the land expires. Towards this, £1,000 has already been given by Sir Bernard Greenwell, and another £1,000 by other donors. Strenuous efforts are now being made to obtain the remaining £8,000, and all friends of Rothamsted are invited to send subscriptions to the Director, Rothamsted Experimental Station, Harpenden. Barclays Bank and the National Provincial Bank have kindly posted the appeal in their rural branches and the National Farmers' Union is asking its branches to help. But the countryside, though sympathetic and appreciative, is not well off, and for much of the £8,000 the Station will have to depend on the generous help of public-spirited men and women who, while recognising the importance of agriculture to the community, are not themselves actually farming. It would be indeed a tragedy if Rothamsted should, after all, lose these fields now that success seems so nearly within reach.

Short Wave Radio Echoes

It is now well-known that all long-distance radio communication takes place by means of electric waves reflected from one of the ionised regions of the atmosphere, the time of travel of the waves from the emitting station up to the reflecting layer and back to the earth being usually a small fraction of a second. Some six years ago, a Norwegian engineer, G. Hals, discovered the existence at certain times on short wave-lengths of wireless echoes received as long as three seconds after the cessation of the original signals (see Nature, **122**, 681, Nov. 3, 1928). These observations were afterwards confirmed by Prof. C. Størmer, and specially organised experiments by experts in different countries showed that echoes of up to 25 or 30 seconds' delay could be detected, although they were of rather rare and uncertain occurrence.

To explain the existence of such echoes, Prof. Størmer put forward the suggestion that the emitted waves had penetrated the ionosphere and were reflected from a belt of electrified corpuscles ejected by the sun and formed into a vast toroid by the influence of the earth's magnetic field. If the waves travelled with their normal velocity, this toroid would have to be situated at a distance of several hundred thousand miles from the earth. Other investigators, however, pointed out that the variation of the group velocity of the waves in the ionosphere might be an important consideration in defining the actual path of the waves. In order to obtain more experimental data on this subject, Prof. E. V. Appleton, of King's College, London, who is well known for his investigations of the ionosphere, has suggested that observations should be carried out by a large body of amateur listeners equipped with suitable short wave receivers. The formation of an organisation suitable for this and other similar investigations is described in *World Radio* of April 6 by Mr. Ralph Stranger, of the technical staff of that journal. It is proposed that a number of powerful transmitting stations in Great Britain and other countries should emit at certain times strong characteristic signals, which will be the subject of observation throughout the world. The results obtained will be collected and carefully analysed. The conclusions reached from the conduct of this large-scale experiment will be awaited with interest.

Centenary of the Royal Statistical Society

The Royal Statistical Society had its birth at a meeting held in London on March 15, 1834, under the chairmanship of the Marquis of Lansdowne, and the centenary will be celebrated on April 17, when the Prince of Wales, an honorary president of the Society, will preside at a meeting to be held at University College, London. The Society arose out of the Cambridge meeting in 1833 of the British Association. During the meeting, which was attended by the famous Belgian mathematician, Quételet, a small gathering of members interested in statistics was held in Trinity College. Through this, Babbage was led to suggest the formation of a statistical section of the Association. His suggestion was approved and a committee appointed. It was, however, soon recognised that for the collection of materials a more permanent society would be required, and this led to the meeting of March 15, 1834; when it was resolved to establish a Statistical Society of London (see Nature, March 10, p. 389). The Society was incorporated in 1887, and is now in a flourishing condition. One of the original recommendations was that it should "of course be one prominent object of the Society to form a complete Statistical Library as rapidly as its funds may admit". The Society has now a library of more than sixty thousand volumes.

Local Government Officers

Important recommendations regarding the qualifications, recruitment, training and promotion of local government officers are made in the recent report of a departmental committee under the chairmanship of Sir Henry Hadow to the Ministry of Health (London: H.M. Stationery Office. 1*s*. 6*d*. net). The Committee considers that considerable revision of the present system of recruiting and training officers is necessary, and makes the principal recommendation that a permanent central advisory committee should be appointed, representative of local authorities, to investigate and advise in all questions affecting local government service. The co-operation of such a central body is necessary to give effect to the Committee's proposals with regard to entry to the service by competitive examinations, the recruitment of an increased number of university graduates, on which special stress is laid, and the investigation of conditions of training, particularly with respect to the

establishment of an administrative examination of appropriate standard for passing from the general grade of clerical officers to the higher grades.

OTHER recommendations relate to the adoption of uniform grading systems and salary scales, the wide notification of vacancies, the establishment of a minimum age limit of sixteen years, coupled with the possession of a school certificate for entry to the service. A certain proportion of junior clerical officers should be recruited at eighteen or nineteen years of age, apart from the systematic recruitment of university graduates and of professional and technical officers from all available sources. A thorough investigation of technical qualifications is required, and coupled with greater precautions against personal influence in making appointments, greater mobility of officers between local authorities, the assignment by each local authority to one establishment committee of all questions affecting the recruitment, qualification, training and promotion of officers; these suggestions should assist in the development of a local government service able to meet the increasingly onerous demands made upon it.

New Cheshire Nature Reserves

THE two Nature reserves in memory of the late T. A. Coward, the well-known naturalist and author of "The Birds of Cheshire" and "The Vertebrate Fauna of Cheshire", of the Manchester Museum, who died on January 29, 1933, have been completed in Cheshire. They have been formed by a committee of naturalists and admirers, the T. A. Coward Memorial Fund, under the chairmanship of the Right Hon. the Earl of Stamford; though as yet some £200 of the purchase money is required. It is proposed to hand the reserves over to the care of some national body like the National Trust. The two sites chosen were Marbury Mere in mid-Cheshire, and Cotterrill's Clough, a 'hanging' wood on the banks of the River Bollin within sight of Coward's home at Bowdon (NATURE, 132, 437, Sept. 16, 1933). Each locality is rich in bird life. At the latter, Coward recorded the grasshopper-warbler, and used it for the recording of the arrival of migrant species, while the former, which includes a large lake and 1½ acres of woodland, and large reed beds which bring the extent up to 8 acres, is where the black tern, bittern, night-heron, whooper swan, Bewick's swan, and great crested grebe have been recorded. Some recent Marbury records include the white wagtail, a drake and two duck wigeon in July, scaup duck, goosander, cormorant, great northern diver, and ringed plover (Nineteenth Annual Report, Lancashire and Cheshire Fauna Committee). The honorary secretary of the Coward Memorial Fund is Mr. J. F. Hodkinson, 50 Selby Street, Manchester, 11.

Roman Scotland

SIR GEORGE MACDONALD'S reconstruction of the history of the Roman wall from Forth to Clyde, and of the strategic position in Roman Scotland in the second century A.D. from the evidence of his excavations, which appeared in the *Times* of April 7, justifies his citation of the dictum of the late Prof. Haverfield that the spade would prove mightier than the pen, but at the same time will suggest to his readers the qualification that its superiority depends upon the skill of the excavator, and his constructive powers in the interpretation of his finds. Sir George's ability in this respect enables him to piece together the data he has obtained from the thirty-seven miles of wall between Bridgeness on the Forth to Old Kilpatrick on the Clyde, with its forts, ditch and flanking road for supply purposes, and to supply from it a conclusive solution for the more puzzling problems of a political and military situation which required the building of the forward line of defence and yet at the same time did not relieve the garrison of Hadrian's wall to the south. The key to the situation, which he now supplies, is the vulnerability of the intra-mural area from the inroads of the Dalriada Scots of Ireland through Galloway. Further, he suggests, the country north of York, being occupied in a military sense only, even though the outer wall provided an efficient barrier against attack by the northern tribes, it was necessary to have a garrison on the southern wall to shut off the partially subdued tribes on the southern side of the wall from those in the occupied Scottish area, in order to prevent any junction of disaffected tribesmen. Sir George's suggestion that shortage of man power and a miscalculation of the pressure which could be brought to bear by Irish inroads is a logical, but none the less brilliant, reading of the situation when about 185 A.D. the outer line of defence was abandoned.

An Expedition to Hainan

ALTHOUGH the flowering plants of Hainan have been extensively collected by Prof. Woon-Young Chun and his associates of the Botanical Institute, National Sun-Yatsen University, Canton, the animals of the island, although previously collected by a few naturalists, are still incompletely known to the scientific world. The Fan Memorial Institute of Biology, the Biological Laboratory of the Science Society of China, the Metropolitan Museum of Natural History of the Academia Sinica, the National Tsing Hua University, the National University of Peking, the National Shantung University and Nankai University have recently organised a joint expedition to Hainan. The purpose of this is to collect zoological specimens as extensively as possible. Cryptogams, orchids and wood samples will also be collected. The Fan Memorial Institute of Biology will be represented by C. Ho, entomologist, and S. K. Tang, taxidermist; the Biological Laboratory of the Science Society of China by Dr. C. C. Wang, invertebrate zoologist, and Mr. K. F. Wang, ichthyologist; the Metropolitan Museum of Natural History by Dr. H. W. Wu, ichthyologist; the National Shantung University by Mr. C. L. Tso, botanist, and Mr. Chungsi H. Liu, anthropologist; and Nankai University by Dr. T. S. Hsiung, invertebrate zoologist. Mr. C. L. Tso, who has had previous experience in the island and is familiar with the natives, will lead the expedition. The members of the expedition were to leave Shanghai about January 15. One party

is going to the famous Wu-tchi-shan or Five Fingers Mountain. As the mountain attains the height of more than 2,000 metres, zoological specimens, especially land vertebrates, will be thoroughly collected in order to study the problem of vertical distribution. Another party will make a coastal survey and pay more attention to the sea fauna.

Research and Industry in New Zealand

New Zealand's position in relation to world commerce was reviewed by the Governor-General, Lord Bledisloe, on September 29 in an address to the Canterbury Chamber of Commerce at Christchurch. In the course of the address he referred to the resentment often expressed in regard to excessive mechanisation and other social and economic ills entailed by the progress of scientific research and the application to industrial processes of the resulting discoveries. The remedy is to be sought, he suggested, not in arresting the march of science, especially in a country which has so much to gain from agricultural and other scientific research, but rather in redoubling research in those fields of economics, psychology, sociology and education in which are to be sought solutions of those problems, which have hitherto baffled mankind, of the distribution of the wealth which the applications of other branches of science have already made abundantly accessible. From the enunciation of this doctrine of the socio-centrality of present-day science, he passed on to consider the limits within and conditions on which State guidance and organisation are likely to produce better results than unshackled individual enterprise.

"Discovery" Report on Foraminifera of South Georgia

A correspondent, Mr. M. E. Challen, has directed our attention to the fact that in Mr. A. Earland's report on the Foraminifera of South Georgia (Discovery Reports, 7, 27–138 ; 1933), a new species (No. 158) *Bigenerina minutissima* is recorded from two stations, WS 199, WS 472, not included in the chart. Mr. Earland informs us that the species in question was not found in the South Georgia area, and that its inclusion was an error observed too late for correction in proof. The two stations, WS 199, WS 472, are in the deep water of the Scotia Sea, within the area covered by his forthcoming report on Antarctic Foraminifera. References to them have also crept into the South Georgia report under *Ammobaculites agglutinans* (No. 116), *Ammomarginulina ensis* (No. 122) and *Clavulina communis* (No. 165), but are of less importance as these species were found elsewhere in the South Georgia area. Protozoologists may be glad to rectify these errors in their copies of the report.

Prof. S. H. Vines, F.R.S.

Our Oxford correspondent writes : "The tenure of the Sherardian professorship of botany by the late Sydney Howard Vines, F.R.S., which lasted from 1888 until 1919, was marked by a notable development in the activity and usefulness of the botanical department of the University. The studies of this department, associated in former years with the names of Morison, Sherard, Dillenius, Sibthorp and Daubeny, to which a quickening stimulus had already been applied by the vigorous personality of Sir Isaac Bayley Balfour, were by Prof. Vines advanced to a high degree of efficiency ; and the results of the energy which he brought to bear on the duties of his office are still apparent in the flourishing condition of the department of which Prof. A. G. Tansley, F.R.S., is the present head. The memory of Vines will live in Oxford as that of one whose outstanding ability and social charm made a deep and enduring impression on all his contemporaries."

Aberdeen Public Library

Arrangements in connexion with the meetings of the British Association in Aberdeen in September are in an advanced state. It happens that the jubilee of Aberdeen Public Library—established 1884—occurs this year, and the Library Committee proposed to celebrate the anniversary by offering the hospitality of the Library to representative members of the British Association, mainly in the form of an evening reception in the Central Library. It happens, however, that no evening is available in the Association's programme. Accordingly, the celebration is to take the form of a luncheon in the Reference Department of the Central Library on Friday, September 7.

New Committee for Research in Mental Disorders

The Medical Research Council, in consultation with the Board of Control, has appointed a new committee to advise and assist in the promotion of research into mental disorders. The reconstituted committee will include representatives not only of psychiatry, medical psychology, and the study of mental deficiency, but also of neurology, physiology, biochemistry, pathology, and genetics. The chairman of the Committee will be Prof. E. D. Adrian, of the Medical Research Council, and the following will also serve : Sir C. Hubert Bond, Board of Control ; Dr. Bernard Hart, University College Hospital, London ; Prof. D. K. Henderson, Royal Edinburgh Hospital for Mental and Nervous Disorders ; Dr. T. A. Ross, Cassel Hospital, Penshurst ; Dr. E. O. Lewis, Board of Control ; Dr. C. P. Symonds, Guy's Hospital, London ; Dr. J. H. Quastel, Cardiff City Mental Hospital ; Dr. J. G. Greenfield, National Hospital for Nervous Diseases, London ; F. L. Golla, Maudsley Hospital, London ; and Dr. L. S. Penrose, Royal Eastern Counties' Institution, Colchester. Sir David Munro, of the Council's staff, will act as secretary.

Research Conference on Spectroscopy and its Applications

On account of the enthusiastic response to the Spectroscopy Conference held at the Massachusetts Institute of Technology last summer, which was attended by more than a hundred workers from America and abroad, it has been decided by the Institute to hold a second conference this year. A

programme of papers and discussions is being prepared on the following topics, among others : absorption spectrophotometry (application to analysis of organic and inorganic substances and to the diagnosis and treatment of disease) ; analysis by the emission spectrum (determination of metallic and other atomic and molecular constituents of samples) ; biological and chemical effects of spectral radiation ; spectroscopy of the ultra-violet and infra-red ; analysis of spectra, and measurement of wave-length. It is anticipated that the earlier sessions of the week will be of especial interest to biologists, medical research workers, and chemists. The main emphasis will then shift to subjects of chief interest to the industrialist and engineer, the geologist, and the metallurgist. The latter part of the week will be devoted to more theoretical problems of the spectroscopist. The meetings will be open to anyone interested in the topics under discussion. The Massachusetts Institute also announces a special programme of summer courses on spectroscopy and its applications to be given during the six weeks preceding the conference, which will deal primarily with applications of spectroscopy to biology, chemistry, geology, metallurgy, and mineralogy. Inquiries regarding the Conference and courses should be addressed to Prof. G. R. Harrison, Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts.

Announcements

THE Garton Prize of £500 and Gold Medal of the British Empire Cancer Campaign, offered this year for an essay on "The Biological Effects and Mode of Action of Radiations upon Malignant and other Cells", has been awarded to Dr. H. A. Colwell, of Middlesex Hospital, London. As one of the other essays was of high merit, the Grand Council of the Campaign has decided that a second award, of £100, should be made to its authors, Dr. F. G. Spear in association with Dr. R. G. Canti, Mr. L. G. Grimmett, Dr. B. Holmes, Miss S. F. Cox and Dr. W. H. Love.

THE HON. OLIVER STANLEY, M.P., Minister of Transport, will unveil a tablet erected at University College, London, by the executive committee of the Trevithick Centenary Commemoration, on April 23. The tablet commemorates Trevithick's locomotive experiments in 1808.

PROF. E. K. RIDEAL, professor of colloid science in the University of Cambridge, will deliver the twenty-fourth annual May Lecture of the Institute of Metals on May 9 at the house of the Institution of Mechanical Engineers, taking as his subject "Gases and Metal Surfaces".

THE Annual Congress of the South-Eastern Union of Scientific Societies will be held at the University of Reading on July 11–14. Further information can be obtained from the Hon. General Secretary, Mr. Edward A. Martin, 14, High View Close, Norwood, London, S.E.19.

A TOUR of Norway (Oslo and Bergen areas) has been arranged by the Geologists' Association to take place on August 2–14. Further information can be obtained from the Secretary, Mr. W. L. Turner, 18, Valley Road, Shortlands, Bromley, Kent.

PROF. F. A. E. Crew, director of the Institute of Animal Genetics, University of Edinburgh, has received the following telegram from Prof. N. I. Vavilov : "All Union Soviet Conference at the Academy of Science, Leningrad, on the Evolution of Domestic Animals express greatest regret on the death of Professor Cossar Ewart, pioneer of investigations on the origin of domestic animals. President of Conference, Vavilov."

A COURSE of lectures on "Pathological Research in its Relation to Medicine" will be given in the lecture theatre of the Bacteriological Department of the Institute of Pathology and Research, St. Mary's Hospital, London, W.2, on Thursdays at 5 p.m. commencing on April 12. Sir Almroth Wright, principal of the Institute, is giving the opening lecture. The other lecturers will be Prof. A. Bethe, H. W. Bell Cairns, Sir Bernard Spilsbury, Prof. J. B. S. Haldane, Prof. J. C. Drummond, Prof. E. N. da C. Andrade, Dr. Leonard Colebrook.

A COURSE of two lectures delivered by Dr. A. N. Whitehead before the University of Chicago last October will be published shortly by the Cambridge University Press under the title "Nature and Life". The book is an attempt in brief to unite the world of science with the worlds of religion, art, literature and morality, and to show that Nature itself has processes, goals, beauty and values.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned :—A head of the Textile Department at the Municipal Technical College, Halifax—The Principal (April 20). A chemist for the Aeronautical Inspection Directorate, Air Ministry, Test House, Kidbrooke, S.E.—The Secretary, S.2, Air Ministry, Kingsway, W.C.2 (April 21). Two economists for the Ministry of Agriculture and Fisheries—The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 (April 23). An assistant lecturer in chemistry (subsidiary botany or pharmacognosy or pharmacy) at the Belfast Municipal College of Technology—The Principal (April 24). Two chemists (Class II), male, in the Department of War Department Chemist—The Under-Secretary of State, The War Office (C. 5), London, S.W.1 (April 28). An assistant lecturer in geography at the University of Manchester—The Registrar (April 30). Examiners in anatomy and physiology for the fellowship and in biology, anatomy, physiology, etc., for the Conjoint Board, at the Royal College of Surgeons of England—The Secretary (May 1). An assistant lecturer in dietetics and physiology at the King's College of Household and Social Science, Campden Hill Road, London, W.8—The Secretary (May 5).

Letters to the Editor

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

Disintegration of the Diplon

IT has been shown by Oliphant, Harteck and Lord Rutherford in a recent letter[1] that the bombardment by high-velocity diplons of compounds containing diplogen gives rise to three groups of particles—two groups of equal numbers of singly-charged particles of ranges 14·3 cm. and 1·6 cm., together with neutrons of maximum energy of about three million volts. They suggest as possible explanations of these results the reactions :

$$ {}_1D^2 + {}_1D^2 \rightarrow {}_1H^1 + {}_1H^3 \qquad (1) $$

$$ \text{and } {}_1D^2 + {}_1D^2 \rightarrow {}_2He^3 + {}_0n^1 \qquad (2) $$

an atom of $_1H^3$ of 1·6 cm. range and a proton of 14·3 cm. range satisfying the momentum relations in reaction (1). In this reaction it is to be expected that the proton and the isotope of hydrogen of mass 3 would recoil in opposite directions, except for a small correction due to the momentum of the captured diplon. The cloud track method is extremely suitable for an examination of this possibility, and I have recently taken expansion chamber photographs of the disintegration particles resulting from the bombardment of a target of 'heavy' ammonium sulphate with diplons, to see if further information can be obtained.

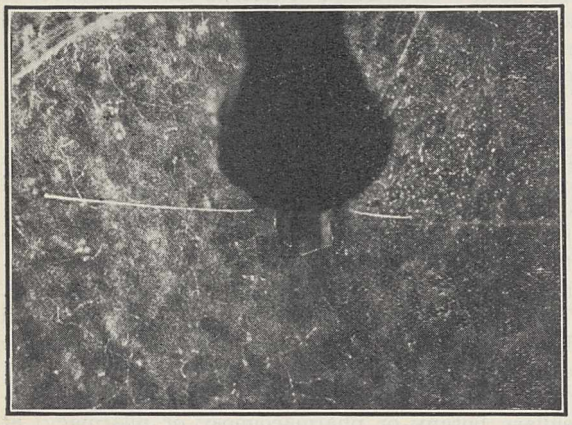

FIG. 1.

The first set of experiments was made with a thin target contained in an evacuated tube at the centre of the chamber. Two opposite sides of the end of this tube were closed with mica windows of 6·3 mm. and 11·4 cm. stopping power respectively. The chamber was filled with a suitable mixture of helium and air to increase the lengths of the tracks of the short particles. Under these conditions, the particles of 14·3 cm. range emerging through the thick window and the particles of 1·6 cm. range emerging through the thin window end in the chamber and the usual re-projection permits precise determination as to whether the two tracks are co-planar and of the ranges. Owing to the fine structure of the grid supporting the thin window the efficiency of collection of pairs cannot be high ; also the companion to a 14·3 cm. particle passing through the thin window would not be able to pass through the opposite thick window. In spite of these difficulties, opposite pairs of tracks of about 14·3 cm. and 1·6 cm. range are observed with far greater frequency than could be attributed to chance. The photograph reproduced as Fig. 1 is a fortunate example, the short track on the right being due to the new hydrogen isotope of mass 3. Detailed measurements of the lengths of the tracks and the angles between them are being made and will be published later.

To investigate the neutron emission, a second series of experiments has been made in which a target of the same material contained in a lead tube of 3 mm. wall thickness was bombarded in the same manner, the chamber being filled with a mixture of 50 per cent helium in air. Under these conditions, thirty-one recoil tracks originating in the gas have been photographed. Assuming that these are due to impacts with neutrons, the latter appear to constitute an approximately homogeneous group of maximum energy of about 1·8 million volts. This energy appears to be in fair agreement with reaction (2) on substitution of the mass of $_2He^3$, which can be estimated from consideration of the energies of the short-range products resulting from the transformation of $_3Li^6$ by protons[2,3,4]. The $_2He^3$ group of reaction (2) with a possible range of about 5 mm. would not pass through the thinnest window used in these experiments, but special arrangements are being made to search for them in an expansion chamber.

These experiments are the first to be made with a new discharge tube constructed following a design due to Dr. Oliphant. I should like to acknowledge the much valuable advice which Dr. Oliphant has always so readily given me in the course of construction of this tube. I am also indebted to him for preparing the diplogen targets used in these experiments.

P. I. DEE.

Cavendish Laboratory,
Cambridge.

[1] NATURE, **133**, 413, March 17, 1934.
[2] *Proc. Roy. Soc.*, A, **141**, 722 ; 1933.
[3] NATURE, **132**, 818, Nov. 25, 1933.
[4] NATURE, **133**, 377, March 10, 1934.

An Artificial Radioelement from Nitrogen

MESSRS. M. DANYSZ and M. Żyw, working in this laboratory, have bombarded diverse substances with α-rays from a thin-walled glass tube (resulting range about 5 cm.) containing some 15 millicuries of radon, and immediately afterwards have tested their activity with a Geiger-Müller counter. An activity decaying exponentially with a half period of 1·2 min. was found on *all* the substances examined, namely, platinum, silver, lead, calcium and nickel. No certain influence of the nature of the substance could be ascertained. The initial activity was of the order of 50 impulses per minute. The effect disappeared when the range of α-rays was reduced by two very thin gold foils or a few millimetres of air.

In subsequent experiments, a strongly activated platinum wire was used as source. In order to avoid contamination, the wire was enclosed in an airtight box, covered with a film of less than 1 mm. stopping power. The effective range of α-rays

from radium C′ was 6·5 cm. The effect was greatly increased, and amounted to about 200 impulses per minute with a source equivalent to 8 mgm. radium.

An obvious explanation of the effect was that it was due to the recoil of some new radio-element produced by the very fast α-particles. (Incidentally, it has been found that the recoil of radiophosphorus is easily detectable.) To test this possibility, experiments have been made (*a*) *in vacuo*, (*b*) in hydrogen, (*c*) in nitrogen, (*d*) in oxygen. As the effect was apparent only in nitrogen, we conclude that it consists in a transmutation of nitrogen[1] of the Joliot type, the probable reactions being :

$$(1)\ {}_7N^{14} + {}_2\alpha^4 = {}_9F^{17} + \text{neutron}, \quad (2)\ {}_9F^{17} = {}_8O^{17} + \text{positron}.$$

An examination of the particles entering the counter showed that they are completely absorbed by some 0·5 gm./cm.² of lead. An experiment with a magnetic field has shown definitely that the particles are positrons.

It appears probable that the transmutation of the Joliot type may be found in all known cases of transmutation of elements involving the emission of protons.

L. WERTENSTEIN.

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March 17.

[1] *Note added to proof.* We have since found that NaN_3 gives a greatly increased effect, which confirms our assumptions.

New Source of Positive Electrons

OBSERVATIONS made with a weak radium source placed inside the Wilson chamber in a magnetic field showed that, in addition to the β-particles of the natural spectrum, a very considerable number of positive electrons are also emitted.

The radiator consisted of a thin layer of radium salt deposited on the inner surface of a thin-walled glass tube. This small tube was introduced into a cylindrical protecting tube (of lead, in our first experiments, and afterwards of carbon) in the wall of which (4 mm. thick) a 2 mm. opening had been made. By this means an almost point-like source of β-rays was obtained, the velocities of which could be measured in the usual way. Under favourable conditions, tracks of positive electrons could be observed once in every three to four expansions on the average. Up to the present, 30 tracks have been observed with the following distribution of velocities :

Energy intervals (e./kv.)	Number of positrons
100–300	8
300–600	16
600–900	6

The number of positrons corresponding to every disintegration can be determined directly by calculating the number of electrons belonging to the natural spectrum, the tracks of which are seen on the same photographs. We have calculated the number of β-rays with an energy exceeding 1,000 kv. ; the total number of disintegration electrons was determined according to the well-known distribution curve of the continuous spectrum. The data obtained clearly show that the number of the emitted positrons are not less than 0·02–0·04 for each disintegrating atom of radium C. This unexpectedly high number exceeds by several times the total number of photo-electrons in the natural spectrum of radium C. (According to Ellis[1] the number of electrons per disintegration of all groups of the linear spectrum of radium C is about 0·009.) This comparison makes it highly improbable that the observed positive electrons are due to the internal conversion of γ-rays. In any event, the coefficient of internal conversion which would have to be adopted on the assumption that the observed phenomenon is due to the internal photoeffect from the levels of negative energy exceeds the theoretical value some hundred times.

The theoretical data available are not sufficient for a comparison to be made. A rough estimate can be obtained by assuming the upper limit of the effect which would be still compatible with theoretical considerations to have the following value :

Nedelsky and Oppenheimer[2] give for the wave-length $\lambda = 4{\cdot}7$ X.U. the internal conversion coefficient $= 5 \times 10^{-4}$. If we assume that all the γ-lines in the spectrum of radium C with $h\nu > 1120$ kv. (the number of quanta per disintegration = 0·45) undergo internal conversion with the coefficient 5×10^{-4} calculated for the limit of the spectrum, then the number of positive photoelectrons will be equal to $0{\cdot}45 \times 5 \times 10^{-4} = 2 \times 10^{-4}$. Thus, some new mechanism appears to be involved in the production of positrons, being presumably connected with β-disintegration.

It may be added that Lecoin[3], using the same method of investigation, was unable to observe the emission of positive electrons in the case of radium E, where the limit of the spectrum does not very much exceed $2\,mc^2$. Neither can the observed phenomenon be ascribed to the effect of α-particles, which has recently been discovered by Curie and Joliot[4], since this would mean one positron corresponding on the average to every 100 α-particles.

Note added in proof (March 17). More recent experiments have shown that a considerable part of the positrons must be due to the action of the β-rays on the walls surrounding the radioactive source. A further communication follows.

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E. STEPANOWA.

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Feb. 12.

[1] C. D. Ellis, *Proc. Roy. Soc.*, A, **143**, 350 ; 1934.
[2] L. Nedelsky and J. R. Oppenheimer, *Phys. Rev.*, **44**, 948 ; 1933.
[3] M. Lecoin, *C.R.*, **197**, 405 ; 1933.
[4] I. Curie and F. Joliot, *C.R.*, **198**, 254 ; 1934.

Decay Constant of Radium C′

IN previous notes[1] an account has been given of a measurement of the decay constant of radium C′. The method consisted in determinations of the number of α-particles emitted from a beam of recoil atoms from radium C at various distances from the source. For the half period a value of the order 10^{-5} sec. was found. During a continuation of these experiments, it was found that the number of α-particles emitted from a beam of recoil atoms depended greatly on the temperature of the walls of the apparatus. When the walls were cooled by liquid air, the source being at room temperature, a large number of α-particles were emitted from the wall facing the source. From these experiments it was concluded that, at room temperature, the recoil atoms are at least partly reflected from the walls of the apparatus. The dependence of the number of

α-particles emitted from the recoil atoms on the temperature of the walls indicated that the shape of the decay curve was complicated by the reflection of the recoil atoms from the walls.

Since Gamow's theory gives a much greater value for the life period than that found in the experiments with moving recoil atoms, it was thought possible to obtain an estimate of the life-period of radium C′ by means of Geiger counters without making use of the recoil phenomenon. The arrangement which was finally adopted[2] consisted of two small counters, placed close to one another in a vessel, which was exhausted to a pressure of 5 cm. of mercury. The central electrodes were connected to the grid of each one of two amplifying valves; each of the anode circuits contained a moving-iron oscillograph. The active material (about 10^{-6} mgm.) was placed between the counters. By closing the counters by aluminium foils of appropriate thickness, it was arranged so that one of the counters was excited only by β-particles, the other by both α- and β-particles.

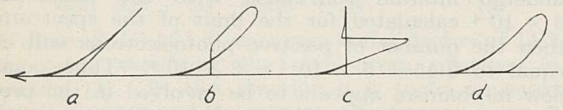

Fig. 1.

The deflections of the mirrors of the oscillographs were crossed, so that one mirror gave a horizontal deflection, the other a vertical one. Light from an arc lamp was reflected successively from the two mirrors and concentrated by a lens on a film, which was moved with a velocity of about 1 cm. per second. The appearance of the deflections obtained is shown in Fig. 1 (*a*, *b*, *c*, *d*). The direction of movement of the light spot on the film is shown by the arrow; *a* shows a true coincidence, in *b* and *c* the counters are excited with a time difference shorter or longer respectively than the duration of the impulse from the counter; for this a value of $1{\cdot}5 \times 10^{-3}$ sec. was obtained in separate experiments; a time difference of a tenth of this could still be detected. In *d* the time difference has the opposite sign to that of *b*. This type of deflection is not suited for measurements, since the position of the bend is difficult to observe.

With radium C as source, a large number of deflections of the types shown in *a* and *b* (or *d*) were observed. The sign of the time differences showed that the β-particle was emitted before the α-particle. Deflections of the types *a* and *b* were obtained in about equal numbers; this gives for the half period of radium C′ a value of 2×10^{-4} sec. with an accuracy of about 50 per cent. A more accurate determination would require a knowledge of the frequency of occurrence of time differences of different lengths. Such a procedure would scarcely be legitimate considering that the magnitudes of the impulses from the counters were varied somewhat.

The existence of eventual time lags in the action of the counters was tested by using thorium C as source. With this substance, only true coincidences were observed; this shows that the time lag in the action of the counters is small compared with 10^{-4} sec.

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March 6.

[1] *Phil. Mag.*, **47**, 23; 1924. Nature, **120**, 874, Dec. 17, 1927.
[2] Nature, **128**, 185, Aug. 1, 1931.

Continuous X-Ray Spectrum from a Thin Target

In order to investigate the true energy distribution in the continuous X-ray spectrum, the target to be used must be sufficiently thin to ensure that the cathode rays passing through it produce only a single excitation. For ordinary voltages, metal foils 10^{-4}–10^{-5} cm. thick can be used for this purpose. The intensity of X-rays obtained under these conditions is very low, a fact which prevented Kulenkampff[1] measuring the energy distribution with a crystal spectrometer.

It was found possible to investigate the intensity distribution in the continuous spectrum from a thin aluminium foil with an ionisation spectrometer equipped with a Geiger-Müller tube counter, instead of the ionisation chamber. The aluminium foils used had an initial mean thickness of $5{\cdot}5 \times 10^{-5}$ cm.; under the bombardment by cathode rays the thickness decreased to such an extent that the cathode spot became semi-transparent, corresponding approximately to the thickness of 1×10^{-5} cm.; all the measurements were performed with these thinned foils.

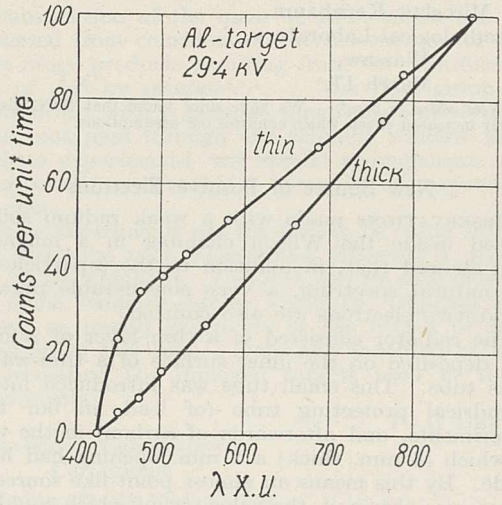

Fig. 1.

The ionisation spectrometer was set at an angle of 90° between the X-rays and the cathode stream. The rays were analysed by a calcite crystal, and entering the tube counter along its axis, did not strike the walls or the central wire. The counter was filled with a mixture of argon at a pressure of 46 cm. and air at 10 cm.

Intensity distribution measurements in the wave-length region from λ_0 to $2\lambda_0$ (λ_0 is the high frequency limit of the spectrum) from thin targets were made at voltages of 20, 30 and 40 kilovolts. For comparison, analogous measurements were repeated with a thick aluminium plate. The intensity curves directly obtained in both cases at 30 kv. are shown in Fig. 1. Similar results were obtained at the other voltages.

The following points must be considered in order to deduce from these curves the true energy distribution: (1) absorption of the rays on their path from the target to the counter; (2) incomplete absorption in the counter; (3) finite slit widths; (4) wave-length dependence of the reflection coefficient of the crystal. In the case of the thick target,

the absorption in the target itself must be also taken into consideration.

Applying the corresponding corrections and calculating from the number of quanta recorded by the counter the energy, one can finally obtain the true energy distribution in the spectrum.

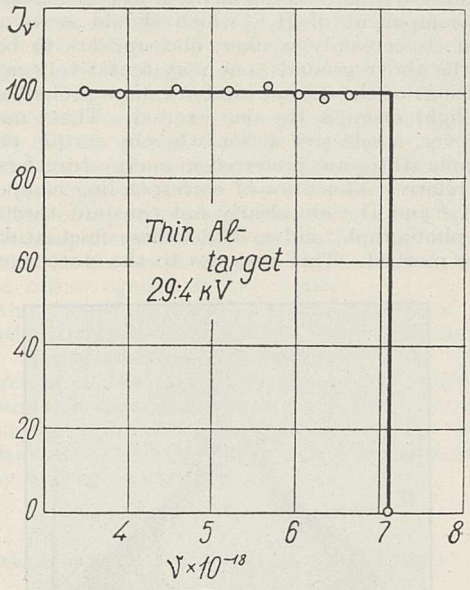

FIG. 2.

For thin targets the energy is found to be independent of the frequency from ν_0 to $\frac{1}{2}\nu_0$. At the high frequency limit ν_0, there is a sharp discontinuity (Fig. 2). This result is in accord with Sommerfeld's[2] theory of the continuous spectrum. For the thick target the well-known energy distribution as represented by Kulenkampff's formula is obtained.

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Feb. 9.

[1] H. Kulenkampff, *Ann. Phys.*, **87**, 597; 1928.
[2] A. Sommerfeld, *Ann. Phys.*, **11**, 257; 1931.

Vibrational States of Rb_2 and Cs_2

THE channelled bands of rubidium and cæsium have already been studied by many authors, but the analyses of the vibrational states have not been completed. By close examination of the spectrograms which I have obtained with a plane grating and a quartz lens of three metres in focal length, I have found the vibrational structures of the bands and made an attempt to analyse them. In the case of rubidium, the frequencies of the heads of the bands may be represented as follows:

For the red system,

$$\nu = 14666 + 47{\cdot}3(n' + \tfrac{1}{2}) - 0{\cdot}15(n' + \tfrac{1}{2})^2 - 57{\cdot}8(n'' + \tfrac{1}{2}) + 0{\cdot}14(n'' + \tfrac{1}{2})^2;$$

for the blue system,

$$\nu = 20930 + 38(n' + \tfrac{1}{2}) - 0{\cdot}3(n' + \tfrac{1}{2})^2 - 57(n'' + \tfrac{1}{2}) + 0{\cdot}1(n'' + \tfrac{1}{2})^2;$$

for the violet system,

$$\nu = 22968 + 38(n' + \tfrac{1}{2}) - 0{\cdot}0(n' + \tfrac{1}{2})^2 - 59(n'' + \tfrac{1}{2}) + 0{\cdot}1(n'' + \tfrac{1}{2})^2.$$

In addition to these three systems, another one at 8800 A. was also observed with a spectrograph with a lower dispersion.

It is generally accepted that the ground state of the molecules of other alkali metals is $^1\Sigma_g^+$, and there are two excited states, $^1\Sigma_u^+$ and $^1\Pi_u$, above this. The system observed in the near infra-red at 8800 A. may be due to the transition $^1\Sigma_u^+ \leftarrow {}^1\Sigma_g^+$, and it is considered that the red one is due to the transition $^1\Pi_u \leftarrow {}^1\Sigma_g^+$ while the blue system may correspond to the blue band system in potassium.

In the case of cæsium, I have tried to arrange 83 heads of the red system at 6300 A. which has already been measured by Rompe[1], but not analysed. The formula is as follows:

$$\nu = 15801 + 25{\cdot}7n' - 40{\cdot}0n''.$$

As a result of the lack of heads corresponding to the higher quantum numbers and the slowness of convergency, the terms of the second order were omitted. In the band system at 7600 A., 38 heads were measured and were arranged as follows:

$$\nu = 13040 + 33{\cdot}7n' - 41{\cdot}3n''.$$

The other band system at 7200 A. was also photographed, but the close crowding of the heads near the system origin makes it very difficult to measure the heads. From the measurements of 16 heads in the region of longer wave-lengths, it was known that the vibrational quanta of the lower and the upper states were 39 cm.$^{-1}$ and 29 cm.$^{-1}$ respectively. A new absorption band was observed in the infra-red spreading from 8735 A. to the farther infra-red.

In the case of cæsium, four band systems were observed near the resonance doublet, but there are only two systems in other alkali metals. Probably at the upper level of the system at 8700 A. and 7600 A. the molecules will dissociate into a normal and an excited $^2P_{1/2}$ atom, while at 8200 A. and

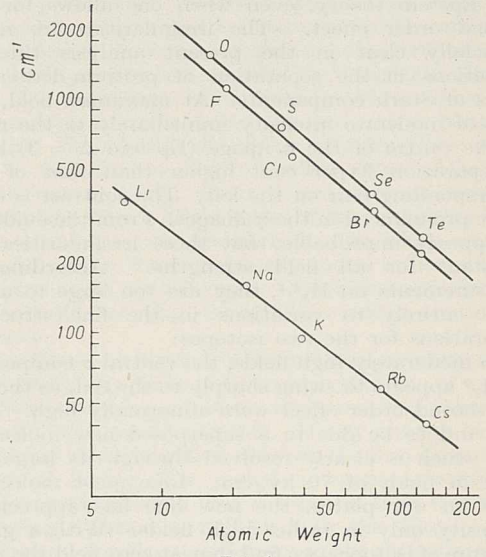

FIG. 1.

7200 A. they dissociate into a normal and a $^2P_{3/2}$ atom.

The strong absorptions at the shorter wave-length end of the band, observed in the cæsium, are due to the fact that on one branch of the Condon parabola the wave-lengths of the heads are nearly constant.

It is very interesting to remark here that the logarithms of the vibrational frequencies in the ground states of the molecules of five alkalis and of four halogens, together with four elements in the sixth group in the periodic table, vary linearly with the logarithms of their atomic weights, as shown in the accompanying figure (Fig. 1). The points corresponding to K, Cl, S were displaced downwards. This anomaly appears also in the fifth group: N, As, Bi lie on a straight line and P below the line.

Full accounts of the experimental results will shortly be published elsewhere.

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Dec. 25.

[1] R. Rompe, *Z. Phys.*, **74**, 175; 1932.

Stark Effect for the Hydrogen Isotopes

Recently we have taken several photographs of the Stark effect in a mixture of the two hydrogen isotopes, using deuterium kindly supplied by Prof. Urey. The measured zero field separation of each pair of Balmer lines persists in high fields with small variations as noted below.

The minimum field for good resolutions in the Stark effect is fortunately the same for nearly all the Stark components of each Balmer pair. It varies, however, from about 50 kv./cm. in $H_{\delta}^{1,2}$ to 130 kv./cm. in $H_{\alpha}^{1,2}$.

From left to right in the accompanying photograph (Fig. 1) of $H_{\gamma}^{1,2}$ one finds alternately components of H_{γ}^{2} and H_{γ}^{1}. The maximum field of 52 kv./cm. is sufficient to show the character of the lines, and to separate completely the two Stark effects.

The displacements are not exactly those given by the Epstein theory, even when one allows for the second order effect. The irregularities are made especially clear in the present analysis through variations in the separation of protium-deuterium pairs of Stark components. At maximum field, the pair of moderate intensity immediately to the right of the centre of the σ image (Epstein $\Delta = 3$) have a separation 9 per cent higher than that of the corresponding pair on the left. The contrast is even more pronounced in the π images. From the evidence it appears improbable that these irregularities are constant for all field strengths. According to measurements on $H_{\gamma}^{1,2}$, they are too large to attribute entirely to variations in the fine structure separations for the two isotopes.

In moderately high fields, the central σ component of H_{γ}^{2} appears to swing sharply to the red, as though the second order effect were abnormally high. This is found to be due to a superposed new molecular line which is clearly resolved through its large red shift in fields of 70 kv./cm. Like most molecular lines on our plates, the new line has appreciable intensity only in rather high fields. With a given mixture of isotopes, we find that at zero field the deuterium line is always stronger in $H_{\gamma}^{1,2}$ than in $H_{\beta}^{1,2}$. In the accompanying photograph, the light hydrogen line is clearly much the stronger in the normal spectrum. With the application of even low fields, however, the energy passes more to H_{γ}^{2}, so that at maximum field the two patterns are of almost equal strength. The intensity variations suggest as their principal origin collisions of the second kind, between atoms of the two isotopes. This phenomenon might be expected to become most prominent in cases of perfect resonance which exist at fields where components of the isotopes cross. In the region between the strong central σ components, and at moderate fields, it may be noticed that a component of H_{γ}^{2} persists, while the component of H_{γ}^{1}, which should cross at this point, is certainly weaker, and appears to be lost. On the above grounds, one may tentatively say that collisions of the second kind are more probable when the light atom is the one excited. There may be, however, a selective action whereby certain pairs of isotopic states are preferred in energy transfers; for the relative intensities of corresponding components of H_{γ}^{2} and H_{γ}^{1} are clearly not constant throughout the photograph, and in $H_{\beta}^{1,2}$ these fluctuations are more marked. This amounts to the statement that

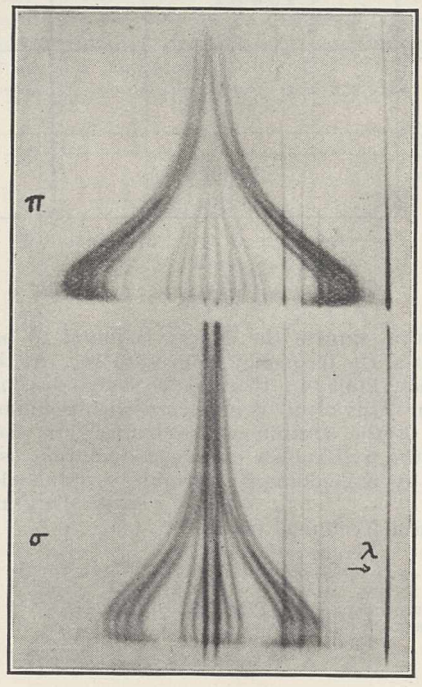

Fig. 1. The spectral line $H_{\gamma}^{1,2}$ in fields up to 52 kv./cm.

there are departures from the Schrödinger intensities, and that the departures are not the same for the two isotopes.

A great many new molecular lines are found with moderate displacements. The research is being extended to include a study of the molecular spectra as well as the atomic spectra with varying proportions of the isotopes.

Explosions occur in Lo Surdo sources when a small amount of oxygen is allowed to mix with the deuterium at a total pressure of one to two millimetres. Under such conditions, explosions are not observed with light hydrogen. In the present case they appear to be set off by a rather intense heating of the cathode surface.

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McGill University, Montreal.
March 1.

Absorption Spectra of Chlorophylls *a* and *b* at Room and Liquid Nitrogen Temperatures

THE absorption spectra of ether solutions of chlorophylls *a* and *b*, prepared by the method described earlier[1], were photographed at the temperature of liquid nitrogen. A Steinheil spectrograph and panchromatic plates were used for the spectral region λ 4100–6700 A. Pyrex glass absorption cells with internal thickness of 1 mm. contained the solutions. Four plane quartz windows in the walls of the Dewar vessel permitted parallel light to pass from the Mazda source through the liquid nitrogen bath and the solid solution of chlorophyll in ether, to the spectrograph slit. The slit width was 0·02 mm. The photographs were taken as soon as possible after freezing the solutions because the development of cracks in the solid ether solution caused it to become rather opaque in two hours.

In the following table is a comparison of the absorption maxima measured at room temperature by a spectro-photoelectric method[2] and those measured at − 196° C. by the photographic method. The bands at room temperature are listed in order of their decreasing absolute intensities. The band intensities at − 196° C. are listed in decreasing order as they appear on the plates.

	Wave-lengths of Absorption Maxima at	
	25° C.	− 196° C.
Chlorophyll *a*	4275 A.	End absorption to 4520 A.
	6600	6640
	4100	4920
	6125	6320
	5725	6180
	5275	6015
	4975	5760
		5365
Chlorophyll *b*	4525	4770
	4300	6510
	6425	4420
	5925	6000
	5675	6350
	5475	5760
	5025	5480

At − 196° C. the absorption bands are considerably narrower than at room temperature and their maxima are shifted. Absorption spectra of "fraction *c*"[1] at − 196° C. were intermediate between those of components *a* and *b*.

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(National Research Fellow in the Biological Sciences).
George Herbert Jones Chemical Laboratory,
University, Chicago.
March 5.

[1] Zscheile, F. P., Jr., *Bot. Gaz.*, to appear in June 1934.
[2] Zscheile, F. P., Jr., Hogness, T. R., and Young, T. F. J., *Phys. Chem.*, **38**, 1; 1934.

Investigation of Paraphysical Phenomena

A CERTAIN interest in the physical aspects of psychical research has recently been shown in these columns[1]. In view of the fact that the controversy seems to turn mainly upon the alleged paranormal or extra-contemporary-physical powers of Rudi Schneider, it may be worth while briefly to record a series of experiments with that medium, although the results are merely of a negative character. Full experimental details will in due course be published in the *Proceedings of the Society for Psychical Research*.

Sittings were held about twice a week from October 1933 until March 1934 inclusive in the *séance*-room of that Society. No evidence of absorptions of a beam of infra-red light of the type recorded by Osty[2] and Herbert[3] could be obtained, notwithstanding frequent announcements by the trance personality that the 'force' had entered the ray. The apparatus used was (1) a Moll galvanometer with Moll thermopiles, and (2) a Westinghouse copper–copper oxide photoelectric cell in series with an Einthoven galvanometer. In both cases the sensitivity and the precautions taken against electrical leaks, vibration, and stray heating effects were such that an absorption of one half per cent could be detected. All visible light was excluded from the beam by a sheet of ebonite of thickness of 0·005 cm., or by a filter of 1 cm. of a saturated solution of iodine in carbon disulphide in a glass vessel, or by both. For this solution Coblenz gives the following transmissions :

Transmission	Per cent	Transmission	Per cent
0·75μ	0	3μ	60
1·0μ	80	4μ	10
1–2·5μ	90	5μ	0

This filter was used because the photographic work of Rayleigh[4] and Herbert indicated that absorptions did not occur at wave-lengths shorter than 1μ, while Herbert and Osty, using photocells which cannot have been sensitive beyond 5–6μ, both recorded absorptions. The thermopiles should have been both sensitive and rapid enough to detect absorptions of the type previously recorded, and the surface density of illumination was kept low, as this is supposed[5] to increase the chance of observing absorptions. The possibility of short-period absorptions was negatived by the use of the photocell.

A cinema camera was installed with a film sensitive to the infra-red, supplied by Messrs. Ilford, and it was found possible to obtain sharply defined moving pictures in a feeble red light. By increasing the flood-lighting, and using horn or ebonite filters, it is confidently expected that cinema films could be taken in total absence of visible light. By this means, motion pictures of telekinetic phenomena could be obtained in a light that is innocuous to the medium. No evidence, however, could be obtained of the telekinetic phenomena recorded by Price[6] and others, with the exception of a considerable number of movements, not exceeding 10 cm., of a hanging curtain. In order to determine whether these were due to draughts, a strip of tinfoil about a foot in length was so hung, about 5 mm. from a vertical metal plate, that a slight draught brought them into contact and rang an electric bell. The whole was so placed that the 'force' had ready access to it and that draughts could not affect it. Under these conditions the bell did not ring, though the curtain continued to move.

The 'force' on several occasions was announced by the medium in trance to have gone into one of a pair of cotton wool lagged boxes and remained there for a period of some 15 minutes. If any change in the difference of temperature between the two boxes was produced during this period a copper–constantan thermocouple showed that it was less than 0·003° C.

During a period of half an hour the 'force' could produce no significant difference in the rate of growth of two strains of *Bacillus fluorescens* or in the fermenting power of yeast.

A comparative investigation of the medium's personalities normally and in trance was undertaken by means of the word association test in conjunction with the observation of the psychogalvanic reflex. A preliminary scrutiny of the results shows that 'Olga',

the trance personality, has a vocabulary limited to the few words used by 'her' during the ordinary sittings.

It has been alleged that the trance personality is aware of what goes on in the dark *séance*-room[2,6]; in these sittings this was not found to be the case.

The rate of breathing of the medium in trance ranged, in these sittings, from 90 to 260 cycles per minute, continuing with two or three intervals of some 15 minutes each, for 5 to 6½ hours. The longest continuous period was 2½ hours, with frequent stops totalling about 10 minutes. In view of the fact that this respiration has been regarded as a remarkable physiological phenomenon, samples were collected and analysed by Dr. C. G. Douglas, showing that the medium in no way overbreathes. As the rate of respiration increases so its depth decreases; the total oxygen consumption per minute observed never exceeded 1410 c.c. at N.T.P., which corresponds to a man walking some four miles an hour. During trance this medium is in constant, often violent movement, so that these results are in no way paranormal. Moreover, we have found no difficulty in imitating his breathing.

Every suggestion made by the medium and the trance personality was acted upon, and both repeatedly expressed their satisfaction with the arrangements and with the investigators. On our side it is impossible to speak too highly of Rudi Schneider's willingness to submit to every suggested test and control; he acted throughout with the most scrupulous straightforwardness.

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Oliver Gatty.

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[1] Nature, **132**, 776, 801, 849; 1933.
[2] E. and M. Osty, "Les pouvoirs inconnus de l'esprit sur la matière", 1932.
[3] C. V. C. Herbert, *Proc. S.P.R.*, **41**, 259; 1933.
[4] Lord Rayleigh, *Proc. S.P.R.*, **41**, 89, 269; 1933.
[5] E. Osty, "Supernormal Aspects of Energy and Matter" (F. W. H. Myers Memorial Lecture), pp. 18, 30; 1933.
[6] H. Price, "Rudi Schneider", 1930; "An Account of some further Experiments with Rudi Schneider", 1933.

Transformation of Yellow Mercuric Iodide into the Red Form

Rodwell and Elder[1] have observed microscopically that when yellow orthorhombic crystals of mercuric iodide are touched, the change into the red variety continues through the whole mass of crystals, and the resulting pseudomorph consists of minute octahedrons of the red form.

It is well known that the yellow form crystallises from a solution of mercuric iodide in alcohol, and exists for varying lengths of time. On viewing under the microscope single crystals free from etched markings, the change from the yellow into the red variety is found to be in accordance with the usual type observed in solid reactions. After about 15 minutes, nucleation usually occurs along the whole length of the crystal edge; the interface then advances rapidly across the crystal parallel to the opposite edge. Occasionally nucleation occurs as a thin strip in the interior of the crystal parallel to the edges; the interface then moves out towards the edges of the crystal with approximately the same linear rate in both directions. It appears that nucleation occurs along some weak axis in the crystal, and immediately spreads along the whole length; the reaction proceeds with the usual parallel advance. At 20° C. the mean linear rate of advance of the interface was 0·0025 cm./sec.

By heating the red variety, very much smaller rhombohedra of the yellow form were volatilised on to a cover-glass. Such crystals commenced to change into the red form after about five hours, the reaction spreading inwards very slowly from all four edges with the usual parallel advance of the interface; octahedra of the red form could be observed in the decomposed part of the crystal.

The linear advance of the interface parallel to the edges of the crystal has previously been observed in the case of true decomposition, for example, potassium hydrogen oxalate hemihydrate[2] and potassium chlorate[3], and it appears to be characteristic also of the transition from one crystalline form into another of polymorphic substances.

Investigation of the reaction is proceeding.

John B. M. Coppock.

Robert Gordon's Colleges,
Aberdeen.

[1] Rodwell and Elder, *Proc Roy. Soc.*, **28**, 284; 1879.
[2] Hume and Colvin, *Proc. Roy. Soc.*, A, **125**, 635; 1929.
[3] Coppock, Colvin and Hume, *Trans. Far. Soc.*, **27**, 283; 1931.

Rate of Nucleation of Copper Sulphate in Vacuum

The rate of growth of the centres of dehydration of $CuSO_4.5H_2O$ varies with the crystal direction. On the large faces of the crystal, the nuclei grow in the form of a cross and the direction of the arms of the cross are parallel to two of the crystal axes. The underlying surfaces of the nuclei prove to be very complex, for a disc of dehydrated material is found to be suspended from the longer arm of the cross. This disc passes into the crystal at an angle of approximately 33°.

Counts have been made of the rate of production of centres of decomposition on the surfaces of a crystal, when this has been removed from the saturated solution, carefully dried and placed in a high vacuum. No visible nuclei appear at room temperature until after an induction period which is of the order of 100 minutes at 18° C. Thereafter, the number of nuclei increases at a linear rate. The length of the induction period decreases with increasing temperature, but on account of variations in the behaviour of individual crystals it has not been possible to determine the temperature coefficient. Scratched crystals give shorter induction periods, and crystals with irregular surfaces give larger numbers of centres than more perfect crystals.

The induction period is most probably due to the slow rate of growth of the nuclei when first formed, this rate being much slower than that of visible nuclei. It is thus incorrect to assume in all cases of solid decomposition that the outward rate of growth of the nuclei is constant at all stages in their growth[1]. In the decomposition of barium azide where the rate of decomposition is given by $dp/dt \sim t^{10}$ and in that of mercury fulminate where $dp/dt \sim t^{24}$, the observed induction periods are in the main to be ascribed to an accelerating rate of nuclear growth.

N. F. H. Bright.
W. E. Garner.

The University,
Bristol.
March 16.

[1] Cf. S. V. Izmailov, *Phys. Z. Sowjet Union*, **4**, 835; 1934.

Photochemistry and Absorption Spectrum of Acetone

IT has been generally assumed that the explanation of the diffuse absorption spectra of aldehydes and ketones in the ultra-violet is the occurrence of a process of predissociation involving the splitting of a C — H or C — C link[1]. Against this observation are the following observations :

(1) The vapours of aldehydes and ketones exhibit fluorescence.

(2) The unimolecular decomposition is always accompanied by bimolecular polymerisation.

(3) The quantum efficiency of decomposition is diminished on passing from C — H to C — C compounds.

(4) Complex ketones decompose in quite a different way from acetone, giving very little carbon monoxide.

(5) The photodecomposition is not a chain reaction.

The photo-reactions of acetone illustrate (1) and (2). In the gaseous state it decomposes with a quantum efficiency of about 0·2 only[2], and we have found that in the liquid state it polymerises (without decomposition) with about the same quantum efficiency. As it is difficult to assume a back reaction to explain the low efficiency[3], it seems more probable that no splitting of a link occurs in the excited molecule. Instead, two processes may occur : (i) bimolecular interaction to give polymerisation, (ii) unimolecular decomposition through the similar interaction of two parts of the molecule, for example,

$$\begin{matrix}CH_3\\CH_3\end{matrix}\!>\!CO \longrightarrow \begin{matrix}CH_3\\|\\CH_3\end{matrix} + CO.$$

In the case of the ketone $\begin{matrix}CH_3CH_2CH_2CH_2\\CH_3\end{matrix}\!>\!CO$ the products are not unexpectedly $\begin{matrix}CH_3-CH\\\|\\CH_2\end{matrix}$ and $\begin{matrix}CH_3\\CH_3\end{matrix}\!>\!CO$.[4]

Unless the above unimolecular dissociation takes place within a rotational period it becomes necessary to find another explanation of the diffuseness of the absorption spectrum of some of these substances. We have recently examined the absorption spectrum of acetone, using pressures 0·5–200 mm. in absorbing columns up to one metre. With pressures higher than a few mm. a region of continuous absorption extends from *c.* 3200 A. to 2400 A., with a maximum at about 2800 A. This is the region characteristic of compounds containing the $>C=O$ group. At lower pressures in longer columns and under higher dispersion (Hilger E_1 spectrograph) this continuum splits up into about four groups each containing about 25 diffuse bands. The centres of the respective groups lie at *c.* 3150, 2900, 2710 and 2570 A. The corresponding intervals are 2740, 2420 and 2010 cm.$^{-1}$. (A strong Raman frequency of acetone is 2900 cm.$^{-1}$.) The width of the bands is of the order 2·5 A. (*c.* 30 cm.$^{-1}$) and their separation uniformly about 4 A. With increasing pressure the bands widen and the groups extend so as to produce an effectively continuous absorption.

This type of equally spaced diffuse narrow diffuse bands is similar to that found in other *Y*-shaped molecules[5]. Assuming that the CH_3 groups of acetone behave as single masses of 15, and using probable interatomic distances, the moments of inertia of the *Y*-shaped molecule are such that the rotation lines in the bands should be separated by only *c.* 0·4 cm.$^{-1}$. There will, moreover, be a double series of *P* and *R* branches. It seems therefore inherently impossible to detect the fine structure in this spectrum, and the diffuseness of the bands can be attributed to an unresolved close packing of the rotation lines without calling upon the additional hypothesis of predissociation.

In the case of formaldehyde, where the moments of inertia are much smaller, it is not surprising that a region of fine structure is observed followed by diffuse bands, indicating unimolecular rearrangements within periods greater or less than those of rotation.

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H. W. THOMPSON.

University College and
St. John's College,
Oxford.
Feb. 27.

[1] G. Herzberg, *Trans. Far. Soc.*, **27**, 378 ; 1931 : R. Mecke, *ibid.*, 359.
[2] G. H. Damon and F. Daniels, *J.A.C.S.*, **55**, 2363 ; 1933.
[3] c.f. NH_3 E. O. Wiig and G. B. Kistiakowsky, *J.A.C.S.*, **54**, 1806 ; 1932 : R. O. Ogg, P. H. Leighton and F. W. Bergstrom, *ibid.*, **56**, 318 ; 1934.
[4] R. G. W. Norrish, *Trans. Far. Soc.*, **30**, 103 ; 1934.
[5] V. Henri and O. R. Howell, *Proc. Roy. Soc.*, A, **128**, 192 ; 1930.

Activated Adsorption and Para-Ortho Hydrogen Conversion on Charcoal

THE para-ortho hydrogen conversion was used by us among other reactions, at the suggestion of Prof. A. Frumkin, in order to investigate the chemical properties of hydrogen adsorbed on charcoal at high temperatures.

It has been shown in a qualitative way by Harkness and Emmett[1] and by Rummel[2] that adsorption of hydrogen on the surface of catalysts diminishes their activity in the ortho-para hydrogen conversion at 90° K.

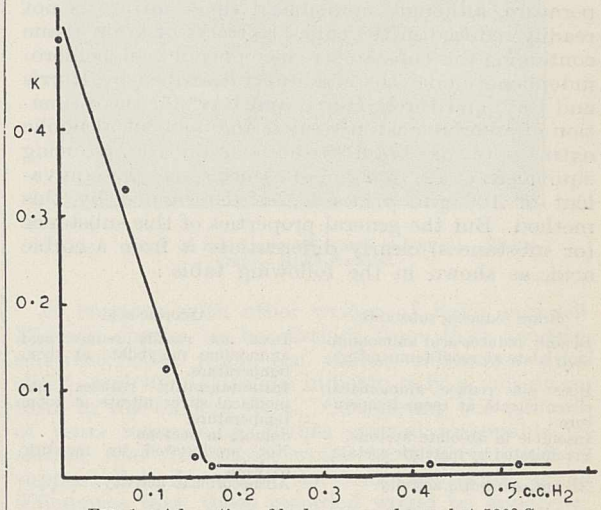

FIG. 1. Adsorption of hydrogen on charcoal at 500° C.

We have investigated the relation between the velocity of the para-ortho conversion at 20° C. and the quantity of gas adsorbed in the activated form. The charcoal was outgassed at 950°, then allowed to cool to the temperature of hydrogen adsorption, and after a definite amount of gas was adsorbed, further cooled to room temperature. The velocity of the

para-ortho conversion was measured at 20° C. using the dynamic method. These experiments (Fig. 1) have shown that the half period of the reaction τ falls in an almost linear way when the quantity of hydrogen adsorbed at 500° increases. The adsorption of 0·17 c.c. hydrogen on 1 gm. of charcoal brings down the velocity to almost zero; this quantity of hydrogen covers less than one thousandth part of the surface. Further increase of the quantity of adsorbed hydrogen has practically no influence on the velocity of the reaction. The poisoning action of hydrogen adsorbed at high temperatures is also observed when the para-ortho conversion was carried out at 300°, but the measurements in this case are inaccurate because hydrogen is already adsorbed with a measurable velocity in the activated form at 300° and the catalyst is therefore gradually poisoned during the reaction.

The change in catalytic activity caused by the activated adsorption cannot be explained merely by a diminution of the van der Waals' adsorption[3], as experiments which we have carried out have shown that the latter is practically uninfluenced by a previous activated adsorption of 0·17 c.c. of hydrogen.

R. Burstein.
Moscow. P. Kashtanov.
Feb. 3.

[1] Harkness and Emmett, *J. Amer. Chem. Soc.*, **56**, 3496; 1933.
[2] Rummel, *Z. phys. Chem.*, A, **167**, 227; 1933.
[3] Bonhöffer, Farkas and Rummel, *Z. phys. Chem.*, B, **21**, 225; 1933.

A Reducing Substance in Brain Tissue

Experiments in this laboratory on the chemical basis of some histological staining reactions of brain tissue have shown that all the brain tissues examined (mouse, rat, guinea pig, ox) contain a substance which has the peculiar property of reducing silver nitrate in neutral or acetic acid solution at room temperature, although ammoniacal silver nitrate is not readily reduced in the cold. Extracts of brain tissue containing this substance reduce phenol 2 : 6 dichloroindophenol under the conditions described by Harris and Ray[1] and Birch, Harris and Ray[2] for the estimation of ascorbic acid in tissues, and aqueous alcoholic extracts of ox brain tissue contain the reducing equivalent of 12–15 mgm. of ascorbic acid per equivalent of 100 gm. of tissue, as determined by this method. But the general properties of this substance (or substances) clearly differentiate it from ascorbic acid, as shown in the following table:

Brain reducing substance	Ascorbic acid
Readily reduces acid ammonium molybdate at room temperature.	Does not readily reduce acid ammonium molybdate at room temperature.
Does not reduce ammoniacal silver nitrate at room temperature.	Instantaneously reduces ammoniacal silver nitrate at room temperature.
Insoluble in absolute acetone.	Soluble in acetone.
Precipitated by mercuric acetate.	Not precipitated by mercuric acetate.
No anti-scorbutic activity.	Anti-scorbutic activity.

Daily doses of ox brain extract containing the reducing equivalent of 6 mgm. of ascorbic acid failed to prevent the appearance of the symptoms of scurvy in guinea pigs fed on a scorbutic diet, and it is clear that estimations of ascorbic acid in brain tissue by the indophenol titration method yield fallacious results.

The activity of solutions of this reducing substance is easily destroyed in both acid and alkaline solutions, which renders concentration difficult, but experiments are proceeding with the view of its isolation; solutions are somewhat stabilised by the addition of cyanide, which suggests the possibility that sulphur is concerned in the activity of this substance. A crystalline semicarbazone, m.p. 251°–252° C. (uncorrected), has been isolated from active extracts, but it is not yet possible to determine whether or not this is a derivative of the active substance.

The possibility of identity of the reducing substance from brain tissue, and that obtained from tumour tissue by Boyland[3] and Harris[4] is under consideration, but it is not proposed to name the substance from brain tissue yet.

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M. Mitolo.
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[1] Harris and Ray, *Biochem. J.*, **27**, 303; 1933.
[2] Birch, Harris and Ray, *ibid.*, **27**, 590; 1933.
[3] Boyland, *ibid.*, **27**, 802; 1933.
[4] Harris, Nature, **132**, 605, Oct. 14, 1933.

Serum Phosphatase in the Domestic Fowl

It has been suggested that skeletal reserves of calcium may be available for eggshell formation in the domestic fowl[1]. If this suggestion is correct, alterations in the metabolic activity of the bony tissues might be expected in association with the laying period in the hen. Moreover, plasma phosphatase has been used to study alterations in calcium and phosphorus metabolism in sheep[2], and the association of increased serum phosphatase with clinical disorders of bone is now fairly well established. As opportunity has arisen, therefore, serum phosphatase estimations have been made on birds at different stages of the reproductive cycle, using Bodansky's technique[3] and his definition of the unit of phosphatase. Some of the results secured so far are given:

Birds used.	Units of Serum Phosphatase.
3 Cockerels	4·1; 4·0; 3·0.
15 Laying Pullets.	9·2; 7·5; 27·1; 10·2; 28·3; 8·3; 8·3; 16·4; 13·0; 9·2; 15·4; 6·9; 27·7; 16·7; 22·6.
2 Pullets in moult after laying.	24·0; 13·9.
9 Pullets, sexually immature.	4·4; 3·2; 2·0; 4·3; 1·7; 3·8; 3·6; 5·3; 2·8.
1 Pullet nearing laying (weight of largest ovum in ovary = 4·4 gm.)	12·1.

The values for cockerels and sexually immature pullets are comparable, those for laying and moulting birds are higher. There may well be a physiological increase of serum phosphatase in the laying hen, although it is realised that the increase may be related to functions other than bone metabolism and shell formation.

The values obtained from laying birds are very variable, and it will be desirable to study these variations in relation to egg production.

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Chemical Research Division,
Ministry of Agriculture,
Northern Ireland.

[1] Common, R. H., *J. Agr. Sci.*, **23**, 555–570; 1933.
[2] Auchinachie, D. W. and Emslie, A. R. G., *Biochem. J.*, **27**, 351–355; 1933.
[3] Bodansky, A., *J. Biol. Chem.*, **101**, 93–104; 1933.

Negative Oxidation-Reduction System of *B. coli*

STEPHENSON and Stickland (1931)[1] demonstrated in *B. coli* an enzyme which could catalyse the reduction of methylene blue by molecular hydrogen. Examination of this reduction process discloses a striking resemblance to the hydrogen electrode.

$$(1)\quad H_2 \xrightarrow{\text{bacteria}} 2H^+ + 2e$$

$$(2)\quad H_2 \xrightarrow{\text{platinised Pt}} 2H^+ + 2e$$

In other words, the bacterium behaves like a platinised platinum surface in bringing molecular hydrogen into equilibrium with hydrogen ions. We have investigated the reversibility of this reaction of *B. coli* using as an indicator $\gamma\,\gamma'$-dimethyl dipyridyl, the E_0' of which lies in the range of the hydrogen electrode from *p*H 7–9.

The reversibility was tested (1) by maintaining the *p*H at a constant level and varying the partial pressure of hydrogen, and (2) maintaining the partial pressure constant and varying the *p*H. The observed potentials agreed well with the theoretical potentials calculated for the hydrogen electrode under identical conditions. This reversible hydrogenase system of *B. coli* is the most negative oxidation-reduction system as yet described in living cells. The complete experimental details will be published shortly.

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[1] Stephenson and Stickland, *Biochem. J.*, **25**, 205; 1931.

Origin of African House Rats

THREE main types, or mutations, are known of the common house rat: (1) a grey type with grey belly (*Rattus rattus rattus*, Linnæus), (2) a brown type with grey belly (*R. r. alexandrinus*, E. Geoffroy), (3) a brown type with a creamy belly (*R. r. frugivorus*, Rafinesque).

From an analysis of the distribution of the wild stock it has been possible to show that this wild stock represented by *R. r. frugivorus* originally came from north-west India, the wild race inhabiting the lower Indus Valley being identical with it; this race is the westernmost of the wild local races of *R. rattus*, and is connected by intermediate types with the other races found in India and Malaya. Rats of the stock developed from this type are common all over Africa, the white-bellied type being imported by coast shipping, and the grey-bellied overland up the Nile Valley so far as Uganda, in the trail of overland traffic, or even earlier with the immigration of the cattle-raising tribes from the north. It has recently been possible to show that in addition to the *frugivorus* stock, and its mutations, another race of Indian rat has been material in building up the house-rat population of East Africa. Both the wild cream-bellied (*R. r. wroughtoni*, Hinton) and a parasitic grey-bellied mutation (*R. r. rufescens*, Gray) of the more rufous South Indian rat have been found on Zanzibar Island, in central Kenya, and as far inland as Uganda. They probably came from India by shipping on the Bombay-Goa-Zanzibar track.

The possibility of analysing an introduced rat population appears to be of importance as it is much easier to trace the origin of these rats than that of either man or fleas carrying disease. It will probably be found that the history of the Uganda plague centre can be reconstructed in this way. It looks as if the various types keep separate, and that they differ in their biology. It is not known at present whether the different races and mutations of house rats differ in their susceptibility to or immunity from plague, although certain observations would point in that direction.

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March 9.

An Ancient Foxtail Pine

MY young friend Mr. Allan Caplan has recently obtained a remarkable series of fossil plants in the Miocene shales at Creede, Colorado. Among these the conifers are especially interesting, and one specimen consists of a small cone, about 19 mm. long, broadly oval in form, the scales armed with long prickles (Fig. 1). I sought the advice of my colleague, Dr. Edna L. Johnson, who at once produced some immature cones of *Pinus aristata*, Engelmann, the foxtail pine of the western mountains of the United States. On comparison, it was impossible to see any difference. Knowlton (1923) described a *Pinus crossii* from Creede, based on foliage which does not appear to differ from that of *P. aristata*.

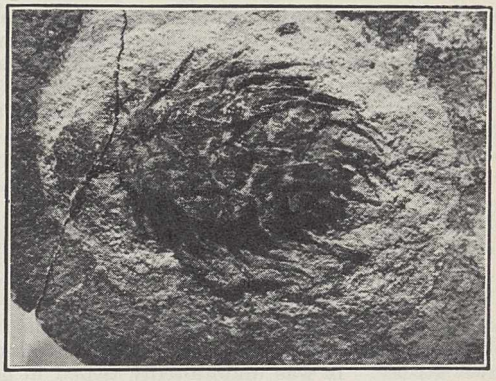

FIG. 1. Cone of *Pinus aristata crossii* (enlarged). Photograph: Hugo Rodeck.

In common with other writers, I have assumed Miocene species to be distinct from their modern relatives, even when the visible differences were slight, and such as might indicate only a variety or form in the modern flora. Considering the millions of years intervening, it has seemed reasonable to assume that the species would be different, and to suppose that if we had the complete plants, other differences than those recorded would be apparent. What shall we do, however, when there are no visible differences?

In a paper recently received[1] on the Miocene flora of Oregon, Mr. H. D. MacGinitie proposes a new species, *Acer negundoides*, based on fruits which he says are "plainly referable to *Acer negundo*, L." He not only fails to cite any differential characters for his species, but also expressly states that there are none, so far as the material shows. Similarly,

the foxtail pine from Creede appears to have no characters separating it from the living tree. In such cases it appears premature to offer a new specific name, though an argument can be made, that in all probability the plants are not identical, and only appear so owing to the lack of adequate fossil materials. Perhaps the most reasonable compromise would be to use trinomials; in the cases referred to, *Pinus aristata crossii* and *Acer negundo negundoides*. This system at any rate enables us to avoid committing ourselves to the doctrine that the plants are positively, and in all respects, identical.

From a general biological point of view, it is relatively immaterial whether the Creede fossil pine is exactly the same as the modern one. The significant thing is, that it is substantially the same, and that this type of pine has existed in these western mountains of the United States from the Miocene down to the present day. In all this time, like the snail-genus *Oreohelix*, it seems to have occupied the same general area, the higher elevations of our south-west country. It has not spread into Mexico, British America, or the eastern United States. It is an isolated type, but a Californian species, *P. balfouriana*, may be regarded as an offshoot from it.

It seems probable that the Creede flora may be essentially contemporaneous with that of Florissant, though very different in most of its species. Creede is to-day at a considerably higher elevation than Florissant, and presumably was so in Miocene times. If two floras of the same age, but from different elevations, are preserved in a now temperate region, the one from the higher elevation may be expected to resemble most that now living in the same district, and hence may be regarded as more modern. Very few high altitude Tertiary floras have been preserved, so that at Creede assumes more than ordinary importance.

T. D. A. Cockerell.

University of Colorado,
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Dec. 29, 1933.

[1] Carnegie Inst. Publ., 416.

Heredity of Aniridia

A very remarkable pedigree of aniridia was published in 1915 by an American ophthalmologist, Samuel Risley. It was undoubtedly issued in good faith by a man, now dead, who accepted, without verification, the statement of a hospital patient who suffered from the defect. This almost blind man, aged 27, described the occurrence of a total absence of iris in 111 of his 119 relations in four generations; he gave, moreover, the age, or age at death, and the Christian name of most of these 119 relations; his statement was confirmed, from hospital notes, in the case of one individual only.

Now this pedigree is such as to arouse instant mistrust on the part of a geneticist. A few years ago, I took some considerable pains to get in touch with the family to obtain support for the facts. These efforts met with no success, and I was ultimately advised by the late Dr. Lucien Howe, a former president of the American Ophthalmological Society, who had also inquired into the matter, that the history was entirely untrustworthy and should be suppressed.

Risley could never have considered the facts presented to him by his 'junior house surgeon', for he even includes the statement concerning one case of *bilateral* aniridia, that the woman had one blue eye and one black eye.

Unfortunately, the history has been repeatedly reproduced in America and in Great Britain; recently it has been made use of for propaganda purposes[1]. It was even presented to the Prevention of Blindness Committee by a witness who was called, as an expert, to advise on the prevention of blindness due to hereditary causes.

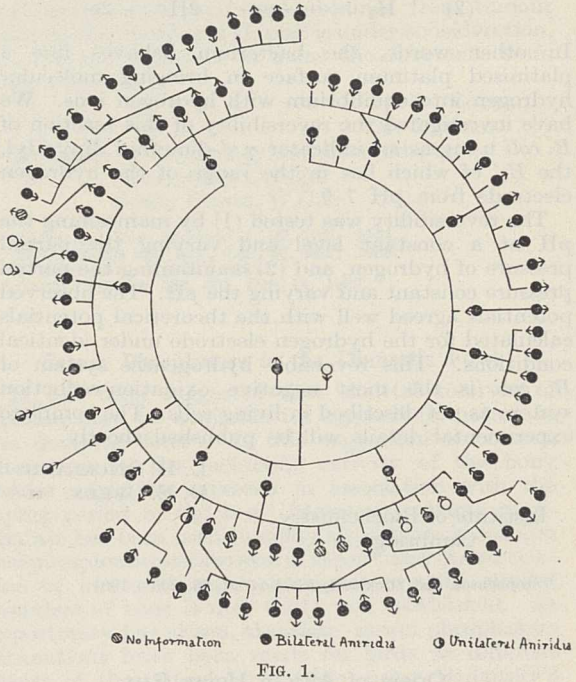

Fig. 1.

A warning regarding the pedigree in the "Nettleship Memorial Volume" has been, apparently, ineffective. I therefore append a copy of the pedigree (Fig. 1) and hope my warning will be supported by the publication of this letter in Nature.

Julia Bell.

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Gower Street, London, W.C.1.
March 1.

[1] *Eug. Rev.*, **24**, p. 121, and *Brit. Med. J.*, Jan. 1934, p. 96.

Thermal History of the Earth

Prof. Arthur Holmes has written to me to point out that I have misunderstood his meaning in his recent paper on the above subject[1]. In this paper he states (p. 187 and Fig. 9, p. 179) that the condition for permanent convection currents to be possible in the earth's crust below a certain depth is that the adiabatic and freezing point gradients of the fluid substratum should become tangential at that depth. I assumed that he meant that, if the actual numerical values of the two gradients at various depths were plotted against the depth, the two resulting curves would touch at the critical depth, and that consequently if the freezing point gradient were greater above this depth it would also be greater again below it.

What Prof. Holmes actually intended was, that if

starting at any point on the freezing point against depth curve, we plot a second curve giving the temperatures of a column of liquid in convective equilibrium, there would be a certain depth at which these two curves become tangential. This means that below this depth the freezing point gradient is less than the adiabatic gradient, which is, as is well known, the correct condition for the existence of permanent convection currents in a liquid radioactive column cooled slowly at the top and in contact at its highest point with its own solid.

On re-reading Prof. Holmes's paper and carefully examining his curves, I see that the latter view is what he expressed and I should like to take this opportunity of apologising to him for misrepresenting his real opinion in my recent paper on "Some Difficulties in Current Views of the Thermal History of the Earth"[2]. There is, I think, little doubt that the requisite condition will be satisfied at some depth in the crust. The available data are insufficient to fix the depth, but such as they are, point to a value of some hundreds of kilometres[3].

J. H. J. POOLE.

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Dublin.

[1] *J. Washington Acad. Sciences*, **23**, No. 4, April 1933.
[2] *Sci. Proc. Roy. Dub. Soc.*, **21**, (N.S.), No. 2, 10, Jan. 1934.
[3] Jeffreys, H., "The Earth", 2nd Ed., p. 141; and Poole, H. H. and Poole, J. H. J., *Phil. Mag.*, p. 666, March 1928.

Surface Markings of the Henbury Meteorites

DR. L. J. SPENCER, in describing the Henbury meteorites[1], states: "The surface markings . . . in all cases appear to be the result of sculpturing by weathering processes. No clear evidence was detected that the original surface on any of the masses had been preserved." Having examined nearly all the irons found at Henbury both by our parties from the Kyancutta Museum and by prospectors and others, I consider that Dr. Spencer's statement needs qualification.

The irons buried to considerable depths are certainly rusted and have lost all resemblance to the original surface markings, and the same is true, to a less extent, of the buried portions of those irons which were only partly exposed; whilst other rusted irons have been at one time buried, but exposed later by lowering of the ground surface. Omitting further reference to these rusted irons, there remain two groups of material which I regard as exhibiting clearly the original surface markings.

The clearest evidence of unweathered condition is found in many of the twisted 'slugs' torn from crater meteorites in landing or in the subsequent explosion. These have cuts, scratches and bruises which cannot be attributed to wind erosion or other forms of weathering, but are as clear and fresh as if recently made. This evidence, if accepted, indicates a probability that some of the 'individual' irons may be in equally fresh condition, and several such have been actually found. (See Plate XV, Fig. 10, l.c.) These 'individual' irons show a variety of surface markings. Apart from the rust-pitted, partly-buried surfaces, and the 'pock-marks' which are admittedly the result of atmospheric weathering, these markings may be classified as (1) blebs, bosses and rounded ridges, somewhat resembling brain convolutions, (2) 'gouge-marks', well shown in the plate mentioned, (3) wide, very shallow concavities. I am inclined to relate these three types respectively to the forward, lateral and hinder parts of the meteorite in flight; but all three types are not necessarily present on a particular specimen, the variation being perhaps due to the amount of rotation and the general shape.

An interesting point is that the size of these markings corresponds roughly with the size of the iron. Thus the 'gouge-marks' in the iron of 33 lb. shown in the plate mentioned average $\frac{3}{8}$ in. across; those on a very perfect little 4 oz. iron are only $\frac{3}{16}$ in.; and those on the largest iron I have seen average an inch. This grading of size would be difficult to explain on the assumption of atmospheric weathering, but on that of flight-pitting it may be accounted for by the fact that small irons would lose their velocity and incandescence in the upper rarified air, whilst large ones would retain these in the lower denser levels.

The totally different surface markings of an 'individual' meteorite and a 'slug' cannot be accounted for by weathering. Irons of both kinds, lying on the surface, have been exposed to identical conditions, and had a substantial thickness of iron been removed by weathering, the surface sculpturing of both varieties should tend to approximate, as is admittedly the case with buried and rusted irons.

Not only do the best of the individual irons show these clearly defined forms on their exposed surfaces, but in many instances, especially in recesses of pits, there remain traces of a peculiar even scale, which I regard as the original scale formed in flight. This, in common with the remainder of the exposed surface, is covered by a limonite glaze of secondary origin, due to hydration of a thin film of the original surface scale and iron; this glaze forms an extremely hard protective patina and may be responsible for the perfect preservation of the surface features.

The flight pitting of an iron meteorite differs from that of a stone one. Stone is only subjected to incandescence and gaseous flow (compare the 'welding torch' of an oxy-acetylene blowpipe); whereas iron is subjected to oxidation as well (compare the 'cutting torch' in which an additional nozzle sprays oxygen on to the incandescent metal). Nor will the flight pitting of irons which have been observed to fall necessarily duplicate the features of the Henbury irons, which are known by their crater effects to have been of exceptionally high velocity.

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Kyancutta, South Australia.

[1] *Min. Mag.*, Sept. 1933, p. 390.

THE preservation of the fine series of material, now in the meteorite collection of the British Museum, from the meteorite craters recently discovered near Henbury in Central Australia, is entirely due to the energy and enthusiasm of Mr. R. Bedford. This material, 1,000 lb. in weight, was collected by him, and he has given much thought and study to the matter on the spot. The numerous individual masses of meteoric iron show a considerable variety of surface forms and markings which are certainly puzzling. Some of them he admits are due to subærial erosion and some to subterranean weathering. But others he believes are the original surfaces; that is, those resulting from the friction and burning of the meteorites during their brief flight through the

earth's atmosphere. This I concluded could not be the case for the following reasons :

(1) None of the masses shows the thin jet-black skin on smooth rounded surfaces characteristic of freshly fallen meteoric irons.

(2) None of the polished and etched sections shows an exterior heating zone (with granulation, due to the transformation of α-iron to γ-iron at about 850° C.)—proving that the masses are weathered remnants.

(3) Some of the masses show various stages of breaking up, from the penetration of iron oxides along cracks to the detachment of flakes.

(4) Iron-shale of various types is found in large amount in close association with the meteoric irons, and has evidently been formed by the weathering of the masses.

(5) Each crater must have been formed by the fall of a single large mass of iron, which became broken up by the force of the gaseous explosion. If the meteorites had fallen as a shower of individuals of the sizes now found, they would have met with a relatively greater air resistance, and no crater would have been formed. (Large meteoric stones are broken up in the air and fall as a shower without the formation of a crater.)

The curious striæ and other markings on the surface of the 'slugs', commented on by Mr. Bedford, may perhaps be explained by the weathering of strained and twisted metal. These 'slugs' show a contortion of the lamellar crystalline structure, and they were evidently torn from the main mass by the force of the explosion.

L. J. Spencer.

British Museum (Natural History),
South Kensington,
London, S.W.7.
Feb. 15.

The British Coal-Tar Colour Industry

Whilst the original discovery of a coal-tar dye was made by an Englishman, W. H. Perkin, in 1856, and the early industrial development of the dyestuff industry took place in Great Britain, the rapidly growing industry soon found better conditions for its development in Germany. The consequent decline of the British coal-tar colour industry was already well marked in 1875, and in 1886 had proceeded so far that 90 per cent of the dyes then used in Britain were of foreign manufacture. This condition of things persisted and, in the decade prior to the War, German domination of the industry was nearly complete.

It is not an overstatement to say that the development of this highly scientific and extremely profitable industry in Germany instead of in Great Britain had enormous, if not decisive, political and economic effects both before and during the War. It has also been an important factor in shaping the world conditions of the present day. An immediate effect was that, in the very early days of the War, one of our great industries, that of the manufacture of textiles, which was of vast importance both on the military and civil fronts, was threatened with strangulation. With the view of affording information regarding the origin and uses of dyestuffs, I published in 1915 a compilation of important addresses given on the subject : papers published between Perkin's original discovery in 1856 and 1914 and papers published during the War period[1]. On the publication of this book a letter was received from Sir John Brunner which contains a statement of his opinion that, with sufficient financial backing, the colour-manufacturing industry might have been developed here instead of in Germany.

In view of the remarkable success of the firm of Brunner, Mond and Co., the considered opinion of Sir John Brunner on this point is of great historical interest and importance.

The letter, which is published with the approval of Sir Felix Brunner, Bt., the grandson of Sir John, is subjoined :

Walter M. Gardner.

Lawnhurst,
Didsbury,
Manchester.

Silverlands,
Chertsey.
Nov. 7th, 15.

Dear Mr. Gardner,

I am greatly interested to read the advertisement of your new book on "The British Coal Tar Industry".

When my brother Henry returned in 1857 from his studies at the Polytecknikum at Zurich he entered the service of F. Crace Calvert, who was then the public analyst of Manchester.

He used to come home to my father's house at Everton every Saturday, and show us, from 1858 to the beginning of 1861, skeins of silk treated with aniline dyes that he had himself prepared.

We were in our 'teens' and we never got any farther than enjoying the colours.

I have many a time reflected that if he and I had had the command of money, which came to us in later life, that the Coal Tar Industry would never have gone to Germany.

Yours faithfully,
John Brunner.

W. M. Gardner, Esq., M.Sc., F.I.C.

[1] "The British Coal-Tar Colour Industry; its Origin, Development and Decline". By Walter M. Gardner. Pp. 437. London, 1915. Williams and Norgate.

Technique of Height Measurement of the Ionosphere by the Pulse Method

It has been shown[1] that in the pulse method of Breit and Tuve for the measurement of the heights of the regions in the upper atmosphere from which wireless waves are reflected, the quantity to be measured is the equivalent path $c\int ds/U$, where U is the group velocity along an element of path ds and c is the velocity of light. The group velocity U is, by definition, the velocity of the crest of the disturbance. Now the crest is by no means an obvious point in the photographic registration, and it has been usual therefore to refer measurements to the beginning of the pulse. A great deal of ingenuity has been called forth in making this point readily recognisable, by shortening the pulse, increasing the rate of build-up, etc., so that errors due to variation in amplitude may be reduced to a minimum. Errors due to dispersion have been ignored or accepted as inevitable.

Since the crest is the point of greatest importance it must be *made* obvious. Consider the pulse shown in Fig. 1 (*a*) ; there is no point on the curve that is obviously defined. But if we differentiate it we obtain the curve of Fig. 1 (*b*) and we see that three

points, corresponding to the beginning, crest and end of the pulse, are clearly indicated, for they cut the zero line at an angle and this angle can be made as large as we please by increasing the amplitude. If we differentiate a second time, obtaining the curve of Fig. 1 (*c*), we define the beginning and end still more accurately since there are discontinuities at these points, and we also define the points of inflexion of the original curve. So that, first, we can readily measure the quantity we wish to measure and, secondly, we have four other points available for the

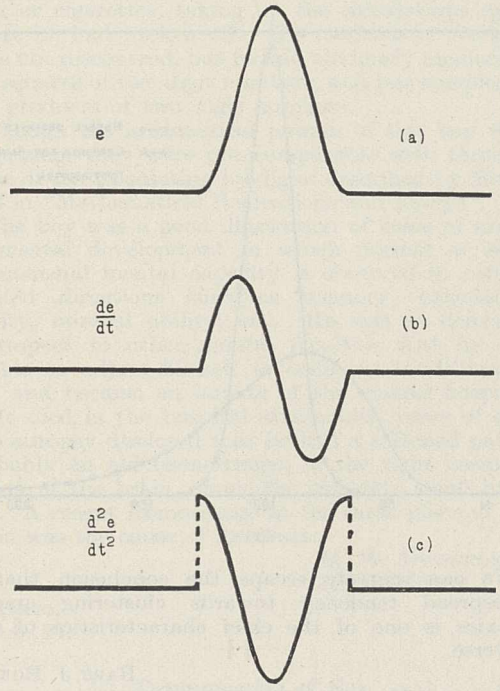

FIG. 1.

measurement of distortion or of dispersion of the pulse.

The differentiation of such a pulse is an operation which can be performed very simply by an electrical circuit, and all that is necessary is to connect a large capacitive impedance in series with a relatively small resistance across the output of the receiver normally used for echo delineation, to amplify the voltage across the resistance and to apply the output from this amplifier to the cathode ray oscillograph in place of the receiver output. A second capacitance-resistance potentiometer across the output of the amplifier will give the second differential of the pulse.

The use of the differential curve in place of the pulse itself results in a number of practical advantages, quite apart from those already mentioned. When taking continuous records of heights with either time or frequency as the second variable, it is customary to select a strip of the echo pattern by means of a narrow slit; in all the systems in use, disturbances, such as noise, decrease the contrast between the trace and the background, whereas by using the differential curve the definition of the trace indicating the peak of the pulse is practically constant, though that of the beginning and end are affected as before. The band-width of the component frequencies of the pulse indicated above is quite restricted compared with that necessary for the same accuracy of measurement by the usual method, for there are no abrupt changes in the rate of increase of amplitude; it can be shown that heights greater than about 100 km. can be measured to an accuracy better than 1 per cent using a band-width of only 1 kc./s., this incidentally resulting in a considerable increase in the signal/noise ratio. If we require resolution better than 100 km., we are forced to use band-widths correspondingly wider, the actual resolution being inversely proportional to the band-width. By using the differential curve in place of the pulse proper, the resolution is increased twofold, and if the second differential is used and the pulse is symmetrical, we have a further twofold gain; the above follows directly from a consideration of overlapping pulses. The technical difficulties of producing such a pulse are not at all serious. Finally, in those cases where a common control frequency is not available at transmitter and receiver and a self-synchronising scheme has to be devised, it becomes feasible to use the ground ray to start the time base. In such cases, though a portion of the up-stroke may be missing, the important part, the peak, can be made to occur on the time base, so that no loss of accuracy results.

Fig. 2 shows a record taken at these Laboratories using a differential curve in place of the pulse itself. The beginning of the ground ray is not visible, for a pulse-tripped time-base, as mentioned above, is in use. At the lower edge of the record is the fine black line defining the peak, and just above it, the edge defining the end of the ground ray. Along the middle of the record runs the trace of an echo reflected from the Appleton region at a height of 300 km., and the central line corresponding to the peak is clearly defined. For recording, the base line only of the echo pattern is visible as in the method described by Builder[2]. Note that the same definition of the central line could be maintained for a height scale some 5–10 times as great, so that measurements to an accuracy much better than 1 per cent should be attainable, though light intensity considerations may then

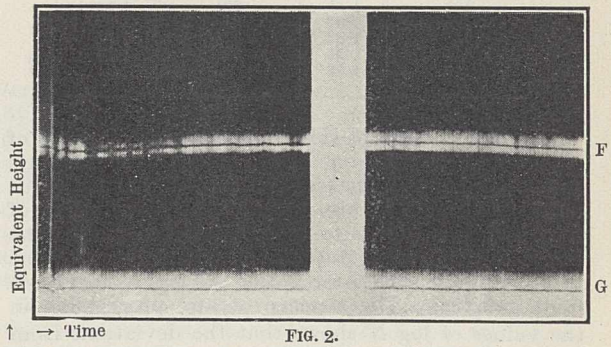

FIG. 2.

become the limiting factors. The echo recorded was a very simple one, but even if it should be complex we record more information with greater accuracy by this method than by direct pulse delineation.

O. O. PULLEY.

Halley Stewart Laboratories,
King's College, London.
Feb. 17.

[1] E. V. Appleton, *Proc. Phys. Soc.*, **41**, 43; 1928. J. C. Schelling, *Proc. Inst. Rad. Eng.*, **16**, 1471; 1928.
[2] G. Builder, *J. Inst. Elect. Eng.*, **73**, 443, Oct. 1933.

Apparent Clustering of Galaxies

A considerable amount of material on the distribution of external galaxies has become available through the publication of the Harvard and Mount Wilson surveys. Shapley and Hubble have both discussed the observed irregularities in the distribution of these galaxies. Shapley emphasises the non-uniformity of the distribution of matter in the metagalaxy. Hubble finds that "statistically uniform distribution of nebulæ appears to be a general characteristic of the observable region as a whole", and hesitates to admit the reality of clusters or groups of galaxies with the exception of the few that are readily recognised as such. Statistical analysis of the available material is now possible ; and as the comparison between the observed distribution curves, corrected for the effect of dispersion in the limiting magnitudes, and the theoretical frequency curves, computed on the assumption of random distribution, has yielded some rather definite results, it seems worth while to communicate them in advance of publication in more detail.

The Shapley-Ames catalogue of galaxies brighter than the thirteenth magnitude[1] exhibits conspicuous deviations from a random distribution. Both galactic polar caps were divided into a number of equal areas (well-known clusters being excluded), and the number of galaxies was counted in each area. The observed frequency curve had a much larger dispersion than the theoretical curve, computed on the assumption of random distribution. The accompanying table shows conclusively that the irregularities in the distribution cannot have been caused by galactic or extragalactic absorption.

North Galactic Polar Cap

No. of galaxies (Shapley-Ames)	$\overline{\log N}$ (Hubble)	No. of galaxies (Shapley-Ames)	$\overline{\log N}$ (Hubble)
½	1·92	15	1·79
1½	1·99	17	1·85
4	1·86	18½	1·87
5½	1·90	22	1·96
6½	1·88	24	1·95
10	1·87	26	1·87
10½	1·88	29½	1·86
12½	1·87	31	1·88
14	1·83	31½	1·86
14½	1·95	36	1·94
14½	1·93		

The first column of this table gives the number of galaxies counted for one of the areas in the Shapley-Ames catalogue. The centres of 9–13 survey fields used by Hubble in his study of the distribution of faint galaxies (down to mag. 19·5) fall within the limits of each area, and the second column of the table contains the mean value of log N for these faint galaxies. The absence of any progression in the values of $\overline{\log N}$ shows that the deviations from random distribution are due to a real clustering of galaxies and are not caused by the absorption of light in space.

Both the Mount Wilson[2] and Harvard[3] surveys of faint galaxies show evidence of clustering. The diagram (Fig. 1) gives a comparison between Hubble's observed distribution curve (dots), corrected for a dispersion of $\pm 0{\cdot}15$ mag. in the limiting magnitude of the Mount Wilson plates, and the theoretical curve (crosses) computed on the assumption that the galaxies are distributed at random.

Similar deviations from random distribution are found in the Harvard material. The observed frequency curve in log N has, for the north galactic polar cap, a dispersion of $\pm 0{\cdot}25$, and as the maximum value of the error dispersion amounts to only $\pm 0{\cdot}15$ (most probable value $\pm 0{\cdot}09$), the true dispersion must be of the order of $\pm 0{\cdot}20$ in log N. The dispersion computed theoretically for random distribution is not larger than $\pm 0{\cdot}03$ in log N. For the south galactic polar cap the discrepancy is even greater. We should in addition consider Shapley's elegant and definite proof for the presence of clustering in nine regions[4].

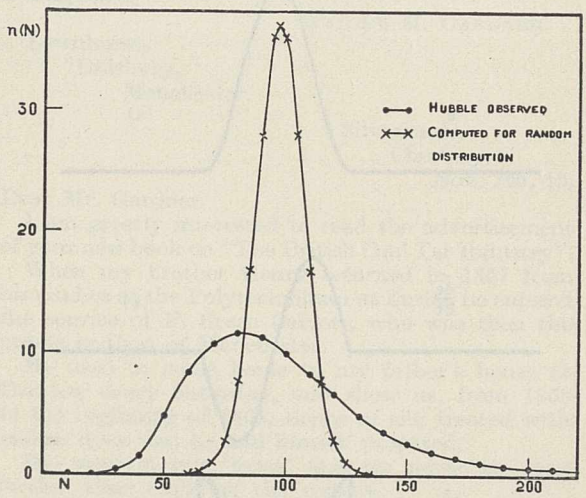

Fig. 1.

We can scarcely escape the conclusion that a widespread tendency towards clustering among galaxies is one of the chief characteristics of our universe.

Bart J. Bok.

Harvard Observatory,
Cambridge, Mass.
Jan. 27.

[1] *Harv. Ann.*, **88**, No. 2 ; 1932.
[2] *Astrophys. J.*, **79**, 8 ; 1934.
[3] *Harv. Bull.*, 889 ; 1932. Harvard Reprint 90 ; 1933.
[4] *Harv. Bull.*, 890 ; 1932.

An Arithmetical Prodigy in Egypt

A boy of unusual arithmetical ability named Mohammed Ismail Turki El Attar has recently died in a Government asylum in Cairo. He was the son of a grocer in a small country village near Teh el Barud in the Delta, and when first discovered used to make a precarious living by exhibiting his powers as a calculator in cafés in Cairo. He was unable to read or write and was obviously a boy of poor general intelligence. His powers were tested on various occasions. The following is a summary of some of the calculations he performed mentally.

The squares of numbers of two digits were given correctly, almost instantaneously, but there was occasionally hesitation in giving the products of pairs of two digit numbers. Products and squares of 3 digit numbers were given in times varying from eight to forty-five seconds. Cubes of 2 digit numbers were worked out in from two to three minutes, while the product of two numbers of 10 digits was worked out correctly in twenty minutes.

8^{16} was correctly computed in five minutes, 5^{10} in twenty seconds and 6^{10} in seventy seconds.

Division was a slower process and 9 digits divided by 3 took times varying from two and a half to seven and three quarters minutes.

Square roots of 6 digit numbers were extracted in less than a minute while cube roots took longer. Curiously enough, the memorising of a number of 27 digits was not done successfully, although he could repeat questions which had been put to him and their answers after some days had elapsed, and would break off calculations in the middle to ask for milk or cigarettes, taking up the calculations again where he had broken off. His methods of working were not discovered, but he had obviously memorised the squares of two digit numbers, and less completely the products of two digit numbers.

Though the arithmetical powers of this boy were surprising, they were not comparable with those of some of the calculating prodigies described by Rouse Ball in "Mathematical Recreations and Essays".

The boy was a good illustration of cases of arrest of mental development in which normal or even phenomenal mental capacity is observed in certain limited directions such as memory, calculating ability, musical ability, etc. He was so defective in respect to other mental faculties that he was unable to adjust himself to ordinary conditions of life, and became an inmate of the mental hospital.

He died in the hospital at nineteen years of age. The autopsy disclosed that he had a softened patch, probably an old hæmorrhage, in the right occipital region of the brain, about the size of a small hen's egg. A recent hæmorrhage at the same place of the brain was the cause of his death.

H. W. DUDGEON.
H. E. HURST.

Cairo.
Feb. 24.

Determination of Sex

THOSE who are interested in the heredity of sex will be grateful to Prof. MacBride for again exposing in these columns[1] the *naïveté* of some early views of this problem (which he attributes to Morgan). Especially will they be reassured by his conclusion. He points out that sex is essentially the same thing wherever it occurs. He concludes :—"It seems clear that there are fundamentally *opposed* male and female constitutions, but that the constitution of every individual is a mixture of the two, and that the structural manifestations of sex depend on the *proportion* of these constitutions and on which gains the upper hand in development" (italics mine).

This view is somewhat similar to that reached by way of experimental genetics. Thus Goldschmidt, reviewing his experiments since 1910[2], states that "the resulting sex is dependent upon two genetic somethings, one of which shifts sex towards the female, the other towards the male side". Again, Morgan's colleague Bridges[3] says that "both sexes are due to the action of *opposed* sets of genes, one set tending to produce the characters called female, and the other to produce the characters called male. These two sets of genes are not equally effective, for in the complement as a whole the female-tendency genes outweigh the male-tendency genes and the diploid (or triploid) form is a female. When the *relative number* of the female-tendency genes is lowered by the absence of one X, the male-tendency genes outweigh the female and the result is the normal haplo-X male."

Thus, as my italics show, the experimental geneticist seems to agree with what Prof. MacBride has expressed in more generally intelligible language ; not only in admitting the essential sameness of sex in all organisms but also in understanding the function of proportion in its determination in some of them. Unanimity among the different branches of biology has therefore been reached after a long period of divergence, from entirely different data and, what is more, apparently unawares. Such an event, surely, should not be allowed to pass without notice and without applause. The usual view that the chromosome theory of sex determination criticised by MacBride was a special hypothesis put forward by McClung in 1902[4] and therefore not attributable to Morgan, who accepted the hypothesis only in 1911[5], should perhaps also not pass without mention.

C. D. DARLINGTON.

John Innes Horticultural Institution,
London, S.W.19.
March 14.

[1] NATURE, **133**, 359, March 10, 1934.
[2] *Quart. Rev. Biol.*, **6**, 127 ; 1931.
[3] *Amer. Nat.*, **56**, 59 ; 1922.
[4] *Biol. Bull.*, **3**, 43–74 ; 1902.
[5] *Science, N.S.*, **32**, 839 ; 1911.

I AM delighted to find that such a distinguished cytologist as Dr. Darlington "Though a long compass round be fetched" has arrived at somewhat similar conclusions to those to which I myself have been led respecting the nature of sex. I do not, of course, view the 'gene' in the same light as he does, but since in an article shortly to be published in NATURE I have given my views as to the nature of the gene, Dr. Darlington and I need not quarrel about the matter now.

E. W. MACBRIDE.

43, Elm Park Gardens,
Chelsea, S.W.10.
March 17.

Ergine

RECENTLY we showed[1] that the four ergot alkaloids (ergotoxine, ergotinine, ergotamine and ergotaminine) by treatment with alcoholic potassium hydroxide give rise to a crystalline base ergine, which constitutes about half the parent molecule.

We have since proved that ergine is the amide of an acid, $C_{15}H_{15}N_2.COOH$, and further analyses of ergine and its salts show that the formula for ergine requires correction to $C_{16}H_{17}ON_3$ in agreement with the formula for the acid now isolated.

Jacobs and Craig have published a paper[2], in which they have described the action of alkali upon ergotinine and the isolation of a crystalline acid, $C_{16}H_{16}O_2N_2$, which they name lysergic acid. We have no doubt that this is identical with that prepared by ourselves from ergine.

S. SMITH.
G. M. TIMMIS.

Wellcome Chemical Works,
Dartford,
Kent.
March 27.

[1] *J. Chem. Soc.*, 1543 ; 1932.
[2] *J. Biol. Chem.*, **104**, 547 ; 1934.

Research Items

Neolithic Age in Western Europe. Recent interpretation of archæological evidence has shown an increasing tendency to reduce the duration of the neolithic age as against the claims of the mesolithic and bronze ages, until, as a period, it has seemed in danger of extinction. In Britain, recent researches, notably the pottery analyses of Mr. Stuart Piggott, have placed the neolithic on a more assured basis; and a similar service is performed for the neolithic and chalcolithic periods of western Europe in *Antiquity* of March by Jacquetta Hawkes. As a starting point is taken an early culture which is identified in south and east France. It passed, presumably up the Rhone Valley, to the western Swiss lakes, where it became established in the first Danubian period. Thence it passes to Britain without touching Brittany. It is not yet possible to determine the exact limits of distribution of this culture. In the next phase, a period of differentiation, one offshoot, coming under Danubian influence, forms the Michelsburg culture, while another branch, spreading westward, joins with an influence from southern France, producing a more sophisticated type of pottery, and is responsible for the Chassey culture. This spreads farther westward and joins with other elements to produce the elaborate chalcolithic culture of Brittany. Cutting across this 'western culture' from Belgium to the Channel Islands is the Seine-Oise-Marne culture, of which the most characteristic feature is the vase with everted rim, well-marked shoulders and splayed foot. The pottery of this last-named culture, it has been suggested, shows a relationship with that of the peoples who in the meanwhile, and after severe flooding, had resettled the western Swiss lakes, their culture showing affinities with that of their predecessors, but developing new features.

Birds' Bones from Prehistoric Eskimo Ruins. On St. Lawrence Island in the Bering Sea, Eskimo habitations dating from more than 2,500 years ago to village sites of half a century back have been excavated during several seasons, and several thousand bones of birds have been found amongst the food refuse. In all, 45 species were represented, ten of them new to the fauna of the island (H. Friedmann, *J. Washington Acad. Sci.*, **24**, 83, Feb. 1934). Commonest in all sites of all ages (found in 69 diggings) was Pallas's murre (*Uria lomvia arra*), still the most abundant bird on the island. The other birds generally used for food included the crested and paroquet auklets, the Pacific and king eiders, the latter more common than the former in the older diggings, contrary to their relative abundance to-day, and, curiously enough, the pelagic cormorant (*Phalacrocorax pelagicus*), represented from the most ancient to the most recent site. Other pelagic birds include fulmars, shearwaters and the short-tailed albatross. Considering the difficulty of obtaining such birds, it seems strange that birds so large and so abundant on St. Lawrence Island as geese should be poorly represented, the more so as geese are now much hunted for food by the Eskimos.

Transposed Hinge Structures in Lamellibranchs. Under this title, W. P. Popenhoe and W. A. Findlay describe several cases of valves with the hinge elements reversed, those normally occurring in the right being found in the left valve, either wholly or partially (*Trans. San Diego Soc. Nat. Hist.*, **7**, No. 26; 1933). The relations of the individual teeth to one another, and to the bilaterally symmetrical parts of the shell, are exactly similar to the relationships which are present in the normal individual. The shells in question belong to the genera *Venericardia*, *Astarte*, *Transennella* and *Unio*. Many other genera were examined, chiefly venerids and tellinids, but out of 2,000 no reversed specimens were seen. The dentition in these abnormal forms may be completely or partially transposed, but no complete transposition involving cardinals, anterior and posterior laterals has been found in this study. The tendency is for the cardinals and anterior laterals to transpose together. The posterior laterals, which are formed independently of the others, do not usually transpose. In rare cases the posterior laterals transpose and not the cardinals. This hinge transposition has usually been regarded as a very rare phenomenon, even rarer than the comparable abnormality of inverse coiling in gastropods, but these notes show that it takes place quite as frequently as in some of the helices in which reversal is much easier to see. The authors are of the opinion that the abnormal hinges described represent examples of a systematic abnormality, not pathogenic, except in very rare cases, in which certain of the primary lamellæ from which hinge-teeth are derived have developed in the opposite valve from that in which they are normally found.

Atomic Composition of Plants in Relation to Atomic Number. Summarising the results of large numbers of analyses, Vinogradov (*C.R. Acad. Sci.*, **197**, 1673; 1933) claims that the relative number of atoms of any chemical element present in living matter tends to be inversely proportional to the atomic number of that element. The curves showing this relation also tend to show a regular periodicity. Maxima occur, for example, at atomic numbers of 18, 36, 54, 72 and 90, and special significance is claimed for the elements found at these and at other periods. It may be noted that no biological function is at present known for most of these significant elements.

Replacement of a Bud by Roots. Mr. Samuel Sandison writes from the Department of Botany, University College, Dundee, to report a striking case noted during some observations upon the propagation of *Forsythia suspensa* by cuttings. Usually roots arise from buds at the basal end of the cuttings and always from the basal half of the bud. In this case, when the bud scales were stripped off, the bud-apex had disappeared and in its place five roots were seen arising from a common point of origin, somewhere about the original base of the bud.

Pigment of *Aspergillus* Spores. Further results of his investigations on aspergillin, the brownish-black pigment of the spores of *Aspergillus niger*, have been recorded by Dr. Adolfo Quilico in *Rend. R. Ist. Lombardo Sci. Let.*, Parts 11–15, 1933. This pigment exhibits an acid character, which is ascribed to the presence in its molecule, not only of phenolic hydroxyl groups, but also of carboxyl groups. It is, indeed, able to displace carbon dioxide from alkali and alkaline-earth carbonates, and, when heated to

150°–250° C., it liberates appreciable amounts of carbon dioxide and water, at the same time losing its solubility in alkalis. When oxidised by hydrogen peroxide, it yields, together with acid products not yet characterised, mainly mellitic acid, which is also formed, along with a small amount of oxalic acid, on oxidation with nitric acid. Consideration of the chemical behaviour indicates that aspergillin is a typical humic acid, analogous to that extractable from peat, lignite and soil. This is the first known case of the formation of a humus substance in a vegetable organism from a carbohydrate such as sucrose, and is of interest as a contribution to the problem of the genesis of humic matters. Unlike peat, etc., the *Aspergillus* spores yield a particularly pure humic acid, which lends itself well to chemical investigation.

Scolt Head Island. A study of the physical processes at work on the north coast of Norfolk has led to some interesting conclusions with regard to this island, which lies to the east of Brancaster. In a lecture to the Royal Geographical Society on March 12, Mr. J. A. Steers discussed the relative effects of tidal and wave action on this coast. The island apparently began by wave action separating the shingle from the sand on an extensive foreshore, a stage that can be seen at other places on that coast. A shingle ridge near high-water mark formed an off-shore bar, became more stable, extended westward by wave action and formed a recurved end. Dunes formed on its surface. Newer ridges were added by wave action to the main ridge and pushed backwards, a process that can still be seen in action. At other times the new ridges were of sufficient size to form permanent additions to the island. The island lies not parallel with but at a slight angle to the coast. Wave action would tend to build at right angles to the coast-line, but this would force the distal end into deep water and so subject it to greater wave action, which necessarily drives it back. The island is about four miles long, with a width that varies with the state of the tide. The dunes show various stages of consolidation, and between them lie salt marshes which increase in height from the younger in the west to the older in the east.

The Constant Pressure Air Thermometer. A number of careful determinations of the volume coefficients of condensable gases have been made by Coppock and Whytlaw-Gray using the Callendar compensated thermometer (*Proc. Roy. Soc.*, A, Feb.). The gases used were ethylene, air, carbon dioxide, dimethyl ether, nitric oxide, carbon monoxide and sulphur hexafluoride, under pressures up to 1 metre of mercury. The gases were carefully purified and butyl phthalate was used as a manometer liquid. The values obtained with a glass bulb, when extrapolated to zero pressure, gave values for the coefficient layer, then the 'perfect gas' value, and this was ascribed to adsorbed gases on the walls of the vessel. These are liberated as the temperature rises and give values for the coefficient which are too high. The difference was less marked for a fused silica containing bulb, and the authors suggest that silica is a suitable material to adopt as a standard in determining the volume coefficient for condensable gases.

Positive Electrons from Lead ejected by γ-Rays. In a communication which was unfortunately too long for use in our correspondence columns, but will, we hope, shortly be published elsewhere, Dr. A. Alichanow, of the Physical-Technical Institute, Leningrad, describes measurements of the velocity distribution of the positive electrons ejected from lead by the γ-rays of radium C′. A semicircular focusing apparatus was used, and the electrons were detected by coincidence counts in two contiguous Geiger-Müller counters. Two pronounced and two subsidiary maxima were found in the distribution curve, which appear to agree well with the known γ-rays of energy greater than $1{\cdot}78 \times 10^6$ volts. Similar measurements were also carried out with a source of radon enclosed in a thin glass tube, and also in this case positive electrons were found with a somewhat similar velocity spectrum. The total number of the positive electrons in the latter case is 0·5–1 per cent of the number of β-rays of the corresponding continuous spectrum. This is in agreement with the measurements of Dr. Skobeltzyn, whose experiments are described in a letter in this issue of NATURE (p. 565), where he points out the problems raised by this result.

Isotopes of Hydrogen. In three preliminary notes in the *Proceedings of the Royal Academy of Sciences of Amsterdam* (**36**, Nos. 6 and 7, 1933; **37**, No. 1, 1934) Zeeman and de Gier reproduce very clear parabolic traces obtained by the use of the J. J. Thomson mass-spectrograph with gases containing hydrogen isotopes and inert gases. Curves were obtained which could be interpreted as belonging to hydrides of the inert gases, since they do not exhibit multiple charges. Various kinds of ions were detected: $(H_2^1H^2)^+$, $(H^1H_2^2)^+$, $(H_3^2)^+$, and others due to traces of impurities in the apparatus. The mass differences between He and $H_2^1H^2$, HeH^1 and $H_1H_2^2$, HeH^{2+} and H_3^{2+} were measured with some accuracy. In an experiment with hydrogen obtained by passing water vapour over sodium, a faint parabola with $m/e = 4$ was obtained after an exposure of half an hour, and the hydrogen isotope was thus detected without previous concentration.

Structure of some Platinum and Palladium Compounds. Chemical and X-ray experiments by Cox, Saenger and Wardlaw (*J. Chem. Soc.*, 182; 1933) with the dimethyl sulphide derivatives of platinous and palladous chlorides, $[Pt(Me_2S)_2Cl_2]$ and $[Pd(Me_2S)_2Cl_2]$, indicate that the two isomeric forms of the former are planar *cis-trans* compounds. The α-form is the *trans*-compound, not the *cis*-compound as was suspected by Werner, or a tetrahedral configuration as suggested by others. The results with the β-isomer are less definite, but it seems likely that the sulphur atoms are in *cis*-positions and that the compound is ionised in the solid state. In the case of the palladous compound, only one form was obtained, which is isomorphous with the α-platinous compound and is therefore no doubt the plane *trans*-compound. The chemical reactions of the substances differ very considerably, particularly with silver oxide. The β-platinous compound reacts rapidly with silver oxide with production of silver chloride and a basic substance, which forms an alkaline solution in water and reproduces the original compound with acid. The α-form, on the other hand, reacts only slowly, with evolution of dimethyl sulphide and precipitation of platinum, as hydroxide or oxide. A so-called third form of $Pt(Me_2S)_2Cl_2$ had been shown by Tschugaev and co-workers to be really the plato-salt, $[Pt(Me_2S)_4][PtCl_4]$, a result confirmed by the present investigators.

Ground Levels in Bihar in relation to the Earthquake of January 15, 1934

By Col. Sir Sidney Burrard, Bt., F.R.S.

In an article published in Nature of February 17, p. 236, Dr. de Graaff Hunter has endeavoured to show that the surface of the plains where the earthquake of January 15 occurred in India had been proved by levelling to have been rising in height throughout the present age, at the rate of 4½ ft. per century. This conclusion is so important that I feel justified in submitting my reasons for questioning it. Dr. Hunter bases his theory on the results of levelling, but these are not confirmed by the geographical facts of Bihar. The accuracy of levelling is estimated from the agreement between two independent levellers. Although they take independent observations, they work together, and there are sources of error which affect them both.

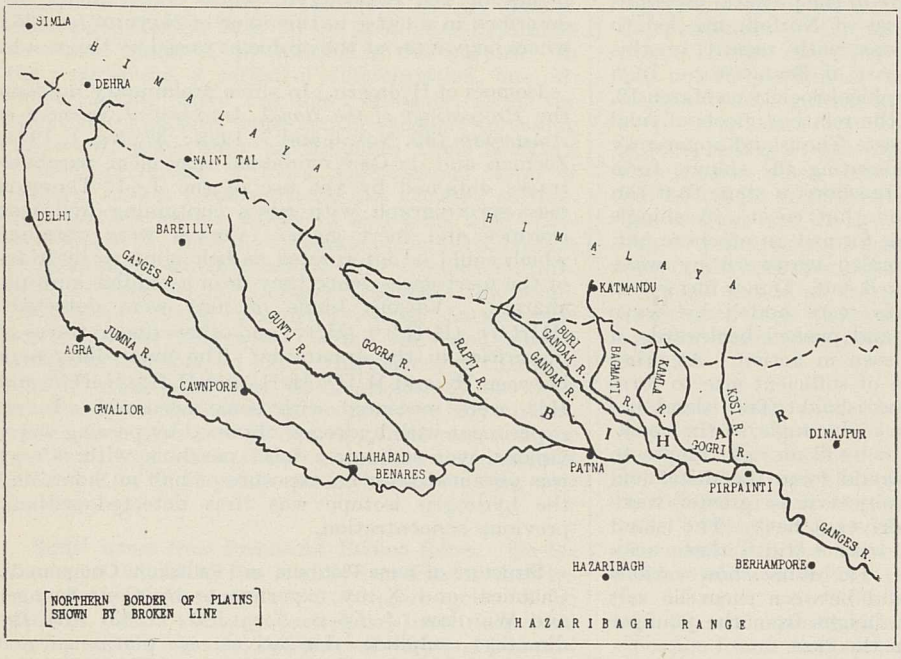

Fig. 1. Rivers of Bihar.

The history of levelling has placed on record several examples in Egypt, India and France of errors being accumulated and being only discovered when the levelling was connected with mean sea-level. We have no mean sea-level in Bihar, and the only check here upon levelling errors is provided by the rivers (Fig. 1). The numerous rivers that traverse the flat plains are governed, like sea-level, by gravitation. The surface of the plains differs in form from that of the sea, in that they have a gentle slope from north to south and a still gentler slope from west to east. The combination of these two slopes compels the numerous rivers, as soon as they escape from the Himalaya, to follow courses that converge upon the south-east corner of Bihar. It is perhaps not strictly correct to say that the slopes determine the courses of the rivers, for the rivers have created the slopes. If Bihar were at sea-level, its surface would be spheroidal, but as it is raised above the sea by two hundred feet of unconsolidated alluvium, the rivers have so shaped its surface that they may reach the sea along curves of least resistance. The adjustment of the surface to the rivers is very delicate; and it is not possible to say that either is the governing factor: their co-operation is perfect.

The rivers have to carry immense volumes of water from the Himalayan snows across densely inhabited level plains, and although they have the guidance of skilled engineers, a constant rise of the ground level across their paths would upset their balance and deflect their courses. No such results have been observed in confirmation of the levelling theory.

It may even be doubted whether a flat surface overlying alluvial depths could possibly be raised 4½ ft. per century as the levelling theory assumes. If any area of alluvium were to be raised above the normal level of the surface, or above the normal saturation level, the rise would probably be converted into 'blown sand', and would be removed by winds.

Dr. Hunter's conclusion that the surface of the earthquake area has been rising 4½ ft. a century is based upon three levelling results — Pirpainti, Benares and Dinajpur.

Pirpainti Levelling. A discrepancy of 3·178 feet was discovered at Pirpainti, when in 1929 a new line of levels intersected the old line of 1862. Dr. Hunter believes that this levelling discrepancy of 3·178 feet denotes a rise in the height of Pirpainti between 1862 and 1929. I find it difficult to place such faith in the accuracy of this levelling. Pirpainti is a station of the East India Railway: the levelling along this railway was carried out in 1862, the levellers were inexperienced, their instruments were primitive. When the bench-mark was originally cut at Pirpainti station, it was not intended to be a standard datum for scientific observations. No pendulum observer would take observations in this railway station. I feel that the discrepancy of 3·178 feet at Pirpainti may be due to an accumulation of errors arising from the instability of the site, from the inexperience of the levellers in 1862, and from the 'secondary' character of the check levelling in 1929.

Benares Levelling. A discrepancy of 2·170 feet was discovered at Benares when in 1916 a new line of levelling intersected the old line of 1863. This discrepancy is attributed by Dr. Hunter to the rise of Benares between 1863 and 1916. The levelling in 1863 to Benares was a continuation of the Pirpainti line, and its result is dependent on Pirpainti. The levelling of 1916, which first disclosed the discrepancy

of 2·170 feet at Benares, was brought from Calcutta across the mountainous region of Hazaribagh. This levelling was carefully observed, but no levelling over mountains can have a high degree of accuracy. The rays to the fore and aft staves are exposed to unequal refraction. I do not think that the level of the flat plains of Bihar can be tested by mountain levelling. A bench-mark on Hazaribagh rock would be a reliable standard datum for Bihar, provided it were not high up, but on a steep ascent levelling accuracy deteriorates.

Dinajpur Levelling. In 1900 (after the publication by the Geological Survey of the memoir on the great earthquake of 1897) a line of levels was carried across Bengal from south to north, from Calcutta to Dinajpur, by Capt. H. L. Crosthwait and Lieut. H. M. Cowie : this line was in every way scientific, and the height of Dinajpur was determined as accurately as was possible. In 1925 a new line of levels intersected the 1900 line at Dinajpur. The discrepancy between the 1900 and the 1925 results was 0·963 foot.

Dr. Hunter assumes this discrepancy of 0·963 foot to be due to the rise of Bengal between 1900 and 1925, and he converts the observed error of 0·963 into a theoretical rise of 4 feet in 100 years. Dr. Hunter's procedure is based upon the assumption that there was no levelling error on either of the lines that met at Dinajpur. Such an assumption is contrary to experience. If we bear in mind that the 1925 level-line had to pass through the streets of Calcutta and to cross the Hugli, and that both the 1900 and 1925 lines had to cross the main stream of the Ganges, we may feel justified in thinking that a discrepancy of 0·963 foot in 500 miles is within the limits of accumulated error.

The safest way of proving whether Dinajpur has risen in height would be to re-observe the whole levelling line of 1900, bench-mark by bench-mark, from Calcutta to Dinajpur. A single intersection of this line by another line does not furnish convincing evidence.

By Dr. J. de Graaff Hunter, C.I.E.

My short account of the results of spirit-levelling in Bengal, accumulated between 1862 and 1930, and their interpretation, are given in the Survey of India Geodetic Report (6, 104–6). In such a report considerations of space preclude the inclusion of every corroborative detail which the full records of the work contain.

Sir Sidney Burrard, not quite rightly, says that my theory rests on three levelling results. Actually it rests on a group of levelling circuits all giving evidence in the same direction ; but the results which he cites are certainly important. The first of these does not rest on the single bench-mark at the railway station. If reference is made to pp. 71–97 *loc. cit.*, it will be seen that two bench-marks, a quarter of a mile apart, were picked up at Pirpainti and gave results agreeing within 0·05 ft. Further, the connexion with Pirpainti was made after results at Bhagalpur and Luckeesarai had indicated a rise of more than two feet ; which the Pirpainti connexion confirmed. The 'secondary' levelling of 1929 is almost of the same type as what was formerly (before the introduction of levelling of high precision) known as levelling of precision.

The Benares result depends in part on Pirpainti, now justified, and on modern levelling through the mountainous region of Hazaribagh. In the case of a much more mountainous Himalayan circuit, I investigated the refraction anomaly, and found it to be trivial, a much more important error being due to the variation in length of the wooden levelling staves, during the course of the day. This tends to increase with the total amount of ups and downs of the line, which in the case of the Hazaribagh line are not enough to justify rejection of results, though nowadays we should employ invar staves in such a case.

Careful consideration was given to the errors which might naturally be expected in all these levelling lines, including those on which the Dinajpur result was based ; and the special difficulties of wide river crossings were not forgotten.

The geographical evidence is sufficient to cause Sir Sidney to mistrust the levelling of 1862 because the workers were inexperienced and had primitive instruments ; and more modern work when it passes through mountains such as occur in Hazaribagh. I cannot bring myself to discount all the spirit levelling in this way and prefer to judge it by its own internal and unbiased evidence, not omitting to consider the 'systematic' error as usually evaluated.

The spirit levelling evidence is limited to the area of its observations, and so gives only a partial picture. This covers roughly the triangle Calcutta–Darjeeling–Benares. So the contours of my chart (Nature, Feb. 17, p. 236) extend little into the area of Sir Sidney's sketch of the rivers of Bihar. Most of this river area may have risen almost uniformly, which would certainly be in keeping with my area of underloading. Why, then, should extensive geographical changes be expected, or their absence be regarded as in opposition to the results of much spirit-levelling ?

In my opinion much of the so-called 'systematic error' in levelling must be due to secular changes of ground level operating during the progress of the lines forming a circuit. On this account we are probably assessing the precision of spirit levelling below its true value.

Research in the Sea*

THE latest available issue of the *Journal of the Marine Biological Association* contains many valuable memoirs, being records of research undertaken chiefly at the Plymouth Marine Laboratory but also at the Scottish Marine Station, Millport, the Port Erin Marine Station, Isle of Man, and the Dove Marine Laboratory, Cullercoats, Northumberland. The whole is admirably planned and emphasises the fact that oceanography in its broadest sense is the object of all the work done in these laboratories, that is to say, the study of the sea and its contents both animate and inanimate and of all factors which influence these, centring round the fish itself. It is impossible nowadays to separate pure science from the practical side, or to say that any matter connected with the sea is irrelevant to its study, and we find these researches carried on in the marine laboratories of Great Britain tend more and more to fit into one another and show real progress in general knowledge of the interpretations of marine phenomena.

A glance at the subject matter will show how varied are the contents, but yet how well everything

* *Journal of the Marine Biological Association*, N.S., **19**, No. 1, August 1933, pp. 1–286. (Plymouth : The Association.)

really hangs together. Perhaps the most notable of the contributions is Mr. E. Ford's account of the herring investigations conducted at Plymouth during the years 1924–1933, which is a summary of his own work in connexion with the Plymouth herrings covering this period. He shows how far we have now gone in elucidating herring problems—a considerable distance, for we now can predict fairly well the probable constituents of the main portion of the herring fishery some years ahead, although weather and other agents may always upset calculations. The breeding of the herring is now becoming well understood: where the eggs are deposited, where the newly-hatched larvæ are to be found and those slightly older, their migrations out to sea in search of food and their spawning migrations inshore. Intensive studies of bones show how temperature has a distinct influence on the number of vertebræ and therefore of size, and thus the problem of races may be interpreted; and the reading of the scales tells us the ages of the fishes and the year classes to which they belong, so that we may know what classes are likely to make up the fisheries of future years. This full and valuable paper is indeed worth reading.

Mr. G. A. Steven's account of the food of the shags and cormorants round the Cornish coast also appeals directly to the fishing industry. Here a long-standing error is corrected, showing that the shag, which is far commoner on the open coast than the cormorant, is innocent of the destruction of commercially important fishes, its main food being smaller fishes of little value and usually not consumed by man. The cormorant, feeding much farther inland, certainly does considerable damage by preying on our edible fishes, especially flat-fishes.

Trematode parasites of fishes are dealt with by Mr. E. Idris Jones, and Miss D. Atkins describes a very interesting new orthonectid in the bivalve mollusc *Heteranomia* showing quite new features.

The shell-fish industry is represented by an important paper on oysters by Prof. J. H. Orton, following up his previous work on sex, showing the fate of unspawned ova and the change from male to female. The results described here of years of experiment with oysters in cages prove definitely for the first time that male individuals of *Ostrea edulis*, our common commercial oyster, pass into the female condition in significant proportion within twelve months, and that greater proportions attain the female condition in two years.

Information as to the food of fishes and of invertebrates is at all times desirable, and on this subject there are several papers dealing with the plankton, Mr. F. S. Russell on the seasonal distribution of macroplankton, Miss O. Jorgensen on the marine *Cladocera* of the Northumberland plankton, and three papers of great interest by Dr. A. G. Nicholls and Miss S. M. Marshall on *Calanus finmarchicus* from the Clyde area. In these last the copepod, which is of the greatest significance as fish food, especially of the herring, is dealt with in a masterly way, and its reproduction and seasonal distribution, its variation in size and its vertical and diurnal migrations are described. Mr. G. N. Spooner's experiments on the reaction of marine plankton to light are very suggestive and may lead to the elucidation of some of the difficult problems connected with migrations.

From animal plankton we come to vegetable plankton, and find Mr. H. W. Harvey's paper on the rate of diatom growth, showing how the neritic diatom *Nitzschia closterum*, taken from the pure cultures grown by Dr. E. J. Allen continuously for many years, react to experimental conditions, and Mr. F. M. Ghazzawi, on the littoral diatoms of the Liverpool and Port Erin shores, touches a section of these Algæ which has been too long neglected and is of considerable importance in the economy of the sea.

In connexion with the long standing and classic Mendelian work on *Gammarus* by Mrs. E. W. Sexton, which has been going on for many years in the Plymouth Laboratory, it is interesting to find that Mr. Bassindale has discovered abnormal eyes in wild *Gammarus* in the Tay Estuary.

The inorganic element is well to the fore, and in two papers Dr. L. H. N. Cooper continues his work on chemical constituents of biological importance in the English Channel and shows how winds influence the salt content in the sea, whilst Dr. W. R. G. Atkins and Dr. H. H. Poole discuss the use of cuprous oxide and other rectifier photo-cells in submarine photometry, and Dr. Atkins describes a method for rapid estimation of the copper content of sea water.

University and Educational Intelligence

A Mathematical Colloquium will be held in St. Andrews on July 18–28, under the auspices of the Edinburgh Mathematical Society. Courses of lectures will be given by Prof. E. A. Milne (Oxford), Prof. B. M. Wilson (Dundee), Prof. H. W. Turnbull (St. Andrews), and Mr. W. L. Ferrar (Oxford). The local secretary is Dr. D. E. Rutherford, United College, St. Andrews.

The educational film has now an assured place as a teacher's tool. The Central Information Bureau for Educational Films, established to further its employment, publishes a bulletin, *Film Progress*, in the December–January issue of which is announced the completion of a catalogue (price 3*s*. 9*d*., post free, Central Information Bureau for Educational Films, 103 Kingsway, W.C.2) of about two thousand films (35 mm., 16 mm. and 9·5 mm.) already made and approved by authoritative associations or individual experts on agriculture, engineering and industry, geography and travel, vocational guidance, and science, including hygiene, physics, chemistry, geology, physiology and psychology.

We have received from the University of Leeds a handsomely illustrated booklet presenting the salient features of its organisation, actual and projected, and an account of its chief courses of study. It recalls the fact that the land and buildings of the University have been provided almost entirely as a result of private generosity, sometimes unsolicited and sometimes in response to public appeals such as that which has recently produced £430,000. Unshackled by commitments of imperfectly prescient founders of long ago, the University is taking shape in the disposition of its main buildings as an example of planning for maximum efficiency; the departments comprised in the faculties of arts, law, economics and commerce, science and technology being grouped around the new Brotherton library and within five minutes' walk of the medical and dental schools, which are adjacent to the General Infirmary. Attention is directed to the fact that more than a quarter of the full-time students are in halls of residence.

Science News a Century Ago

Mary Somerville at the University of Cambridge

In the spring of 1834, Dr. William Whewell sent an official invitation to Dr. Somerville and his wife, Mary Somerville, the distinguished author of the "Mechanism of the Heavens", to visit the University of Cambridge for a week or so. Apartments had been arranged for them in Trinity College. Prof. Adam Sedgwick, the geologist, was entrusted with the social arrangements and general itinerary. In a letter to Dr. Somerville, dated April, 1834, Sedgwick, in characteristic vein, says :—

"My dear Somerville, your letter delighted us. I have ordered dinner on Thursday at 6½ and shall have a small party to welcome you and Mrs. Somerville. On Tuesday you will, I hope, dine with Peacock ; on Wednesday with Whewell ; on Thursday at the Observatory. For Friday Dr. Clarke, our professor of anatomy puts in a claim. For the other days of your visit, ample employment. A four-poster bed (a thing utterly out of our regular monastic system) will rear its head for you, and Madame in the chambers immediately below my own ; and your handmaid may safely rest her bones in a small inner chamber. Should Sheepshanks return, we can stuff him into a lumber room of the Observatory ; but of this there is no fear as I have written to him on the subject and he has no immediate intention of returning. You will of course drive to the great gate of Trinity College, and my servant will be in waiting at the Porter's lodge to show you the way to your academic residence. We have no cannons at Trinity College, otherwise we would fire a salute on your entry ; we will however give you the warmest welcome we can." ("Personal Recollections of Mary Somerville", by her daughter Martha Somerville (1873).)

American Railroad Progress

The first American railroad to be constructed with the intention of using steam locomotion only was the South Carolina Railroad, commenced in 1827, but the first to be opened was the Baltimore and Ohio Railroad, a part of which was brought into service in 1830, Peter Cooper's *Tom Thumb* engine running for a short time. With the adoption of British practice and the importation of English locomotives, which were far better than the early American locomotives, railroad projects created increased interest and, by the spring of 1834, there were no fewer than thirty-seven incorporated railroad companies in the State of New York alone, having a total capital of nearly thirty million dollars. As in England, the construction of the permanent way presented many difficulties, and when the Philadelphia and Columbia railroad was built, three different systems were tried. On one part of the line the rails were laid on continuous granite sills, on another on stone blocks three feet apart, and on another on continuous wooden sleepers. The difficulty with flat iron rails was referred to in a letter by Mr. A. C. Jones of Philadelphia written on April 15, 1834, to the editor of the *Journal of the Franklin Institute*. In this letter Mr. Jones said that on the Little Schuylkill Railroad there were two locomotives plying, and during the course of the last season they ran off the track fourteen times. Wooden roads he considered the only proper kind for locomotives, but the trouble arose from the flat iron rails, 2 in. wide and ⅝ in. thick, being joined improperly. Such plate rails were, however, soon afterwards abandoned for the inverted T-shaped rail originally introduced by Robert Livingstone Stevens in 1830.

Audubon's "Birds of America"

The year 1834 saw John James Audubon, the American ornithologist, continue his visits to England to exhibit his bird paintings in order to raise subscriptions for the publication of his work on "The Birds of America". Early in March 1834, he left Charleston and passed north to Washington, Baltimore, and New York. In a letter of April 6 to Miss Maria Martin, Audubon wrote that he had collected £600 and had sent £500 to Mr. Victor in bills of exchange to await them at London. Audubon, his wife and son, John, finally sailed from New York on April 16, 1834, in the packet *North America*, for Liverpool. In a letter written the day before he sailed, to Edward Harris, acknowledging receipt of 400 dollars in advance for a copy of his book, he wrote : "My drawings shipped from Charleston are safely in the hands of Victor at London. I have been able to forward to him 650£ and I have 30 sovereigns to defray expenses from Liverpool to the Great Metropolis. In 1824 poor J. had dreams but how far was I then from believing that I should ever have succeeded as I have ; who will believe my story ? Only one or two besides yourself have an idea of what I have undergone, but if God grants me life I shall publish that story, and send you sheets thereof as they are struck by the printer."

Audubon brought to England all the collections he had accumulated in three years' travel in the United States and British possessions, and the passage to Liverpool took him nineteen days. On arriving at Liverpool, Audubon renewed his friendship with the local naturalists, though Roscoe, founder of the Liverpool Botanic Gardens, had died since his previous visit. His stay was brief and he continued on to London, arriving there on May 12.

Marine Steam Engine Improvements

With very few exceptions, all early steam vessels had engines fitted with jet condensers and used sea water in their boilers. The principal pioneer of the marine surface condenser as used to-day was Samuel Hall, who was born at Basford, Nottingham, in 1781 and died in 1863 at Bow in East London. Hall had been successful with patents for gassing lace and net, and was fifty years of age when he turned his attention to the marine steam engine. He took out several patents, one of his most important being No. 6556 of Feb. 13, 1834, for a combination of a circulating pump, an air pump, a tubular surface condenser and an evaporator. Shortly after this, on April 19, 1834, the *Mechanics Magazine* noted that the "well-tried favourite of the public the *Prince Llewelyn*, now plying twice a week betwixt the Menai Straits and Liverpool, is the first packet that has been fitted out on Mr. Samuel Hall's principle for the improvement of steam engines, consisting of a superior method of condensing the steam and using fresh instead of salt water, thereby creating a great saving in the boilers, and at the same time consuming one-third less of fuel". In spite of the many advantages of Hall's improvements, surface condensers were not used on a large scale until forty years later.

Societies and Academies

London

Physical Society, February 16. T. Smith: (1) Integrals of products of experimentally determined magnitudes. The integral of a product of quantities known only for discrete values of a variable is given correctly by the simple sum of the products for uniformly distributed values of the variable. Nothing is gained by increasing the number of component products beyond the number of observed values of either factor. (2) Condensed tables for colour-computation. It is sometimes sufficient in the spectrophotometry of coloured materials for the determination of their colour co-ordinates on the C.I.E. system to take measurements at intervals of 10 mμ instead of the standard interval of 5 mμ. Special tables have been computed for use in these cases. C. E. Wynn-Williams: A relay memory for a thyratron counter. An automatic mechanism consisting of sixteen interconnected relays and capable of carrying out a complicated cycle of operations in correct sequence in less than half a second. The apparatus is used in conjunction with a valve amplifier and an automatic thyratron counter for the analysis of α-particle groups by means of a magnetic focusing method. The relay mechanism arranges for alternate comparative counts of α-particles to be made under two different sets of experimental conditions. W. G. Penney: A note on the twisting-frequency in ethylene. From the experimental value for the fundamental twisting-frequency in ethylene, the magnitude of a certain carbon-carbon exchange integral J is determined as $0{\cdot}72 \pm 0{\cdot}10$ electron-volts. According to this result, the energy needed to twist one of the CH_2 groups through an angle $\pi/2$ with respect to the other about the C-C axis is $1{\cdot}0 \pm 0{\cdot}2$. This agrees well with the experimental value for the heat of activation of dimethyl maleate to dimethyl fumarate. F. C. Connelly: The instantaneous projection of thermionic valve characteristics. Two mirror oscillographs are employed with axes at right angles, one indicating the anode current and the other the grid potential. A suitable alternating voltage of small amplitude from a 50-cycle supply is applied to the grid, causing the characteristic to be traced out 50 times a second, and persistence of vision causes the whole curve to be visible. The instrument indicating current is a Sprenger oscillograph, while the voltage-controlled vibrator is a special instrument designed for the purpose.

Paris

Academy of Sciences, February 19 (*C.R.*, **198**, 685–776). J. Costantin: Cultures of the potato at high altitudes and in high latitudes. Details of experiments on the growth of potatoes at the summit of the Pic du Midi, at Skarsvaag in the north of Norway, in the Alps and in the Andes. R. Fosse, P. E. Thomas and P. de Græve: Allantoin possessing rotatory power. Lævorotatory allantoin can be obtained by the action of allantoinase (from soya bean) on inactive allantoin. J. Haag: The calculation of mechanical or electrical oscillations. Mme. Hilda Geiringer: Applications of a new general method of theoretical statistics. Michel Petrovitch: A general mode of representation of elliptic functions. Mlle. M. Charpentier: Some properties of the curves of Birkhoff. Georges Kurepa: The linear continuum. T. Viola: The theorem of identity for holomorph functions of several variables. Julius Wolff: A property of the conformal representation of bands. A. Martinot-Lagarde: A change of regime in the flow of air round a model of an aeroplane wing. Ary J. Sternfeld: The trajectories allowing the approach to a central attracting body starting with a given Keplerian orbit. J. Géhéniau: The Dirac equations of the second order. L. Goldstein: A theory of quantification of matter. Mlle. M. Quintin: A method of determination of normal potentials. René Lucas: The diffusion of light and molecular polymorphism. A. Kastler: The proportion of polarisation of the fluorescence of pure mercury vapour. Pierre Daure: Study of the circular polarisation of the Raman lines of pinene, illuminated with circularly polarised light and observed longitudinally. Albert Pérard: The red line of cadmium is essentially reversible. René Audubert and Mlle. Geneviève Lebrun: The influence of the intensity of the light on photovoltaic phenomena. Further experiments in support of the theory that photovoltaic phenomena must be principally attributed to a photolysis of water under the action of the radiation. Marcel Servigne: A liposoluble compound of polonium. Experiments on the solubility of polonium camphocarboxylate in oil and in organic solvents. Marcus Francis and Tcheng Da-Tchang: The value of the ratio of bifurcation of the actinium family with respect to the uranium-radium family. The number of atoms of protactinium disintegrated in unit time for 100 atoms of uranium I disintegrated in the same time has been redetermined, using the tantalum method. The result, 4 per cent, agrees with the value of Grosse obtained by the zirconium method. Henri Lefebvre and Maurice van Overbèke: The chemical action of the condensed spark on mixtures of carbon monoxide and hydrogen. If the tube containing the mixture of carbon monoxide and hydrogen communicates with a tube maintained at − 183° C., the products consist mainly of carbon dioxide, acetylene and water. René Wurmser and J. A. de Loureiro: The reversibility of oxido-reduction systems derived from the glucides. Mlle. O. Hun: The cryoscopic study of the total hydration of the ions of nickel chloride. E. Rouyer: The cryoscopic determination of the total hydration of the ions of barium chloride. Paul Woog, Jean Givaudon and Fernand Dayan: The variation of the thawing point (*fluage*) of mineral oils accompanying changes in their state. E. Canals and P. Peyrot: The molecular diffusion of light in fluorescent liquids. J. Cournot and F. Hiltbold: The properties of German silver. Jean Savard: The ionisation potentials and energies of formation of non-polar molecules. L. Andrieux and M. Dodero: The electrolysis of fused silicates and the preparation of silicon and silicides. Description of experiments on the electrolysis of fused lithium silicate. The products obtained were silicon-lithium alloys containing crystallised silicon. G. Gheorghiu: The isomerisation of some 2.2 disubstituted derivatives of indanedione. L. Barrabé: The Tertiary formation which has covered the eastern part of Guadeloupe. Jacques de Lapparent: The Samos emery deposits. J. Cuvillier: The distribution and stratigraphic value of *Nummulites lævigatus* in the Egyptian Eocene. Hubert Garrigue: The slightly penetrating radiation at the Pic du Midi. A. Guilliermond: The nature and meaning of Golgi's

apparatus. ALBERT F. BLAKESLEE and MME. SOPHIA SATINA: Do plants differ from animals by the lethal gametes? PH. L'HÉRITIER: The comparative demographic study of four strains of *Drosophila melanogaster*. EMILE F. TERROINE and MLLE. GILBERTE MOUROT: The real value of endogenous purine metabolism.

CRACOW

Polish Academy of Science and Letters, November 6. F. LEJA: The existence of a domain of convergence of series of homogeneous polynomials. TAD. BANACHIEWICZ: A problem of geophysics. The author discusses the problem of the determination of the altitude H at the zenith of the point lighted by the grazing rays of the sun. An approximate formula is given, $H = H_0(1 + K)$, where H_0 is the altitude calculated for a spherical earth and K is a small quantity for which tables are given. M. CENTNERSZWER and M. BLUMENTHAL: The formation and dissociation of the alkaline peroxides. The authors show that the dissociation of the known peroxides of the alkali metals is a reversible phenomenon. Certain peroxides dissociate in the solid state below their melting points. J. KOZAK and F. PAZDOR: The photokinetics of reactions of bromination (5). The bromination of the alkyl derivatives of naphthalene in light. The velocity of bromination of these compounds varies with the wave-length of the incident and absorbed light. There is a difference between the substitution and addition reactions. B. PAWLOWSKI: Studies on the delphiniums of central Europe belonging to the section *Elatopsis*. B. SZAFRAN: The flora of the diluvial Muscineæ of Starunia. T. KORMOS: Fragments of bone of small vertebrates found in the diluvial clay of Starunia. F. LANGERSDORFF: The Diptera of the diluvial layers of Starunia. F. ZEUNER: The Orthoptera of the diluvial layers of Starunia. Z. GRODZINSKI: The development and comparative anatomy of the axial blood vessels in the anterior extremities of mammals. J. ZACWILICHOWSKI: The innervation of the sensorial organs of the wings of the bee (*Apis mellifica*).

LENINGRAD

Academy of Sciences (*C.R.*, N.S., No. 3, 1933). B. SEGAL: A general theorem expressing some properties of an arithmetical function. D. EROPKIN: The problem of the existence of oxygen in the atmosphere of Mars. Theoretical suggestions for the solution of this problem by obtaining evidence of the presence or absence of ozone, which strongly influences the ultra-violet region of the spectrum even if present in extremely small quantities. G. RUMER: The eigenfunctions of atoms in an impulse space. A proof of Balmer's formula is offered which is considered simpler than the usual one. M. LEVITSKAYA and V. DLUGAC: A selenium compound with thermoelectric power. An alloy containing 35 per cent of selenium and 65 per cent of copper prepared at a temperature above 1,000° possessed qualities making it eminently suitable for use in thermocouples. O. VEHR and M. M. ROMANOV: Some alloys resistant in phosphoric acid. The chromium steel containing carbon, 0·48 per cent; silicon, 2·74 per cent and chromium, 38 per cent, proved to be resistant in 80 per cent phosphoric acid at 135°. Very resistant also is an aluminium bronze containing about 0·5 per cent of chromium, as well as a bronze containing 9·46 per cent of aluminium, 0·37 of chromium, 0·26 of iron and copper. A. RUSHCHINSKIJ: The possibilities of obtaining by synthesis valuable aromatic aldehydes from new sources. The methods are discussed for obtaining vanilline, burbonal and heliotropine by introducing the aldehydogenous group, and from phthallic anhydride. P. IVANNIKOV, A. FROST and M. SCHAPIRO: Influence of heating on the catalytic activity and other qualities of zinc oxide. The greatest catalytic activity is exhibited when the catalyst is heated to 230°. The temperature of heating does not affect the crystal lattice of the zinc oxide. A considerable growth of crystals begins at temperatures above 900°. M. K. TCHAILAKHIAN: The formation and decomposition of chlorophyll in the leaves of winter and spring cereals. The additive effect of darkness upon the decomposition of chlorophyll permits an independent utilisation of the quantity of chlorophyll as a method of distinguishing spring forms from winter forms. V. NOVIKOV and E. HERBER: The inducing of rubber formation in plants by ultra-violet rays. The seedling of the tau-sagiz rubber plant from seeds exposed to irradiation of a quartz mercury lamp showed a great increase in activity of the catalase. Plants grown from irradiated seed produced a greater quantity of rubber than the controls. B. B. POLYNOV: The types of erosion and their distribution according to the geomorphological conditions. A general classification is offered of the forms of rock erosion and their genetic connexion is briefly outlined.

ROME

Royal National Academy of the Lincei: Communications received during the vacation, 1933. A. BEMPORAD: Stellar currents about R.A. $14^h + 52°$ Decl. Q. MAJORANA: New investigations on metallic photo-resistance. Results obtained with deposits of aluminium and of sodium are described. M. CAMIS: Endopleuric pressure and atmospheric pressure. Experiments with sheep and rabbits confirm the fact that lowering of the endopleuric pressure accompanies diminution in the atmospheric pressure. G. SCORZA DRAGONI: Multiplication of series which converge conditionally (1). U. BROGGI: Certain problems of the summation of divergent series. B. DE FINETTI: The law of large numbers in the case of equivalent aleatory numbers. MARIA CIBRARIO: The polynomials of Bernouilli and Euler. G. ARRIGHI: The statics of floating and the dynamics of buoyancy. LUISA PELOSI: Parallelism defined by angular variations. M. MAGGINI: The influence of colour on the photoelectric measurements of stars. Various examples considered show that, in some cases, variations in the colour of stars may be such as to mask those of the brightness, and that, in addition to stars varying in relation to their luminous intensity, there may be some which vary only as regards colour. G. MEZZADROLI and A. AMATI: Action of certain alkaloids on invertase. The activity of invertase is diminished greatly by the presence of small proportions of strychnine nitrate, the effects of caffeine or of quinine sulphate being far less marked. N. MÉTALNIKOFF: Experiments on the multiplication of infusoria under the action of oscillating circuits. The multiplication of *Paramecium caudatum* is accelerated by oscillating circuits, those of smaller diameter exerting a more pronounced influence than larger ones. FAUSTA BERTOLINI:

Teeth of Selachii in relation to nutrition. Different species of Selachii show four distinct types of teeth, which correspond with four different types of nutriment. Margherita Ollino: Experimental investigations on the metamorphosis of anuric amphibia. Transplanting experiments in relation to larval stages and to hormonal (thyroid) conditions. Eufrosine Ruzza: Investigations on the development of the pronephros of amphibia. R. Novello: Observations on the chloroplasts of the palm. G. Moruzzi: The existence of transneuronic degenerations.

Forthcoming Events

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

Monday, April 16

Royal Society of Arts, at 8.—Prof. J. G. Gray: "Gyroscopes". (Thomas Gray Lecture. Succeeding lectures on April 23 and 30.)

Royal Geographical Society, at 8.30.—Prof. E. de Martonne: "The Andes of the North-West Argentine".

Tuesday, April 17

Eugenics Society, at 5.15—(in the rooms of the Linnean Society, Burlington House, Piccadilly, W.1).—A Symposium on "Birth Control". Speakers: Representatives of the National Birth Control Association and the Society for the Provision of Birth Control Clinics.*

Wednesday, April 18

Royal Society of Arts, at 8.—W. R. Gordon: "The Utilisation of Coal".

Society for Constructive Birth Control and Racial Progress, at 8.—(at the Essex Hall, Essex Street, Strand, W.C.).—Dr. Marie Stopes: "Lord Dawson's Contraceptives Bill: what has happened and what must still be done".

Thursday, April 19

Chemical Society, at 8.—(at the Royal Institution, Albemarle Street, London, W.1).—The Right Hon. Lord Rutherford: "The Periodic Law of Mendeléeff and its Interpretation" (lecture to commemorate the centenary of Mendeléeff).

Friday, April 20

Royal Institution, at 9.—Prof. P. M. S. Blackett: "Cosmic Radiation".

Electrical Association for Women, April 19–20. Ninth annual conference to be held in London.

Official Publications Received

Great Britain and Ireland

An Index to Acts of Parliament and Statutory Rules and Orders affecting the Chemical Industry. (Published for the Association of British Chemical Manufacturers.) Supplement No. 3. Pp. 6. (Cambridge: W. Heffer and Sons, Ltd.) 6*d*.

Armstrong College: Dove Marine Laboratory, Cullercoats, Northumberland. Report for the Year ending July 31st, 1933. Pp. 53. (Cullercoats.) 5*s*.

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1552 (T. 3344, 3367, 3390): Methods of Visualising Air Flow. By K. W. Clark. Pp. 10+18 plates. 1*s*. net. No. 1563 (T. 3040 and 'a'): Abstract—A Survey of the Air Currents in the Bay of Gibraltar in 1929–30. By J. H. Field and Dr. R. Warden. Pp. 3+1 plate. 6*d*. net. (London: H.M. Stationery Office.)

Ollsgoil Na h'Eireann (The National University of Ireland.) Calendar for the Year 1933. Pp. viii+299+622+281. (Dublin.)

Report of the Marlborough College Natural History Society for the Year ending Christmas, 1933. No. 82. Pp. 120+6 plates. (Marlborough.) 3*s*.; to Non-Members, 5*s*.

Scottish Marine Biological Association. Annual Report, 1932–33. Pp. 23. (Glasgow.)

Other Countries

Memoirs of the Faculty of Science, Taihoku Imperial University. Vol. 10, No. 2: Mathematics No. 7: Über Flächen und Kurven, 6: Eilinien und Eiflächen; Beiträge zur Geometrie der Kreise und Kugeln, 8. Von Sôji Matsumura. Pp. 21–70. (Tokyo: Maruzen Co. Ltd.)

U.S. Department of the Interior: Geological Survey. Bulletin 844–C: The Suslota Pass District, Upper Copper River Region, Alaska. By Fred H. Moffit. (Mineral Resources of Alaska, 1931.) Pp. ii+137–162+plate 2. 15 cents. Bulletin 844–D: Mineral Deposits of the Rampart and Hot Springs Districts, Alaska, by J. B. Mertie, Jr.; Placer Concentrates of the Rampart and Hot Springs Districts, by A. E. Waters, Jr. (Mineral Resources of Alaska, 1931.) Pp. iv+163–246+plates 3–5. 10 cents. Bulletin 857–A: Mineral Industry of Alaska in 1932. By Philip S. Smith. (Mineral Resources of Alaska, 1932.) Pp. ii+91. 10 cents. Bulletin 857–B: Past Placer-Gold Production from Alaska. By Philip S. Smith. (Mineral Resources of Alaska, 1932.) Pp. 93–98. 5 cents. Circular 6: Mineral-Water Supply of the Mineral Wells Area, Texas. By Samuel F. Turner. Pp. ii+9+1 plate. Professional Paper 175: Shorter Contributions to General Geology, 1932–33. Contents and Index. Pp. iv+115–117. (Washington, D.C.: Government Printing Office.)

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 16, No. 4: Deep-Sea Fishes of the Bermuda Oceanographic Expeditions—Family Idiacanthidæ. By William Beebe. Pp. 149–241. (New York City.)

The University of Lucknow. Abstracts of Publications by Members of the University (Department of Botany), 1928–1932. Pp. 41–89. (Lucknow.)

Transactions of the Astronomical Observatory of Yale University. Vol. 10: Catalogue of the Positions and Proper Motions of 8703 Stars; Re-observation by Photography of the Astronomische Gesellschaft Zone between Declinations +20° and +25°, reduced to 1875·0 without applying Proper Motions. By Frank Schlesinger, Ida Barney and Carolyn Gesler; together with Photographic Magnitudes determined by means of the Thermoelectric Photometer, by Jan Schilt. Pp. iii+5+176. (New Haven, Conn.)

Publications of the Observatory of the University of Michigan. Vol. 5, No. 12: A Study of Class B Stellar Spectra. By Roy K. Marshall. Pp. 137–167+2 plates. (Ann Arbor, Mich.)

Publications de l'Observatoire astronomique de l'Université de Belgrade. Tome 6: Annuaire pour l'an 1934. Rédigé par V. V. Michkovitch. Pp. 112. (Beograd.)

Publikationer fra det Danske Meteorologiske Institut. Aarbøger. Isforholdene i de Arktiske Have (The State of the Ice in the Arctic Seas) 1933. Pp. 17+5 maps. (København: G. E. C. Gad.)

Journal of the Indian Institute of Science. Vol. 16A, Part 11: Studies in Bridge Formation, Part 3: The Influence of the Methyl and Carbethoxy-Groups in the Internal Dehydration of *gem*-Disubstituted Dihydroresorcinol Esters; Part 4: Tautomerism in *iso*-Phorone. By P. S. Mayuranathan. Pp. 113–127. 1 rupee. Vol. 16A, Part 12: Synthesis of Proteins in Plants, Part 1: Conversion of Nitrates into Protein in *Helianthus annus*, Linn. By K. S. Varadachar. Pp. 129–138. 12 annas. Vol. 16A, Part 13: Contributions to the Study of Spike-Disease of Sandal (*Santalum album*, Linn.), Part 15: The Rôle of Plant Acids in Health and Disease. By A. V. Varadaraja Iyengar. Pp. 139–152. 1 rupee. Vol. 17A, Part 1: The Thermal Dissociation of Cadmium Carbonate. By P. Y. Narayana and H. E. Watson. Pp. 6. 12 annas. Vol. 17A, Part 2: Studies in Indian Essential Oils, 5: Essential Oil from the Rhizomes of *Curcuma longa*, Linn.; 6: Essential Oil from the Rhizomes of *Acorus calamus*, Linn. By N. C. Kelkar and B. Sanjiva Rao. Pp. 7–31. 1.8 rupees. (Bangalore.)

Fiskeridirektoratets Skrifter, Serie Havundersøkelser. Report on Norwegian Fishery and Marine Investigations, Vol. 4, No. 8: Some Observations on Cod in Northern Waters—Preliminary Report. By Thor Iversen. Pp. 35. (Bergen: A. S. John Griegs Boktrykkeri.)

Dominion of Canada. Sixteenth Annual Report of the National Research Council, containing the Report of the President and Financial Statement 1932–1933. Pp. 113. (Ottawa.)

Carnegie Institution of Washington. Publication No. 440: Contributions to Palæontology—Papers concerning the Palæontology of California, Arizona and Idaho. Pp. iii+136+28 plates. (Washington, D.C.: Carnegie Institution.)

U.S. Department of Agriculture. Circular No. 305: The Boxwood Leaf Miner and its Control. By William Middleton and Floyd F. Smith. Pp. 8. 5 cents. Technical Bulletin No. 388: The Southwestern Corn Borer. By E. G. Davis, J. R. Horton, C. H. Gable, E. V. Walter and R. A. Blanchard; with Technical Descriptions by Carl Heinrich. Pp. 62. 10 cents. (Washington, D.C.: Government Printing Office.)

U.S. Department of the Interior: Geological Survey. Bulletin 846–C: The Climax Molybdenum Deposit. By B. S. Butler and J. W. Vanderwilt; with a Section on History, Production, Metallurgy and Development, by Charles W. Henderson. (Contributions to Economic Geology, 1933, Part 1). Pp. iv+195–237+plates 23–38. 50 cents. Bulletin 858: Bibliography of North American Geology, 1931 and 1932. By John M. Nickles. Pp. ii+300. 25 cents. Circular 5: Geology of the North and South McCallum Anticlines, Jackson County, Colorado, with Special Reference to Petroleum and Carbon Dioxide. By J. C. Miller. Pp. 27+2 plates. (Washington, D.C.: Government Printing Office.)

Annual Report of the Imperial Council of Agricultural Research for the Year 1932–33. Pp. iii+61. (Delhi: Manager of Publications.) 6 annas; 8*d*.

Catalogues

The B–S Pocket Refractometer. Pp. 4. (London: Bellingham and Stanley, Ltd.)

Eastman Organic Chemicals. (List No. 25.) Pp. 112. (Rochester, N.Y.: Eastman Kodak Co.).

Medicinal Glucose (Anhydrous) Dextrose B.P. Pp. 16. Gonococcus Vaccines. Pp. 16. (Nottingham: Boots Pure Drug Co., Ltd.).