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## The Royal Commission on the Civil Service.*

READERS of Nature will recall that when the present Government announced its intention of setting up a Royal Commission on the Civil Service, with terms of reference of a seemingly comprehensive character, our satisfaction was qualified by a contemplation of the list of the members of the Commission. Without in any way belittling the attainments and achievements of its sixteen members in their respective avocations, we were compelled to point out that not one was a scientific man or engaged in the application of science to the needs of the community, and that not one was known to have devoted consideration to the more fundamental problems of public administration.

The Commission has now issued a conscientious and painstaking Report, the character of which has confirmed all too well the misgivings which we expressed at the time of its appointment. The Commission shows itself to be dominated almost entirely by the official witnesses, who view with complacency an administrative structure designed by them in relation to the needs of an earlier and more primitive social organisation. It is entitled to credit for having studied and answered—though usually in the negative—the numerous and often constructive criticisms brought to its notice by staff organisations; but it must be rarely that a Royal Commission, confronted with a problem of the magnitude indicated by the terms of reference, can have been so sterile of constructive ideas of its own, and so content to put forward mere glosses on an existing structure, many features of which, so far as it has been modernised, were hurriedly improvised in the immediate post-War years.

Those of us who attribute in no small measure the difficulties with which Great Britain is confronted to failure to give full scope to the scientific and technical expert, had our hopes raised by the inclusion in the terms of reference of the Commission of an instruction to inquire into and report upon the "structure and organisation of the Civil Service". We have never pretended that scientific and technical men and women are not concerned with questions of remuneration, but it has always been our view that remuneration would adjust itself once the true function of the expert had been recognised and his status duly adjusted. The Commissioners, however, following the unfortunate precedent of the Carpenter Committee on the staffs of Government

* Royal Commission on the Civil Service, 1929–31. Report. (Cmd. 3909.) Pp. viii + 252. (London: H.M. Stationery Office, 1931.) 3*s*. 6*d*. net.

scientific establishments, have carefully avoided consideration of any fundamental questions of structure, including especially those arising out of the employment of specialists—to use a wide term to comprehend professional, scientific, and technical staffs—in the administrative departments of State. The Commissioners' interpretation of the above essential element in their terms of reference is as follows :

"It is not our duty to redistribute the functions of Government between Departments, or to reorganise or determine the staff of a Department. But, taking things as they are, it is our duty to determine the most satisfactory general principles to be followed, in regulating recruitment, in fixing terms and conditions of employment, in classifying grades or classes, in distributing functions between grades and classes, and in other like matters."

Two large-scale official inquiries, one dealing with the State scientific services and one dealing with the Civil Service as a whole, have thus seen fit to avoid investigating the wider questions of structure and organisation, beside which matters of staffing, remuneration, and conditions of employment fade into insignificance. There was much in the Report of the Carpenter Committee which could be welcomed as revealing some perception of the need for the development of a State scientific service, even although the problem was not actually visualised in this form, but was approached as a mere simplification of grading and scales of pay so as to ensure uniformity among staffs employed on comparable duties in different departments. Nevertheless, whatever the approach, the Carpenter Report represented progress. The present Royal Commission's Report, however, is little more than a laudation of the *status quo* and an endorsement of Treasury principles and practice based upon conceptions of the scope of public administration current in the latter part of the last century. Without touching on larger questions of administrative policy, however, there were certain proposals with which the Commission deemed itself competent to deal and which were elaborated in the evidence of the Institution of Professional Civil Servants and supported from other points of view by both the British Science Guild and the Association of Scientific Workers.

In the first place, specialist officers are denied a proper share in the formation of policy, a function which resides in the hands of non-technical administrators who alone are entitled to access to the supreme authority represented by the Minister ; in the second place, it is most exceptional for the professional or scientific officer, however gifted administratively, to enter the charmed circle of the administrators ; and in the third place, there is a complete failure to perceive the fundamental unity which underlies the employment of technical experts by the State, a type of recognition which in other walks of life—even on the administrative side of the Civil Service—has done much to promote esprit de corps, the pre-requisite of administrative efficiency.

There can be no doubt that, in the interests of efficiency, the technical hierarchies should be accorded a status equal to that of the administrative hierarchies, and that, in particular, the chief technical officer in a department should rank on terms of practical equality with the administrative head of the department. When policy is in course of formation or when larger decisions are being taken, the chief technical adviser should be permitted to play as prominent a part as the chief administrative adviser of the Minister, and the board system in one form or another seems peculiarly suitable for securing this result. Under the present system it frequently happens that the technical staff prepare a report and guide the hands of the administrators up to a certain point and then hear no more about the Minister's views until perhaps there is a public pronouncement on the platform or in parliament.

The Commissioners state that they heard no evidence to justify the view that at the present time specialists are disregarded. This statement is apparently based upon the fact that a long series of permanent secretaries expressed complacent satisfaction with the present system. If the Commissioners had heard first-hand information on the point, from professional and scientific heads of departments, we have little doubt that they would then have been satisfied that there is a case for a reform of the present system. They have been misinformed when they assert that "there is no real danger that their (specialist) advice would not be placed before the Minister or official on whom falls the responsibility for the final decision on the issue under consideration ".

Nevertheless, the Commissioners are constrained to admit that there may still exist among specialists a feeling that their advice is not always sought and considered, and the pious remedy proposed is that

"those in positions of administrative responsibility should take special precautions to ensure not merely that specialists are properly consulted and that full consideration is given to their views, but that they are given no ground for feeling that their value is not appreciated. It is important

that specialists as well as other officers whose duty it is to give advice should be made aware of the decision taken by the responsible authority."

It is precisely because these things do not happen as a matter of course under the present system that there is an urgent need for according the technical advisers a more assured status and a more definite right to assert their points of view in the presence of those who have to take the ultimate decision.

Accepting without qualification the official Treasury evidence, the Commissioners state that they have received no evidence indicating that, when an appointment to the permanent headship of a department is under consideration, regard is not and will not be had to the claims of officers other than those serving in an administrative capacity, and in support of this statement they mention that two of the present permanent heads of departments began their careers on the specialist side of the Service. The Commissioners' findings on this important point are rather discounted by a passage in the chapter of the Report devoted to the Post Office, in which, when discussing the position and remuneration of the engineer-in-chief, they state that they would

"have expected that over a period of years some technical officers would have been found to possess qualities rendering desirable their transfer to the administrative side. We were told, however, that no officer from the technical side had ever been promoted to an administrative post in the department."

We may remark in passing that entry into the administrative class may be obtained by those whose specialisation at the universities has not been in literary subjects, through the medium of the open competition for posts in the administrative class. This fact is apparently not generally known, and we propose to return to the subject in a subsequent issue. However, we would urge that the very fact that the administrative faculty in its highest sense is rare, renders it essential that the field from which administrators are drawn should be as wide as possible, and just as it is now repugnant that qualified persons should be denied public appointments on political, social, or religious grounds, so it should be equally accepted that no man should be virtually debarred from administrative preferment merely because he possesses precise and ordered knowledge of a particular branch of science.

Finally, there was the possibility of approach to the problem of raising the status of the technical expert by simplifying the extraordinarily heterogeneous collection of grades and salaries which obtains in the professional and technical services. As we have indicated, the Carpenter Committee made important recommendations, which are endorsed by the Commissioners, to secure greater uniformity in the scientific departments. According to the evidence submitted by the Institution of Professional Civil Servants, there are actually more than five hundred separate grades in the professional and technical services, revealing minute salary differences one from another, ostensibly based upon a fine weighing up by the 'establishment' experts (all of whom are administrators) of the relative values of the services performed by these officers. One would have thought that a *prima facie* case for rationalisation would have been afforded by the history of the non-technical services, which in the past revealed the same multiplicity of grading, most of which has disappeared as a result of a process of 'reorganisation'. A similar problem has confronted the Canadian technical service, and the recent report of the Canadian Royal Commission has recommended the replacement of 203 separate grades by seven simplified hierarchies.

This issue of simplification is something more than a desire for symmetry, for the acceptance of the principle that the grading and remuneration of professional and technical officers in different occupations should be unified would pave the way to that public recognition of the technical services of the State, which is a necessary precursor to the granting to the staff concerned of a higher status in the official hierarchy. The Commissioners state that it was not possible for them to review in detail the organisation of the various specialist classes outside the terms of reference of the Carpenter Committee, nor, as we understand, did the Commissioners make any detailed investigation of the actual working of the professional and technical departments. The fact that they were without any real first-hand acquaintance with the specialist services did not prevent the Commissioners from pronouncing quite definitely against the various proposals to which we have referred for enhancing the status of the expert or from stating that there is no justification for an improvement in remuneration except in the case of some of the highest technical posts.

The constructive proposals put to the Commission were rejected out of hand, with the qualification

that the Commission admitted the extraordinary anomaly of paying between £1600 and £1700 a year to the engineer-in-chief at the Post Office, responsible for the technical side of the conduct of the State's telegraph and telephone enterprises, and for the control of an army of workmen and of professional and technical officers, whereas the secretary of the Post Office receives £3000 a year. The Commission recommends that the engineer-in-chief should receive £2500. This, coupled with a suggestion that the secretary of the Department of Scientific and Industrial Research, who now receives £2200, should receive £2500, and that in the highest professional posts adjustment of salaries is required, represents substantially the whole of the Commissioners' reactions to the suggestion that the employment of specialist officers by the State presents a special problem that requires reconsideration in the light of modern conditions.

When confronted by the problem of the Post Office, the Commissioners not unnaturally quailed, and took refuge in a suggestion that the importance of the issues raised by a State trading enterprise pointed to the need for a special committee or commission to inquire into Post Office organisation. It does not appear to have occurred to the Commissioners that *a fortiori* there was an overwhelming case for a special committee or commission to inquire into the even more difficult problem of the professional, scientific, and technical services, to which they admit they gave no detailed consideration.

While we have no hesitation in describing the Report as a disaster from the point of view of the welfare of the community, it would not be just to place the whole of the blame upon the Commissioners, many of whom, in view of their public position, must be regarded as being in close touch with informed public opinion. The failure to appreciate the significance of the expert in public administration is but a symptom of the more widespread failure to realise that the ills which now beset civilised communities can only be solved by scientific method and the utilisation of scientific discovery. Our task must continue to be the creation of an informed public opinion which will instinctively exhibit indignation when important public questions involving scientific considerations are discussed without the assistance of experts, and will insist that on all public inquiries there should be a due representation of experts familiar with the subject matter of such inquiries.

## Magical Belief and Practice.

(1) *Amulets and Superstitions : the Original Texts with Translations and Descriptions of a Long Series of Egyptian, Sumerian, Assyrian, Hebrew, Christian, Gnostic, and Muslim Amulets and Talismans and Magical Figures, with Chapters on the Evil Eye, the Origin of the Amulet, the Pentagon, the Swâstika, the Cross (Pagan and Christian), the Properties of Stones, Rings, Divination, Numbers, the Kabbâlâh, Ancient Astrology, etc.* By Sir E. A. Wallis Budge. Pp. xxxix + 543 + 22 plates. (London : Oxford University Press, 1930.) 30*s.* net.

(2) *Le livre de recettes d'un dabtara abyssin.* Par Marcel Griaule. (Université de Paris : Travaux et mémoires de l'Institut d'Ethnologie, tome 12.) Pp. xi + 180. (Paris : Institut d'Ethnologie, 1930.) 70 francs.

(1) BELIEF in the power of the amulet is one of the most interesting phenomena in the history of religious belief. In close alliance with 'magic' it appears as one of the earliest forms of man's belief in the forces which he believes to lie behind the perceptions of his senses : as the mascot it serves to testify to the last act of faith of a disintegrated religion. How closely the extremes of the scale approach one another appears in some instructions on the choice of amulets published a few years ago, in which the writer argued the possibility that there might be something in it on the analogy of wireless telegraphy. No anthropologist in search of *mana* in religious belief could desire a more illuminating example ; but after saying this we hesitate to suggest that Sir Wallis Budge himself is not guiltless of flirting with the idea that "there may be something in it".

In his study of the amulet and allied beliefs, Sir Wallis Budge has confined himself to ancient Egypt and Babylonia, the later Kabbalists, the Gnostics, pagan and Christian, and the astrologers. Virtually his field is the ancient Mediterranean area. Within these limits he has covered the ground with no little thoroughness. In fact there is scarcely any aspect of magical belief and practice on which he has not touched. In addition, he has added to the evidence from his experience among makers of horoscopes, casters of nativities, diviners, crystal-gazers, palmists, and fortune-tellers of all kinds whom he has met while engaged on official missions in Egypt, the Sudan, and Mesopotamia—a fruitful field as all will agree who know the superstitious reverence and profound belief with which such classes are regarded by the populace in these countries.

"The use of amulets", says the author, "dates from the time when animism or magic satisfied the spiritual needs of man"; but on a previous page, to some extent following the lead of that distinguished authority, the late Dr. Seligmann, he tells us "the use of amulets is the result of the belief in the powers of the Evil Eye in man and beast". These two statements appear to need some qualification, or at least, reconciliation. In the Mediterranean area, without doubt, the amulet is predominantly used against the evil eye; but among the peoples of simpler culture the amulet is primarily a potent protector against any spiritual influence, vaguely conceived, rather than concerned with the specific concept of a human embodiment of malevolence operating through the eye. In fact, it is difficult not to feel that the author in his account of primitive spiritual beliefs has allowed his views to be too strongly coloured by early Mesopotamian demonology.

Again, the author says: "He [primitive man] required amulets to enable him to beget children, to give him strength, to overcome his enemies, visible and invisible, and above all the evil eye, and to protect his women and children and house and cattle; and his descendants throughout the world have always done the same". But taking the first part of this statement of the objects for which an amulet is employed, the character of primitive beliefs relating to the amulet all the world over would seem to suggest rather that it is not so much to enable man to do these things as to ward off influences that would prevent him from doing them that the aid of the amulet is invoked. Even in the case of the modern mascot of civilisation worn as a 'luck-bringer', so far as the belief is capable of analysis it is just as much a 'bad luck averter' as a 'luck-bringer'. Why is the mascot carried on the bonnet of a motor car? Why were mascots so much in vogue during the War?

The question is of something more than formal import as it implicates a quite definite change in attitude towards the supernatural. The primitive attitude of mind is one of fear; and the 'luck-bringer' implies some form of influence or control. Fear, if not entirely eliminated, has at least been deposed from its dominant position. The transition no doubt may be sought in the spell or incantation, the 'word of power'. If this does not warrant a certain looseness of terminology and definition in the author's more general statements, it may, perhaps, be regarded as justifying him when he comes to deal with matters of detail in his admirable accounts of the various types of spell to be found among Assyrians, Hebrews, Samaritans, and other peoples ancient and modern.

A wider view, in a geographical sense, would have added considerably to the value of the account of the swastika. It is here suggested that the swastika of the terramaricoli was really a cross. America is not mentioned; but it would have been interesting to know what the author thinks of the types and distribution of the swastika on that continent. The waved form in a circle of America also occurs in eastern Asia. Is this significant, or do other considerations outweigh the coincidence?

The contents of this book justify the author's contention that he should have used the term "magic" in the title instead of "superstition". The mere recital of the sub-title would support a claim that it might serve as a text-book of the magic art. Should the reader wish to know what forms of divination were current among the ancients, what rings they wore and why, how they used the waxen image of witchcraft, what were the various theories of numbers, or what virtues they assigned to precious stones, all this and more is here under his hand. Sir Wallis tells us that this book is an answer to the questions he was asked by the public in his department at the British Museum. Truly the curiosity of man about the things that are hidden is insatiable.

(2) Vol. 12 of the *Memoirs* published by the Institute of Ethnology in Paris is a collection of charms and medical receipts which very appropriately may serve to supplement and illustrate Sir Wallis Budge on charms and incantations. The collection is taken from a book purchased by M. Marcel Cohen in Abyssinia in 1910–11—a duplicate copy belonging to one of the priestly class, from which he was apparently prepared to part in the belief that it would not be understood. It consists of charms against magical powers and particularly the evil eye, while a second part is concerned with specific diseases, and ills of various parts of the body. It affords a considerable amount of information as to plants in medicinal use. Numerous taboos have to be observed, and much stress is laid on orientation, both in gathering and in using the plants. The value of the text is much enhanced by the editor's notes and appendices on the various types of spirits and magical beliefs current among the people. These are partly based on information obtained from Abyssinians who were fellow-students with him in Paris.

## The Formation of Atolls.

*Coral Reefs and Atolls: being a Course of Lectures delivered at the Lowell Institute at Boston, February 1930.* By J. Stanley Gardiner. Pp. xiii + 181 (15 plates). (London: Macmillan and Co., Ltd., 1931.) 10*s.* 6*d.* net.

ALL interested in the many fascinating problems of the formation and maintenance of coral reefs, be they marine biologists, geographers, or geologists, have reason to be grateful to the president of the Lowell Institute of Boston. It was as a result of his invitation that Prof. J. Stanley Gardiner delivered a course of lectures at Boston in 1930, and that now we have a volume embodying these lectures, which represent the fruits of thirty-five years' interest in coral reef problems and five years of personal observation on the reefs of the Indian and Pacific Oceans.

While probably many people are aware of the difference between fringing and barrier reefs and atolls, few who have never visited coral reefs have any clear picture in their minds of what a reef is really like. A study of Saville Kent's magnificent pictures of the Great Barrier Reef gives a totally wrong impression. The exposed face of a reef is a buttress of immense strength but certainly not a forest of beauty. In his introductory chapter, Prof. Stanley Gardiner gives an admirably lucid and well-balanced account of the various kinds of reefs, which should correct the previous mental impressions of many of his readers. He also disposes of the too arbitrary distinction which has been made between fringing and barrier reefs, pointing out that an island may possess a fringing reef off one coast and a barrier reef off the other, the two merging into one another, and being usually dependent on the presence of a gently sloping or a precipitous coast respectively.

While the skeletons of corals are the bricks with which reefs are built, the equally important cement which binds together these bricks and covers every exposed, dead surface is provided by the coralline algæ, the nullipores, of which *Lithothamnion* is the best known of the five important genera. On and in the reefs dwell a varied collection of animals and plants (the latter, however, strangely sparse to the eyes of a marine biologist accustomed to temperate seas) which, with the corals and the nullipores, form that characteristic marine community of tropical seas which to a biologist is a coral reef. All these living constituents of reefs, with the parts they play, constructive, passive, or destructive, in the maintenance of that mass of limestone which, to the geologist and geographer, is a coral reef, are passed in brief, yet adequate, review by Prof. Stanley Gardiner.

Of the great, probably vital, significance of the unicellular zooxanthellæ which are invariably present in reef-building corals and all other cœlenterates on reefs, there can be no question. Prof. Gardiner stresses the importance of the oxygen produced by the zooxanthellæ, and suggests also that carbohydrate may be passed from them to the coral. Here it is impossible entirely to agree with him (for reasons which the reviewer has given elsewhere), while the resemblance between the conditions in corals and in *Convoluta* is more apparent than real. The illustration, in Fig. 14, of the gametes of the zoochlorellæ from *Convoluta* suggests, moreover, that the zooxanthellæ possess similar gametes, whereas they are apparently so degenerate as to have lost the power of sexual reproduction.

There can be nothing but praise for Prof. Gardiner's handling of the problem of the origin and formation of atolls. Much of the book is occupied with this matter, and rightly so, for it is the crux of the coral reef problem. How did these limestone rings, their vegetated summits barely rising above the surface of the sea, come to be dotted over the surface of the tropical oceans, surrounded as they frequently are by water thousands of fathoms in depth? The subsidence theory of Darwin and Dana, which has been recently so strongly defended by Prof. W. M. Davis, is here rejected as the explanation of the origin of atolls, and for good reasons. If the atoll has not been formed from a barrier reef by the submergence of the central land mass, then it must have arisen from beneath the sea, and this necessitates the presence of innumerable submerged banks not more than fifty fathoms from the surface. How have these been formed? In the Indian Ocean, which is here regarded as the site of an ancient continent, and in the western area of the Pacific, such platforms may have been formed by the erosion of islands, the process being possibly completed during the last glacial epoch as postulated by Daly in his well-known glacial control theory. But the atolls of the central Pacific, many of them situated on the summit of an isolated peak, cannot have had such an origin.

The only reasonable explanation is surely that supported by Prof. Gardiner, that these atolls are built up on the summits of extinct submarine volcanoes. Falcon Island, which has three times appeared above the surface since 1883, provides positive

support for this view, while Admiral Wharton long ago suggested that the ash thrown up by such a submarine eruption would quickly be cut down to the level of wind-wave and current action, about 30-50 fathoms in the open ocean. The growth of corals and nullipores around the submerged slopes of Falcon Island prior to its last eruption in 1927, indicates how quickly corals can establish themselves on a bank of this nature.

The shape of the atoll remains to be accounted for. This was easily explained by the subsidence theory, but it is more difficult when an atoll is regarded as something arising from, and not sinking into, the sea. Here Prof. Gardiner follows Murray; he considers that lagoons have been formed by solution and erosion. While it is difficult to believe that solution plays an important part—coral seas are always saturated with calcium carbonate, and Mayor failed to find any dissolution of calcite by sea-water—yet there can be no gainsaying the great destructive action of the innumerable borers, of which molluscs are the most conspicuous but plants (blue-green algæ) the most ubiquitous. Corals do not flourish within lagoons; whereas outside their powers of growth are at least as great as the powers of destruction, within the lagoons this is not so. Conclusive evidence is given of the enlargement of many lagoons and of the carrying out of suspended coral mud by the ebbing tide. It is suggested that corals in lagoons may be killed by the deposition of amorphous calcium carbonate, produced by the removal of carbon dioxide from calcium bicarbonate by the zooxanthellæ. This, however, needs experimental verification. Moreover, the trade winds possibly have a considerable influence on the moulding of atolls.

All too little is known about coral reefs; there is unanimity about nothing. "Coral Reefs and Atolls" is a concise, admirably illustrated survey of the subject, and represents a definite advance in the elucidation of the coral reef problem.

C. M. Y.

## Spherical Astronomy.

*Text-Book on Spherical Astronomy.* By Prof. W. M. Smart. Pp. xi+414. (Cambridge: At the University Press, 1931.) 21*s*. net.

A NEW textbook supplying a real need is always welcome. The book now under review is based on lectures given in the University of Cambridge and is essentially designed for the use of students, but will be found to be of great service to astronomers also. Modern developments in astronomy have rendered the older textbooks incomplete, so in addition to the discussion of the usual problems of spherical astronomy, the book contains much new matter, including the essential discussion of such subjects as heliocentric co-ordinates, proper motions, the orbits of binary stars, and the use of photography in precise astronomical measurements, information on which is only to be found in scattered scientific papers.

Much care has been given to methodical arrangement and to the diagrams, which are generally excellent; while, so far as possible, the simplest mathematical tools have been employed, the formulæ being carefully developed, so that no difficulty should be experienced in following the argument to its logical conclusion. Thus, the first chapter is devoted to the proofs and applications of the formulæ of spherical trigonometry, which form the mathematical foundation of the subsequent chapters.

The traditional portion is generally very well done and calls for no special comment beyond the fact that it is reasoned with great lucidity and that great care has been taken with the diagrams.

Not much space is given to practical astronomy, the meridian circle being the only instrument described, presumably because it is the fundamental instrument by which the precise positions of the heavenly bodies are determined that form the foundation on which our knowledge of proper motions, solar motion, etc., is built.

Amongst the newer features is a paragraph on heliographic co-ordinates by which the positions of sunspots and other markings on the sun's surface are defined. In view of the well-established, but imperfectly understood, connexion between sunspots and terrestrial magnetic activity, this branch of astronomy deserves attention. The subject of the proper motions of the stars is adequately treated, and the derivation of the solar motion and also statistical parallaxes of stars are explained.

Photography now plays a most important part in nearly all branches of astronomy, and in positional astronomy the astro-photographic telescope is second in importance only to the meridian circle, to which it has become a natural auxiliary.

The catalogues of the Astronomische Gesellschaft were the product of a very great expenditure of money, time, and energy; they are now being re-observed, not with meridian circles but with photographic lenses, and the work will be completed for a small fraction of the original effort, and, in addition, the positions derived from the photographs will be of much higher accuracy than those in the original

catalogues. The chapter on astronomical photography is, therefore, of special interest. Here the errors affecting a stellar photograph, its measurements, and the reduction of the measures are fully and carefully explained, and it is shown how, using rectangular co-ordinates, all errors of the first order are corrected by means of six constants.

It should be observed that though terms of the second order may generally be neglected for small areas, with lenses covering large fields of 5° or more —such as are in use for the re-observation of the A.G. Catalogues—this is no longer the case.

Reverting to the meridian circle, the description of the method of determining the collimation error seems rather laboured, and simpler diagrams would have sufficed. The circle of collimation is a purely instrumental condition, and in no way connected with the azimuthal adjustment, so why introduce the azimuth into the argument ?

The paragraph on planetary aberration does not appear to be quite correct. It is easily shown that the apparent position of a planet at time $t$ is the true position at time $t-\tau$, $\tau$ being the aberration time. The usual practice is to antedate the time of observation by the aberration time, thus correcting both planetary and annual aberrations simultaneously.

The diagram illustrating the photographic refractor in paragraph 158 is not very elegant, though this is unimportant; but in the determination of stellar parallaxes, no mention is made of the method of dependences, the very neat modification of the method of least squares invented by Schlesinger and used by all parallax observers.

These points are mentioned in constructive criticism that they may be considered in a second edition, not in detraction of a very excellent work, on which the author is heartily to be congratulated.

## Short Reviews.

*The Wissahickon Hills : Memories of Leisure Hours out of doors in an Old Countryside.* By Prof. Cornelius Weygandt. Pp. xiv + 366 + 10 plates. (Philadelphia : University of Pennsylvania Press; London : Oxford University Press, 1930.) 17*s.* net.

I LOOKED up the Wissahickon Hills in my large atlas and did not find them ; I discovered Pennsylvania to be an immense State, and that the Alleghany and Blue Mountains tail off in its central parts into a welter of hills and streams. I saw that the author is a professor of English literature, and I thought that this is no book for NATURE. I took the book to bed and I read " The Fox Sparrow ". I had never heard of him, but I was charmed with the " big bouncing fellows " with their " high spirits that come from good shelter and full craws, sunlight and the urge of spring ". " In Praise of Wild Cherry " attracted me next, and this was followed by " The Kentucky Warbler ". I am still a yokel at heart, and I dreamt of my own hills and my father's farm-yard. " The Famous Darking Fowl " came next day, and I have never been able to leave this book alone since.

I do not know the country, but the hills, the streams, the birds, all belong to me and I know their ways. " The Old Stock " gives me my people, unaltered and unchanged for centuries. " We have a good deal of local pride. . . . We are rather sure of ourselves. . . . We are workers and few of us are fond of parade and show. . . . We are still stout walkers. We are fond of out-of-doors. We are unafraid of sweat. . . . We own to an interest in natural science more gladly than to an interest in art ", which " we are not sure that we ought to admit ". " Our Village " might be here, while near by Gilbert White and Richard Jefferies might dwell. They loved to potter and note the little wonders by the way. So does the author, and he is not trying to teach me anything. Emphatically this is a book for NATURE, not, perhaps, to be recommended to professional biologists, but to men who agree with Frost that " The best thing that we're put here for's to see ". Emphatically a book likely to become a classic of Pennsylvania and to attain a permanent place in Anglo-Saxon literature.

J. S. G.

*Recent Advances in Analytical Chemistry.* Vol. 1 : *Organic Chemistry.* Editor : Dr. C. Ainsworth Mitchell. Contributors : C. L. Hinton, E. J. Parry, D. Jordan Lloyd, H. Chick, D. W. Kent-Jones, G. D. Elsdon, W. Dickson, J. G. King, R. A. Acton-Taylor, H. R. Ambler. Pp. x + 420 + 6 plates. (London : J. and A. Churchill, 1930.) 12*s.* 6*d.*

WITH the enormous output of original literature in science, it is practically impossible for the scientific worker to keep in touch with more than a very limited field of inquiry. In this book a successful attempt has been made to collect and arrange in accessible form the latest reliable information on various sections of organic chemistry applied to analysis. As indicated by the editor, the aim has been to give a brief critical summary of the literature up to a decade ago. Although this volume is called " Organic Chemistry ", a considerable amount of important information on physical chemistry is included; for example, a very thorough review is given on the applications of the polarimeter in sugar analyses, on purification by electrodialysis, on condensation of gases, etc. From that period onwards, progress has been dealt with more fully, and concise working details of new methods are given.

Each chapter is prefaced by a short synopsis and ends with a bibliography. Throughout the text exhaustive references are recorded. The work is critical, and indications are given as to the direction on which further advance is likely. Although the book is restricted to some four hundred pages, a great number of subjects of industrial importance have been reviewed. These include sugar, oils and

fats, essential oils, proteins, tannins and cereals, milk products, paper, petroleum, coal and gas. Each section is written by an expert in his own field, and the whole work is thoroughly co-ordinated and ably edited. It is an easily readable book, well printed, and with a good index. It is comparatively cheap as modern prices stand. The reviewer suggests that it is a book that should be in the hands of every analytical chemist. J. REILLY.

*Sea-Angling Fishes of the Cape (South Africa): a Natural History of some of the Principal Fishes caught by Sea Anglers and Professional Fishermen in Cape Waters.* By C. Leo. Biden. Pp. xii + 304 + 48 plates. (London: Oxford University Press, 1930.) 18*s.* net.

CAPE COLONY extends from the Atlantic to the Indian Ocean. Whereas on the west side there are almost constant conditions owing to the southern current, the waters of the Indian Ocean lave the southern peninsula, during the summer months. This means migration of fish from the north, while many stationary fish must have well-defined seasons of abundance and scarcity of food, although perhaps feeding is a matter of the psychology of the fish themselves, induced by temperature and other physical and chemical changes in the sea. There are also regular breeding seasons and movements induced by these. The author is clear on these matters in the eighteen chapters, on a like number of fish, which he presents to the angler. Eight are strong swimming pelagic fish, and his account of their local names suggests that seven must belong to genera common to the whole southern ocean, the eighth being the North Atlantic tunny, which is a rare visitor.

We are at once attracted by the much varied heads and teeth of the bottom feeders; these are correlated with equally different habits and food. Clearly, the Cape is a locality where colour fluctuations could be conveniently studied, as affected by environment, temperature, etc. Octopi, mussels, and tunicates are important articles of food. Commercial fisheries are not discussed; but the angler is generally a man of intelligence, and he is presented with a most readable and admirably illustrated account of his fish. Scientific details may occasionally be wrong; but the author is to be congratulated on a most useful book.

*Leçons sur les conduites.* Par Prof. Charles Camichel. (Chaire de mécanique des fluides et applications.) Pp. vii + 101. (Paris: Gauthier-Villars et Cie, 1930.) 30 francs.

THIS monograph gives an account of both experimental and theoretical researches carried out during the last twenty years on pipelines, mainly forming portions of hydraulic installations in south and central France. These researches chiefly concern the waves of pressure propagated along the pipelines, in consequence of the elasticity of their walls and the compressibility of water, when the flow of water is changed more or less suddenly, and also the resonance phenomena associated with these waves. The first chapter treats of pipelines of uniform cross-section and wall thickness, and the second with those of variable section and thickness. The third chapter deals with the effect of reservoirs of air connected with the pipelines, especially in damping down the waves. These three theoretical chapters comprise four-fifths of the book, the remaining portion being devoted to a very brief summary of the design and construction of pipelines subject to high pressures and of the accidents to which they are liable. The book is clearly written and should prove of great interest to hydraulic engineers, as well as to mathematicians interested in the practical applications of hydrodynamics.

*Systematic Inorganic Chemistry: from the Standpoint of the Periodic Law.* By Prof. R. M. Caven and Dr. G. D. Lander. New edition. Pp. xviii + 510. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1930.) 9*s.* net.

CAVEN and Lander's textbook has been known to teachers and students for some years as a carefully written statement of inorganic chemistry based on the periodic system, and it could well supplement any other book in use. It is particularly suited to the needs of the more advanced student who wishes to revise and systematise his knowledge of the subject, and a new edition of the work may be welcomed. The authors have added sections on the modern atomic theory and its bearings on the subject at the end of the book. In view of the rapid changes which are taking place in this part of the subject, it is undoubtedly wise to adopt this plan, the permanent structure of the science being dealt with in the body of the work. The additional sections fit in very well with the general plan of the book. One or two newer discoveries probably came too late for inclusion; for example, the preparation of nitryl chloride, the reactions given not leading to the formation of this substance. The new edition of this excellent textbook may be recommended to teachers and students.

*Siam: Nature and Industry.* Pp. vii + 324 + 60 plates. (Bangkok: Ministry of Commerce and Communications, 1930.) n.p.

IT is seldom that a book of this nature, issued by a State, presumably for propaganda purposes, can be recommended as having any scientific value. This volume, however, is an exception. It avoids the usual guide-book information and self-congratulatory statements, and contains a number of serious chapters on the scientific aspects of the country. Most of these are written by competent authorities under their own names. Thus the book is a valuable compendium on the geology, fauna, flora, ethnology, agriculture, mining, and other aspects of Siam. It is particularly useful, since accurate information on many matters relating to Siam is not easy to find. Several of the chapters were issued as separate pamphlets in 1926. They are now revised and collected in this volume, with additions, which was prepared for the congress of the Far Eastern Association of Tropical Medicine, held at Bangkok in December 1930. There are several maps and illustrations.

# The Architecture of the Solid State.*

By Prof. W. L. BRAGG, F.R.S.

A SOLID body is a mechanical system in equilibrium, an example of atomic engineering, with balance of stresses in the component parts. Analysis by X-ray methods, and more recently by those of electron diffraction, has given us a scale plan of its component parts. To what extent can we explain the way in which the atoms are arranged, and the properties of the body as a whole, by considering the forces which act between the atoms?

A broad generalisation divides solids into three classes—metallic, organic, and inorganic. Though it is easy to cite cases of solids which are intermediate in character, this division into classes is clearly marked, and corresponds to a very fundamental difference in the nature of the bonds which hold the atoms together. Metals are associations of electropositive atoms with each other, organic compounds are associations of electronegative atoms, and inorganic compounds associations of electropositive with electronegative atoms. The fundamental distinction between the laws which govern these associations has been implicitly recognised by assigning to each its own branch of chemistry, metallurgical, organic, and inorganic. The law of combination in inorganic compounds was first foreshadowed by Berzelius, those for organic compounds were founded by Kekulé, and confusion arose in the past from the attempt to bring both classes into a common scheme. The laws of atomic association in intermetallic compounds are again different, and are only now being understood through a study of alloy structures.

The success which has as yet been attained in explaining physical properties by atomic structure is different in these three classes. The structures of the metals are very simple, and were amongst the first to be discovered by X-ray analysis; many alloy structures have also been determined. The difficulty of correlating structures and properties is not due to any lack of knowledge about atomic arrangement, but arises partly because the theory of the metallic state is very complex and as yet incomplete, and partly because the mechanical properties of the metals, which are so important to us, depend rather on the destruction of the perfect crystal than on its behaviour as an ideal crystal. Knowledge in this field is mainly descriptive. On the other hand, those organic substances the physical properties of which as solids are most interesting are very complex forms, such as cellulose or rubber. The difficulty here of giving even a descriptive account of the dependence of properties on structure is mainly that of discovering the atomic arrangement. This is one of the obvious fields in which to concentrate all the resources of X-ray technique in future. Such successes as those which Mark has had with cellulose and Astbury with the wool fibre show its interest and possibilities, but in all cases the structures can as yet be only guessed.

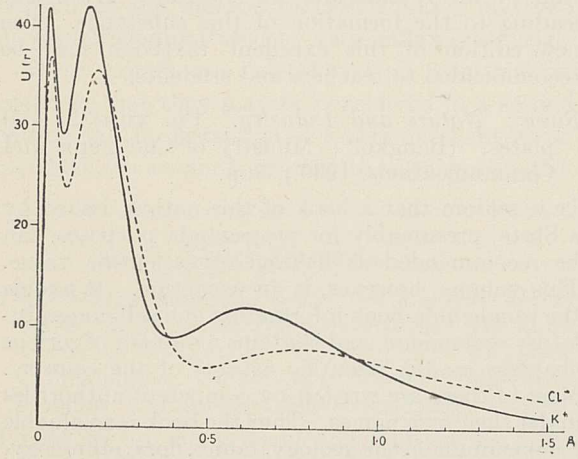


FIG. 1.—The radial distribution of electrons in the ions K and Cl⁻. The peaks in each curve of distribution represent the *K*, *L*, *M* electron groups, containing two, eight, and eight electrons respectively (Hartree).

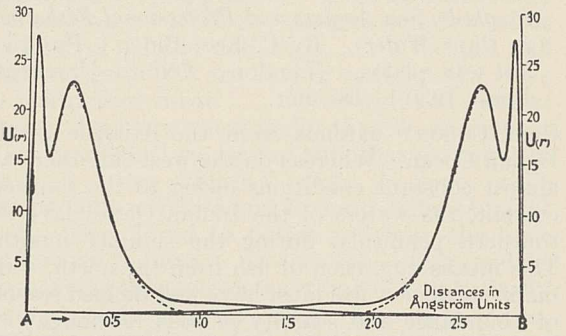


FIG. 2.—The ions $Al^3$ are shown by the dotted curves, at a distance apart of 2·86 A. as in the crystal of aluminium metal (James, Brindley and Wood). The distribution representing the remaining electrons is almost entirely confined to the space between the ions (metallic bond).

In comparison, the inorganic solids are not of such great technical importance, but I propose to discuss their properties because a more complete story can be told. Not only are the structures well known, but also the interatomic forces can to a large extent be treated quantitatively. The landmark in this field is, of course, Born's great work on the dynamics of the crystal lattice, and it is to the inorganic compounds that his ideas have been mainly applied.

The reason for the success in treating the inorganic crystal is that it can be regarded to a large extent as a problem in electrostatics. The typical crystal is built of component parts which are charged positively and negatively. These parts may be simple charged atoms or 'ions', or they may be charged groups of atoms. Further, the forces of repulsion which keep the ions apart and prevent their structures intermingling can be simply expressed, and their strength quantitatively estimated. So a theory of the physical properties of the solid can be built up, a few aspects of which I wish to discuss.

What is the justification for supposing that electrostatic forces bulk so largely in these com-

* Kelvin Lecture delivered before the Institution of Electrical Engineers on April 30.

pounds? It lies in the fact that when two ions approach each other, the force of repulsion which prevents further approach sets in when the structures have scarcely penetrated at all into each other.

The nucleus of an atom is surrounded by an atmosphere of electrons, a kind of space-charge which

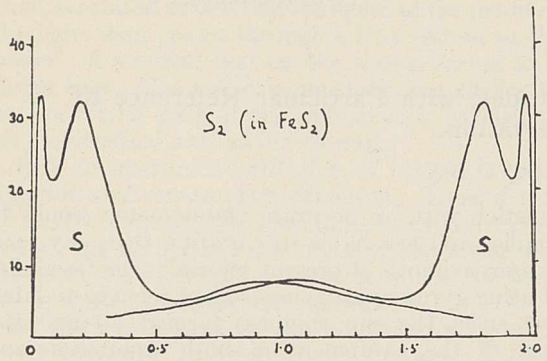


FIG. 3.—The group $S_2$ in $FeS_2$, iron pyrites. The distance between the atoms (2·05 A.) is so small that the $M$ shells overlap (non-polar bond).

exactly (neutral atom) or nearly (ion) neutralises the positive charge on the nucleus. The former idea of a series of electron orbits has been replaced by a wave-mechanical distribution which cannot be visualised. It can be represented in a way which is a very good approximation for many purposes by supposing each electron to move in the field of the nucleus and the other electrons, representing it by the 'smeared out' continuous distribution which the solution of the wave equation gives, and then taking the electron atmosphere to be the sum of these distributions. These atmospheres have been worked out for many atoms, the most accurate results being those of Hartree. Instead of definite electron orbits, we get a continuous distribution with spherical symmetry which may be thought of as the density of the electron atmosphere, or probability of finding an electron in unit volume at different distances from the nucleus. A convenient way of showing the electron distribution is to plot $U_r$ against the distance from the nucleus $r$, where $(U_r)dr$ is the number of electrons between $r$ and $r+dr$. Such a curve for chlorine, which has a charge of $17e$ on its nucleus, and is surrounded by eighteen electrons, is shown in Fig. 1. The distribution has peaks which correspond to the $K$, $L$, $M$ electron groups of atomic theory.

A striking feature is the rapid rate at which the electron atmosphere thins out as the distance from the nucleus increases. For example, the electron density in various parts of the chlorine ion is as follows, the figures representing the number of electrons per cubic ångstrom unit ($10^{-24}$ cm.$^3$).

| | |
|---|---|
| $K$ shell | 3250 |
| $L$ shell | 111 |
| $M$ shell | 1·00 |
| At $r = 1·84$ A. | 0·04 |

The last distance of 1·8 A. is called the 'ionic radius' of chlorine. This theoretically indefensible, but extremely useful, conception of ionic radii expresses the fact that ions in crystals appear to take up a certain amount of space. For example, sodium has an ionic radius of 1 A., chlorine of 1·8 A., and the two ions are 2·8 A. apart in sodium chloride. We may take it here as representing the point where the overlapping of one ion by another takes place. We can see, therefore, that the repulsive force sets in when an extremely tenuous part of each electron atmosphere is involved, in the case of chlorine only $10^{-5}$ of that in the $K$ shell.

The difference between the three types of interatomic bond is shown in a striking way if we take these atomic models, set them distances apart, such as are found in actual crystalline structures, and see to what extent the electron atmospheres overlap. Fig. 2 shows the state of affairs in an aluminium crystal. The aluminium ions $Al^{3+}$, shown as dotted lines, are separated by a wide gap. This interspace is occupied by the valency electrons, and metallic properties suggest that these electrons are not bound each to its own atom but are shared by all.

Fig. 3 shows the group $S_2$ in iron pyrites, $FeS_2$. The bond between the sulphur atoms is of the non-polar type, such as characterises organic compounds, and the two atoms are so close that there is a merging of their $M$ shells. The two structures combine to form a twin structure like a larger atom with two nuclei. Contrast with these the series of polar

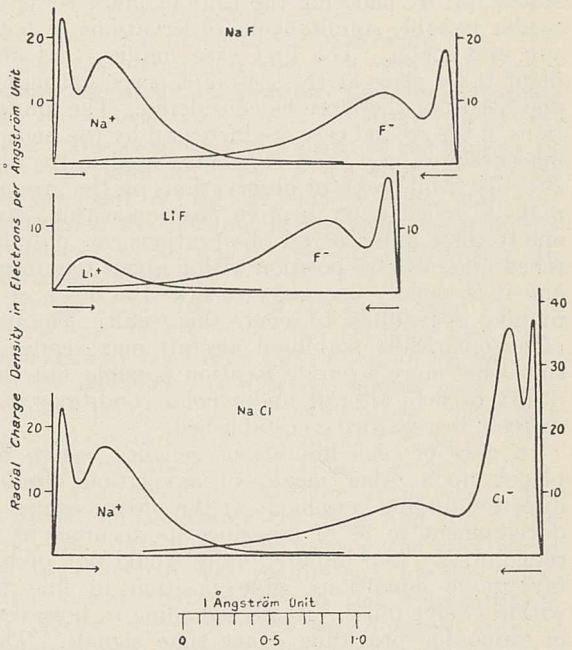


FIG. 4.—The electron distribution in compounds of the sodium chloride type (Brindley). The ionic structures overlap at points where the electron density is extremely small (polar bond).

crystals shown in Fig. 4 (taken from a paper by Brindley). The structures are of the sodium chloride type in which there is a simple alternation of positive and negative ions, and it is seen that the ions scarcely overlap at all. The diagram exaggerates the extent of overlapping, because the curve measures the distribution of electrons in complete spherical shells all round each nucleus, whereas the ions come in contact at one point only.

The first success of Born's theory lay in explaining the heat of formation of these compounds. Suppose the sodium and chlorine ions to remain in regular array, but to be widely separated, and then allow the whole structure to collapse uniformly, ending in the sodium chloride crystal. The energy of the electrostatic field between the ions is reduced in the process, just as when the plates of a condenser come together. This energy can be calculated, and a correction due to the work done against the repulsive forces can be worked out. The latter is small because it only comes into play at the very end of the process. Born showed that the calculated loss of energy was in accord with the heat of formation of the crystal.

(*To be continued.*)

## Determination of Position in High Latitudes, with Particular Reference to Aircraft Observation.

By C. J. STEWART, O.B.E.

THE determination of position from land or air observations in high latitudes is rendered difficult, apart from conditions of temperature, by the unreliability of the magnetic compass and gyroscopic compass. On aircraft the latter is not yet a practicable instrument. Hence, astronomical methods must be utilised. In the consideration of any method of air navigation to the poles it must first be made clear that, even with assumed perfectly accurate instruments and accurate observations with them, astronomical observations from an aeroplane can give an exact position in two cases only: (1) by the observation of two stars; (2) by choosing the time of flight so as to render possible simultaneous observations of both sun and moon. The first case implies that the flight takes place at the season of perpetual night, and need not therefore be considered. The limitations of the second case are increased by the known inaccuracy of any form of sextant used in the air. Broadly, while sextant observations on the ground may be relied upon to give position within, say, one to three miles, aerial observations can only be relied upon to give position within about ten miles, and it is usually necessary to take the mean of a number of readings to secure this result. The use of automatically stabilised aircraft may render a somewhat more accurate location possible, but the utility of such aircraft under polar conditions can scarcely be regarded as established.

In view of such limitations, reliance has to be placed upon other means of navigation. Radio direction-finding is unlikely at the present stage of development to be of use, since its accuracy at a range of, say, four hundred miles would not, under favourable conditions, give position in line to within twelve miles. Radio signalling is, however, of value for providing exact time signals. The navigator is therefore compelled to rely upon the use of the most accurate instruments for—

(1) indicating direction, and
(2) indicating ground speed in magnitude and direction.

This, of course, is virtually the oldest method of navigating, namely, dead reckoning.[1] The instrument used for indicating direction must be some form of sun compass or a gyro azimuth. Of these alternatives, where the sun is available, the sun compass is likely to be the more accurate, since an instrument measuring the sun's position, in conjunction with an accurate chronometer, would be simpler and less liable to variation than any form of gyro azimuth at present known. The feasibility of using gyroscopic devices will be referred to later, but since the sun compass formed an essential part of the equipment of both Amundsen and Byrd in their polar expeditions, a description of such an instrument is necessary.

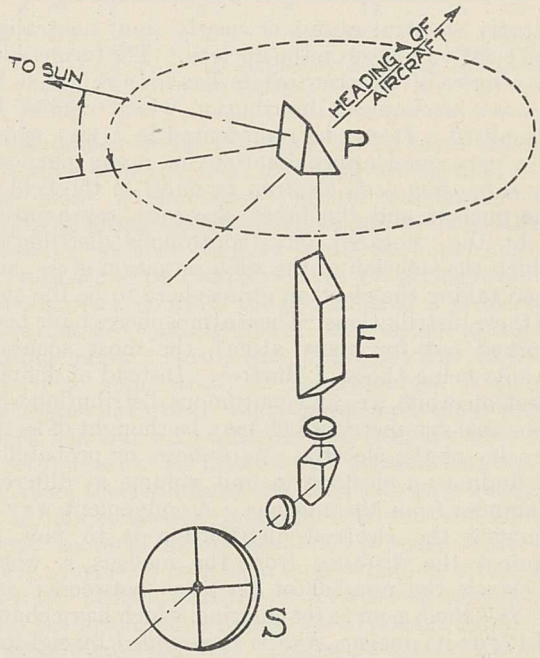


FIG. 1.—Optical arrangement of the Goerz sun compass.

Instruments for measuring ground speed and direction are quite well known [2] and, in their use under polar conditions of temperature, present no great difficulty.

Since the sun is above the horizon during the exploring season, and since it is always at a low altitude, the sun compass forms a very suitable instrument for determining directions. The Goerz sun compass was constructed specially for the Amundsen expedition in 1925 and, according to reports, gave very satisfactory results.[3]

This instrument comprises an optical arrangement which throws an image of the sun on a screen *S* (Fig. 1), when the aircraft is on the desired course. The reflecting prism *P* may be rotated

about a horizontal axis and set according to the declination of the sun. It may also be rotated about a vertical axis and set according to the time of day and the desired course. When the settings have been made, a clock mechanism keeps the prism in the correct orientation. After reflection, the light passes through the erecting prism *E*, which is rotated at one-half the speed of the prism *P*. The light then passes through a lens system to the screen. A vertical line on the screen serves as a lubber line. The compass must be installed with the horizontal part of the optical axis parallel to the longitudinal axis of the aircraft.

Such an instrument will give, of course, a space direction and not an earth direction. Thus, if it is set to give some definite meridian at any given position of the aeroplane, the track of the latter will not be in the direction of the pole unless the position is chosen to lie on that meridian.

By the use, then, of the sun compass and ground speed indicator (incorporating, of course, a drift indicator) the navigator to the pole must attain his object by careful course plotting based on dead reckoning.

Since the determination of ground speed is a vital matter in such dead reckoning, considerable judgment and care is needed in the method of securing a reading. One method is to time the passage of a ground object past two wires on a sight which is so set as to incorporate the height of the aeroplane above the ground, the method itself being based on similar triangles.

This method is liable to error, of course, where the height of the ground is not known exactly. In such a case, the wind speed is determined by flying the aeroplane on different courses and plotting the track or course made good. From two such readings the wind speed and direction may be determined, and thus from a knowledge of the air speed the ground speed on any given course may be obtained.

As an illustration of the difference between ground and air technique for position-finding in high latitudes, the method used by Peary in his journey to the north pole in 1919 may be compared with the method used by Byrd in his flight to the north pole in 1926. Peary followed closely a meridian from the base camp, using dead reckoning for direction and distance, occasionally using a sight on the sun for correcting his distance. When his dead reckoning calculations indicated that he had reached the pole, a meridian sight on the sun showed him that he had covered a distance which would have taken him exactly to the pole had his direction been correct. This sight by itself, however, did not suffice to locate his position on the earth, but a sight on the sun from the same position eighteen hours later in a direction at right angles to the first observation gave his location as five miles from the pole. Byrd in his flight to the north pole in 1926 flew from a known base in a direction indicated by the sun compass and at a ground speed calculated from drift and airspeed observations. At satisfactory intervals of time, observations of the elevation of the sun were taken, which gave him position lines cutting his plotted course at varying angles, some at suitable angles for checking his latitude and distance, others at angles for checking his longitude, and thus his direction.

It will be at once apparent that such aerial observations taken with instruments which, under the best conditions of usage, are subject to error, are less exact than those taken on the ground from the same position at suitable time intervals.

Byrd and his companions in the south polar flight in November 1929 used the dead reckoning method with two sextant readings of the elevation of the sun. Byrd does not claim any considerable accuracy for these sextant observations. His method, which appears as a fine example of dead reckoning navigation, deserves comment. His navigational equipment, comprising a sun compass, drift and ground speed indicator, and airspeed indicator, were all thoroughly tested at the base before the flight to the pole, and were, of course, used with the greatest skill. Any errors due to the use of this equipment can therefore be regarded as being as small as human effort could make them.

The flight may be divided into three parts—

(*a*) From the base camp to the trail camp of the geological party close to the mountains;

(*b*) from the trail camp to the south pole and the return to the supply depot at the foot of the mountains;

(*c*) from that depot to the base camp.

The base camp and the trail camp had been located by ground observations, and these positions may be regarded as accurate to within one or two miles. The geographical position of the trail camp had been determined by Dr. Laurence M. Gould, the geologist of the expedition, who had also determined the position of the east portal of the Liv glacier, which was a short distance nearer the pole than the camp.

The parts (*a*) and (*c*) of the flight need be discussed only briefly, since the territory had been well explored, both from the air and on the ground, and the navigation of it served mainly as a check upon the accuracy of the instruments. The start was made from the base camp at 3 h. 30 m. Nov. 29, 1929, Greenwich Civil Time. At 8 h. 16 m. G.C.T. the plane reached the trail camp, 327 nautical * miles nearer the pole and 361 miles from the south pole. On leaving the trail camp the same course was maintained for 16 miles, when it was changed 30° to the right towards Liv glacier, where a check was obtained from a predetermined position—the east portal of the glacier. Here, owing to difficulty in obtaining sufficient height, the course was changed and continued for 50 miles up and over the glacier. Reaching the plateau, the course was made along the 171st meridian for the flight south to the pole. The position of the aeroplane relative to Mount Nansen and Mount Ruth Gade checked the dead reckoning position from the trail camp. At 10 h. 20 m. the plane was placed on the 171st meridian at parallel 86° 13′, and the sun compass set along that meridian to the pole 227 miles away.

* All the distances referred to are in nautical miles.

Here, then, one may pause to consider the accuracy with which this actual position was attained in view of the difficulties experienced in reaching the position and the deviation from the course laid down. Subsequent instrumental observations appear to indicate that no considerable error was introduced by the manœuvre. Heading south, and holding the plane as closely as possible to the 171st meridian by the aid of the sun compass and the drift and speed indicator, it was estimated that the pole was reached at 13 h. 14 m. Greenwich Civil Time. In this flight it was noted that at local midnight at that meridian, when the sun was beyond the pole and in line with the meridian, the nose of the plane was pointing directly at the sun and a corresponding indication was given by the sun compass, so indicating that the sun compass was showing the direction of the 171st meridian. There was no outside check on how closely the aeroplane was holding to this meridian except the landfall made on the return journey. Two rough checks on the dead reckoning determination of the distance flown were made at 12 h. 38 m. and 13 h. 6 m., when sextant elevations of the sun were obtained. These gave positions from the pole of 56 and 2 nautical miles respectively. The corresponding dead reckoning positions were 50 and 11 nautical miles. Byrd discounts the accuracy of the sextant observations owing to the errors introduced by the motion of the aeroplane, and experienced aerial navigators will agree with his judgment. These checks, nevertheless, serve a very useful purpose since they were the only independent evidence available, and the distances are of the same order as those given by the dead reckoning calculations.

At 13 h. 14 m. it was reckoned that the pole had been reached, but deviations of the plane to the right and left of the course for a distance of three miles, and covering a further directional distance of about five miles, decreased any error in the actual location of the pole so far as the flight was concerned. The aeroplane was headed back over the pole and flown down the 168th meridian at 13 h. 25 m., which should have made the course for the Axel Heiberg glacier. At 15 h. 30 m. the glacier was sighted.

It will be seen, therefore, that, by the skilled use of the drift and ground speed indicators and the sun compass, the navigation had been sufficiently precise to locate the close vicinity of the pole, the sextant observations serving as the check on the dead reckoning determination given by the speed indicator and compass.

It will be noted that a journey of some seven hundred miles was made in a period of about ten hours. In a land exploration a normal distance in such a time would be about ten miles, during which time observations of the position can be made as necessary, although the difficulty of making these relatively exact determinations is far greater than that of obtaining data in an aircraft.

Although gyroscopic methods of position finding in high latitudes suggest themselves as theoretically feasible, it is not profitable in the present state of the art of using aerial or other gyroscopes to discuss such means for position finding. Not only would such gyroscopes have to be far more exact in functioning than any so far produced for aerial work, but also the conditions of temperature would inevitably introduce such troubles in running that prolonged and arduous research would be necessary to devise the apparatus. The dangers of relying solely upon such means in an aerial polar expedition are so numerous as to render any such scheme impracticable.

[1] "Aircraft Instruments." C. J. Stewart. (Chapman and Hall.)
[2] "Aircraft Instruments." C. J. Stewart.
[3] "Aircraft Instruments." Eaton. The Ronald Press Co., New York.
Amundsens Nordpolflug 1925. *Illustrierte Flug-Woche*, July 23, 1925.
"Der Sonnen-Compass." Von C. P. Goerz. *Ibid.*

## Obituary.

### Prof. F. W. Clarke.

FRANK WIGGLESWORTH CLARKE, born on Mar. 19, 1847, at Boston, Massachusetts, was well known among inorganic chemists, mineralogists, and geologists in Great Britain. For mineralogists and geologists his "Data of Geochemistry" was a handbook full of invaluable information, not in other ways readily accessible, especially at the time of its first publication in 1908. In addition to his work directly related to geology and mineralogy, he did important work on atomic weights and thermochemical constants. He was chairman of the International Committee on Atomic Weights in 1900; president of the American Chemical Society in 1901, of the Washington Academy of Arts and Sciences in 1911, and of the Washington Philosophical Society in 1896. He was a foreign member of the Geological Society of London; an honorary member of the Chemical Society, of the Mineralogical Society, and of the Manchester Literary and Philosophical Society; and a corresponding member of the British Association and of the Geological Society of Edinburgh. He was given the honorary degree of D.Sc. by Victoria University, Manchester, and LL.D. by the University of Aberdeen.

Clarke graduated at Harvard in 1867. His first teaching post was in the Department of Chemistry at Cornell University, Ithaca, New York, in 1869. He became professor of chemistry in Cincinnati University, Ohio, in 1874. His first paper, in 1868, was "On a New Process of Mineral Analysis". At Cornell he turned his attention to the determination of atomic volumes of solids and liquids as well as to inorganic analytical methods, and during his professorship at Cincinnati he published, in the *Smithsonian Miscellaneous Collections*, a series of articles on "The Constants of Nature", concluding, in 1883, with the recalculation of atomic weights, of which a new edition was published in 1898.

In 1883 Clarke joined the U.S. Geological Survey and became chief chemist, a post which he held until 1925. He was also professor of mineral-

chemistry in the George Washington University at Washington, of which University he was made a doctor of science in 1899. It was during his service with the Geological Survey that Clarke produced the bulk of his work. In the Royal Society's catalogue for 1884–1900 there appear 39 titles under his own name alone and 17 with other authors. His work in this period included important papers on the constitution of silicates, and especially on the micas and chlorites, and in 1889 a paper, destined to be of great interest in later years, on a platiniferous nickel ore from Sudbury, Ontario. The "Data of Geochemistry" did not appear until 1908: it is now in its fifth edition.

The War period seems to have diverted Clarke's attention from minerals, and he produced a series of papers on the inorganic constituents of marine invertebrates, mostly written in collaboration with G. Steiger or W. C. Wheeler, and now summarised in one volume, of which a second edition was required in 1922. In this year he published a paper on the average composition of igneous rocks in conjunction with H. S. Washington, and this was followed by one on the composition of the earth's crust in 1924. This and the fifth edition of the "Data of Geochemistry" were his last publications. He was then seventy-seven, but still enjoying excellent health, when he paid a visit to England, renewing his acquaintance with many friends.

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WE regret to announce the following deaths:

Prof. Arthur Starr Eakle, professor of mineralogy at the University of California, aged sixty-seven years.

Prof. A. Forel, formerly professor of psychiatry in the University of Zurich, pioneer of neurology and brain anatomy, and author of the "Social World of Ants", aged eighty-three years.

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## News and Views.

No one will deny that Great Britain, and indeed the whole world, is passing through a phase of acute economic and industrial depression. We have referred to this repeatedly in our columns and urged the importance of research in providing new outlets for trade, new methods and new materials. Research in all departments of life must at all costs go on, and we had hoped that the days were gone when the so-called unproductive research department was the first to go when economy was called for. Yet 'research' and 'education' are prominent among the recommendations submitted by the Committee on National Expenditure (Cmd. 3920. London: H.M. Stationery Office. 4*s*. net). Apparently research is still regarded as an expensive luxury. The report emphasises the point raised in our leading article that public opinion is not yet educated to the value of the scientific worker and of scientific method to the community. The Committee on National Expenditure consisted of Sir George Ernest May (chairman), Mr. P. Ashley Cooper, Sir Mark Webster Jenkinson, Mr. Charles Latham, Lord Plender, Mr. Arthur Pugh, and Sir Thomas Royden—the omission of any person of scientific eminence will be noted—and in its terms of reference it was charged to make recommendations for "effecting forthwith all possible reductions in the national expenditure on Supply Services". Among the recommendations are the abolition of the Empire Marketing Board, abandonment of the new programme of research in civil aircraft, reduction by 12½ per cent of expenditure on research and technical development for defence, wholesale reduction at the Ministry of Agriculture and Fisheries, including 50 per cent reduction of grants for agricultural education and limitation of grants for research, and a quarter of a million reduction in the grant to universities. We would urge the Cabinet committee which is to examine these proposals to consider very gravely the proposed restriction of research which, in the long view, can only impede the return of prosperity.

JOHN DRYDEN, the poet, was born three hundred years ago, and in the month of August, though chroniclers do not record anything more exact than that it was on or about Aug. 9, 1631. Dryden was interested enough (as were other literary men of his time, for example, Edmund Waller and William Hammond) to subscribe the foolscap obligation or resolution, dated Dec. 5, 1660, approving the formation of an organised society for the purpose of prosecuting 'Experimental Philosophy'. This was the germ of the Royal Society of London, incorporated a little later, and of which Dryden became an original fellow. He had signed the resolution, it may be mentioned, as "Driden". Born at Aldwinkle, Northamptonshire, Dryden was the eldest of fourteen children. He entered Westminster School as a King's scholar, proceeding afterwards to Trinity College, Cambridge. In Dryden's poem "Annus Mirabilis", written before his return to London at the close of the year 1666, he apostrophised the newly founded Royal Society. Clearly he regarded it as embodying an intellectual awakening of high intent. Dryden lived in Gerrard Street, Soho, and he died there on May 1, 1700, and was buried in Westminster Abbey.

ON July 28 a memorial tablet to Thomas Earnshaw, the horologist, was unveiled outside the Church of St. Giles-in-the-Fields, Bloomsbury, by the Astronomer Royal, Sir Frank Dyson. The tablet has been erected by the Clockmakers' Company and the British Horological Institute. Like his predecessors, Graham and Harrison, and his contemporaries, Mudge and Arnold, Earnshaw came from the country, having been born at Ashton-under-Lyne, Lancashire, on Feb. 4, 1749, but for many years he had a business at 119 High Holborn. To him is ascribed the merit of devising the chronometer escapement and compensation balance precisely as they are now used, while it was he and Arnold who first produced chronometers in large numbers and at moderate cost, thus render-

ing service of the utmost value to navigation and commerce. His improvements were recognised by the Commissioners of Longitude, and he was awarded £3000 by the Government. His death took place in Chenies Street, Bedford Square, on Mar. 1, 1829, and he was buried in St. Giles-in-the-Fields, where it was his custom to worship. He had published a pamphlet in 1806 entitled "Explanation of Timekeepers constructed by the Author and the late Mr. John Arnold", and another in 1808 stating his own claims to the invention of improvements in timekeepers.

IMPORTANT changes in the archæological service in India are foreshadowed in a dispatch from the *Times* correspondent at Simla, which appears in the issue of July 31. He states that the Government of India proposes to submit to the autumn session of the legislature a bill which will place all archæological investigation under the Government of India instead of under the provincial governments as heretofore. It will empower the Government of India to make rules governing work by private investigators and regulating the disposal of the finds. Further, provision will be made to facilitate the co-operation of non-official scientific organisations, Indian and overseas, in archæological exploration. The need for such co-operation has been felt in India for some time. This may have been accentuated by the discovery near Ambala, some two years ago, of remains of the Indus Valley civilisation. An appeal for such co-operation, made not long after the discoveries at Mohenjodaro and Harappa, produced offers of expert assistance; but the obstacle to extended investigation has been a lack of funds. In view of these later finds, it is expected with confidence that further exploration will produce evidence to show an eastward extension of this early civilisation, possibly into the Ganges basin; but systematic investigation with this objective is precluded unless assistance, financial and other, is attracted by the possibility from sources other than official.

THE Indian Research Council of the Royal Anthropological Institute is already in touch with archæological, as well as other branches of anthropological, research in India; but unfortunately it has, at the moment, no funds to enable it to carry on active research in India on the lines on which the Institute is already conducting investigations in another archæological field. It may not be out of place, however, in this connexion to mention another activity of the Royal Anthropological Institute with reference to India which should be of considerable utility at the present juncture in making the public more intimately aware of conditions in that country—conditions which, as has been pointed out time and again, have a vital bearing upon problems now under discussion, but upon which the general public is but ill-informed. The Institute's Indian Research Committee, acting under the direction of the Council, has arranged for a series of public lectures to be delivered in the coming autumn which will deal with the races and cultures of India. The session will be opened by the Marquess of Zetland on Oct. 12 with a lecture on "India, Past and Present". The lectures to follow will be: Oct. 19, Prof. F. W. Thomas—"Kings and Emperors of Ancient India"; Oct. 26, K. de B. Codrington—"Indian Sculpture"; Nov. 2, Col. T. C. Hodson—"Hillmen and Headhunters of Northern India"; Nov. 9, F. J. Richards—"Caste and Creed in Southern India"; Nov. 16, J. V. S. Wilkinson—"Mughal Court Painting". The lectures will be delivered at University College, London.

THOUGH many obituary notices have been written of the late Sir Charles Parsons, it is probable that some time will elapse before a biography worthy of him is available. In the meantime, however, it is to be hoped that some of those who knew him best will not fail to place on record their recollections, for the value of such records will increase with the passing of time. Among the fullest obituary notices we have seen is that by Sir Alfred Ewing contributed to the *Proceedings of the Royal Society*. All too brief as this is, it yet contains much of interest not to be found elsewhere. Born a year after Parsons, Sir Alfred was the first to make an independent trial of a condensing steam turbine; it was on his advice that the radial flow turbine now preserved in the Science Museum was installed at Cambridge, and later on he conducted the trials of the historic *Turbinia*. For forty years Sir Alfred Ewing enjoyed the friendship of Parsons, a friendship which "continued without a break or cloud". Another friend of Parsons was Mr. J. Golder, who from March to June contributed a series of articles on the great engineer to the *New Age*. Towards the end of his life Parsons appeared to Mr. Golder as a 'retired admiral': "Blue reefer suit. Fresh ruddy complexion. Dreamy blue eyes. He was quite unconscious of what he had done. His service, like the navies he transformed, was the service of the silent."

THE habit from which they take their name makes flying-fish so conspicuous and invites observation so much that it is curious to find there is still difference of opinion as to whether they really fly or only use their pectorals as parachutes. In the July-August number of the *Scottish Naturalist* (p. 121), Mr. W. L. Calderwood gives some notes on these fish, as observed in calm weather in the Arabian Sea. His observations were made carefully with prism glasses, and led him to the conclusion that the pace, which was very uniform, was maintained by the use of the pectorals at short intervals. Although it could not be seen, at a long distance from the ship, whether these fins were vibrating or not, it seemed to him that a flight extending sometimes even to 150 yards, and performed at only about a foot above the surface, could not have been kept up except by renewed impulses from the fins. This was exactly the impression formed by the writer of this note after repeated naked-eye study of these fish on a first voyage into the same part of the world. They were seen at times to vibrate their fins when clear of the water, as well as when touching it with the tail, as is generally admitted and very carefully described by Mr. Calderwood in the paper alluded to. The impression their

flights left was that of the starting flutter and patter of the moorhen, continuing as the glide and whirr of the partridge, with the difference that in the fish the end of the first glide was generally also that of the flight.

THE Medical Research Council announces that it has appointed a Therapeutic Trials Committee, as follows, to advise and assist in arranging for properly controlled clinical tests of new products that seem likely, on experimental grounds, to have value in the treatment of disease: Prof. T. R. Elliott, physician to University College Hospital, London (*chairman*); Sir E. Farquhar Buzzard, regius professor of physic, University of Oxford; Dr. H. H. Dale, director, National Institute for Medical Research; the Right Hon. Lord Dawson of Penn, president, Royal College of Physicians, London; Prof. A. W. M. Ellis, physician to the London Hospital; Prof. F. R. Fraser, physician to St. Bartholomew's Hospital, London; Sir John Parsons, ophthalmic surgeon to University College Hospital, London; Dr. J. A. Ryle, physician to Guy's Hospital, London; Sir John W. Thomson-Walker, consultant urologist to King's College Hospital, London; Mr. Wilfred Trotter, surgeon to University College Hospital, London; Prof. D. P. D. Wilkie, surgeon to the Royal Infirmary, Edinburgh; and Dr. F. H. K. Green (*secretary*). Conditions have been the subject of discussion and agreement between the Medical Research Council and the Association of British Chemical Manufacturers, under which the Therapeutic Trials Committee will be prepared to consider applications by commercial firms for the examination of new products, submitted with the available experimental evidence of their value, and will arrange appropriate clinical trials in suitable cases. The Committee will work in close touch also with the existing Chemotherapy Committee, which is engaged for the Medical Research Council in promoting researches aimed at the discovery and production of new remedies.

THE first regular world-wide broadcasting service from the southern hemisphere has now been inaugurated by Amalgamated Wireless (Australasia), Ltd. The programmes are transmitted daily from Sydney, 2ME, and from Melbourne, 3ME, on the wave-length of 31·28 metres. Those who possess short-wave sets should listen in and help the undertaking by sending reports to Amalgamated Wireless at Australia House, Strand, London, W.C.2. The time-table (G.M.T.) of the transmissions from Sydney is as follows: 05·00 to 07·00 for American countries bordering the Pacific; 09·30 to 11·30 for islands of the Pacific and eastern Australia; 11·30 to 12·30 for Japan, China, and India; 19·00 to 21·00 for Great Britain, western Europe, and South Africa. All programmes will have included in them the laugh of the Kookaburra. The transmissions take place on Sundays at the same times. Melbourne, 3ME, transmits on the same wave-length from 10·00 to 11·30 every Wednesday and Saturday.

THE International Union of Geodesy and Geophysics, at its meeting at Prague in 1927, invited the Argentine Republic to co-operate in the International Time Service. In a recent circular letter (in English) the General Director of the Military Geographic Institute announces that the Provisional Government of the Argentine, by a decree dated Feb. 3, 1931, charged the Institute with the transmission of rhythmic time signals, by short wave, twice daily. The service commenced on June 1, 1931, transmission taking place from the powerful station of the International Transradio Company at Monte Grande. The signals are transmitted (*a*) from $11^h\ 45^m$ to $11^h\ 50^m$ G.M.T. through the transmitter *L.S.F.* in 19,600 kc./s. (15·30 m.), using 14 kilowatts, directed by a reflector towards Europe; and (*b*) from $23^h\ 45^m$ to $23^h\ 50^m$ G.M.T. through the transmitter *L.S.D.* in 8830 kc./s. (33·97 m.), using 16 kilowatts, directed towards Europe and North America by the aid of a bi-directional antenna without reflector. The time-station is at the Institute at Belgrano, $3^h\ 53^m\ 44{\cdot}964^s$ west of Greenwich, according to the Potsdam-Buenos Aires longitude determination made by the Institute in 1927–28. The Institute offers to send monthly, to anyone interested, a list in Greenwich sidereal time of the times of reception of the signals in Belgrano itself; and the co-operation of other institutions and observers is invited in the reception of these signals, of which details are given in the circular.

THE recent broadcasts of the song of the nightingale made by the B.B.C. this year, which have been such a popular item, especially abroad, have led to various rumours in the press. We have been told that many of the listeners have distinctly heard the scratch of the needle which accompanies gramophone records, and have suggested that records have been made of the singing so that listeners need never be disappointed. Another and more serious accusation is that birds have been caught, put into cages, and forced to sing into the microphone by gentle persuasion or otherwise. The extraneous noises heard, such as the striking of village clocks, distant motor horns, etc., could easily have been added to mislead the listeners. In the *Wireless World* for July 29 there is a letter from the owner of the house at which the broadcasts were made, and at which he was present, saying that they were genuine transmissions of the bird's singing, and that there was no necessity to have resort to other methods.

THE Convention of the International Commission on Illumination, of which Mr. C. C. Paterson is president, will be held in London in September next. The meeting will be made notable by the flood-lighting of several historical buildings in London in the evenings. Recently Londoners had an opportunity of witnessing experimental flood-lighting of Westminster Abbey and other notable buildings. One of the most successful examples of flood-lighting is Dover Castle, a description of which appears in the Osram G.E.C. *Bulletin* for July. The flood-lighting has proved so successful that it has been decided to make it permanent. Twelve powerful projector lamps are used, each taking a thousand watts. Situated as it is on the top of a hill, it is visible for miles around

and everyone is pleased with the effect produced. Ships passing many miles out in the English Channel can see it plainly, and in clear weather it is a picturesque sight from the French coast. It is one of the best examples of flood-lighting yet carried out in Great Britain.

THREE new automatic wireless beacon stations are to be erected on the Uruguayan coast by the Marconi Company on behalf of the Hydrographic Department of the Government of Uruguay. The stations, which are expected to be placed in commission in the summer of 1932, are to be of the fixed omnidirectional type. Two of the transmitters will be installed in lighthouses —at Lobos Island and Cape Polonio ; and the third in the English Bank Light Vessel. The transmitters are designed to operate on two definite wave-lengths, one of 600 metres and one between 950 and 1050 metres. In addition, the Marconi beacon in the English Bank Light Vessel will operate in conjunction with a submarine sound signalling device, so that navigators can estimate their distance as well as their direction from the light vessel. It is understood that the beacon station at Lobos Island will transmit on a wave-length of 1000 metres. The beacon station at Cape Polonio will transmit on the wave-length of 1050 metres. The allotment of a distinctive signal for the English Bank lightship has not yet been finally decided, in view of the special arrangements for the transmission of a series of dots in conjunction with the submarine signal device.

AN excellent example of the importance of research in industry is the invention of 'paragutta', a material with which the new telephone cable, provided to supplement the growing traffic between the United States and Cuba, is insulated. For the past seventy-five years, the standard materials for insulating deep-sea cables have been gutta-percha and balata. Paragutta is a mixture of about fifty per cent gutta-percha, forty per cent rubber, and ten per cent hydrocarbon wax. Its mechanical qualities are fully equal to those of gutta-percha, its electrical stability in water is the same, but it has much better specific electrical properties. In the *Bell Laboratories Record* for May, a full description of the new material is given by A. R. Kemp. It is pointed out how the mixture can be extruded on to the conductor in a continuous sheath of multiple layers free from mechanical defects. The insulated conductor has then only to be drawn through cold water, when it quickly sets into a firm covering sufficiently tough and flexible to resist rough handling in factory or cable ship. The specific conductance of paragutta is only one-thirtieth of that of ordinary cable gutta-percha and its dielectric constant is twenty per cent smaller. It follows that if paragutta had been available to insulate the permalloy-loaded telegraph cable laid five years ago its speed would have been thirty per cent greater. Its revenue-earning capacity would thus have been increased thirty per cent. This is of great importance from the commercial point of view. The expense of failure in a submarine cable is unusually great. Minute defects in its insulation can do far-reaching damage. Very prolonged and elaborate tests were therefore necessary before the cable users and manufacturers were convinced that it was suitable for practical use.

MR. HUTCHINSON'S visit to Africa in 1930, in the company of General Smuts and with the generous assistance of the botanists and forest officers of the districts visited, must have been one of great interest, and especially as Mr. Hutchinson had previously visited some of the same parts in 1928, at a rather different season. The account given in the *Kew Bulletin*, No. 5, 1931, makes good reading from the botanical point of view, and also has the human touches bringing out the joy of seeing new plants and new country, and such difficulties as the drying of paper to keep pace with the press when collecting in an area so little known and with so rich a flora, the problems of motoring on African roads, and camping in lion-inhabited areas. Mr. Hutchinson's two visits should do much to make the flora of South Africa, and especially Rhodesia, better known; certainly the number of new species (five in the genus *Monotes* alone) and the new data bearing on phyto-geographical distribution, which have been collected on this comparatively short trip, point to the scope for such work. Although of very general interest, Mr. Hutchinson's account should be of especial interest to those who have been to any of the parts visited, and from this point of view, members of the British Association who toured through Matopos, Victoria Falls, Zimbabwe, etc., in 1929, will find mentioned many of the plants with which they became acquainted. The publication of further notes on the species collected and of the further volumes of the "Flora of West Tropical Africa" will be anticipated with added interest.

WE have received from the British Drug Houses, Ltd., London, N.1, leaflets describing the preparation, biological standardisation, and uses of certain of their products. Pituitary (posterior lobe) extract is tested, in accordance with the regulations made under the Therapeutic Substances Act, for its oxytocic activity, the strength being expressed in terms of the international unit. In addition, the pressor activity of each batch is determined. The extract finds its chief uses in obstetrics and in the treatment of diabetes insipidus. Radiostol is prepared by irradiation of ergosterol under controlled conditions. Its potency is expressed in terms of the Coward antirachitic unit ; as soon as the tests are completed, its activity will be expressed in terms of the unit recently described by the Medical Research Council. Radiostol is a specific in the prevention and treatment of rickets and allied diseases and dental caries. Radio-Malt is a preparation containing Radiostol in combination with a highly active concentrate of vitamin A together with malt extract. It provides vitamins A, B, and D in a palatable form. The tests for vitamin potency are all carried out on rats, the growth response being the criterion for vitamins A and B, and the deposition of calcium at the ends of the long bones of rachitic animals that for vitamin D. The leaflets are illustrated

with reproductions of actual tests, and with diagrams of the growth of rats on vitamin-free diets supplemented with Radio-Malt.

THE Ministry of Agriculture and Fisheries has published a new *Bulletin*, entitled "Some Diseases of Rabbits". In short clear paragraphs accounts are given of the symptoms of twenty-two diseases to which domestic rabbits are liable, and suggestions are made for treatment. Published by H.M. Stationery Office at the price of 3*d*., this pamphlet should be a useful guide to the many breeders of rabbits for commercial purposes. It should be noted that the Ministry itself carries out at its veterinary laboratory post-mortem examinations and bacteriological work in connexion with rabbits. For a fee of 3*s*. a carcass, it is open to rabbit-keepers whose rabbits are dying, or who have other evidence of disease in their stock, to avail themselves of this opportunity for reliable diagnoses. The make-up of the pamphlet is so far in advance of the older publications of H.M. Stationery Office that we dislike pointing to its unbusinesslike publication, but the inefficiency is glaring. In the first place, a note in italics prominently printed upon the 'contents' page states that "The Ministry does not accept responsibility for statements made in the advertisement pages of this publication"—and the only advertisement in the whole pamphlet is one of the Ministry's own publications. In the second place, the most valuable advertising spaces in the pamphlet, the back cover and the inside front cover, are vacant, while there is no indication of the subjects of the thirteen *Bulletins* which have preceded this one. Surely a list of the series cries for one of the vacant pages.

THE Report of the National Research Council of the United States for the year ending June 30, 1930, which appeared in the Report of the National Academy of Sciences for the same period, has now been published as a separate pamphlet of 120 pages by the Government Printing Office, Washington. The expenditure of the Council for the year was about £190,000, which was provided mainly by the Rockefeller Foundation, the Carnegie Corporation and Fund, and the Education Board. The issue of comprehensive reports on current knowledge in particular fields has been continued, and several have had to be reprinted—and in general where this has been necessary the opportunity has been taken to revise them, so that they are thoroughly up to date. The research fellowships maintained during the year numbered: in mathematics, physics, and chemistry 63, in biological sciences 41, and in medical sciences 20. The research work of these fellows is supervised by boards which consist of some of the most renowned workers in each particular field. From the total sum expended on fellowships during the year, the average value of a fellowship appears to be £450 per annum, and they are only awarded to candidates of Ph.D standing who have shown marked ability in research.

THE Report of the Librarian of Congress, Washington, D.C., for the year ending June 30, 1930, is a volume of more than 400 pages, dealing with the general administration of the Library and with the numerous additions made during the preceding twelve months. The total number of printed books and pamphlets up to June 30 was 4,103,936, of maps and views 1,161,478, and of music (volumes and pieces) 1,062,194. "The most substantial addition to our resources by donation effective during the year", says the report, "was the grant from the Guggenheim fund for the promotion of aeronautics." A part of the fund, 75,000 dollars, was for the endowment of a chair of aeronautics, to which Prof. A. F. Zahm was appointed, while another part was available for the purchase of aeronautical literature. By April 1930 the aeronautical collections comprised no fewer than 9327 volumes and pamphlets, and included the Gaston Tissandier collection, the Samuel Pierpont Langley collection, and other notable collections. "There are, of course," says Prof. Zahm, "many American institutions equipped to furnish ready information in practically the whole range of aeronautics. . . . But for comprehensive, thoroughgoing, systematic research, requiring the greatest range of reference literature, the national Library is, and naturally should be, pre-eminent." Moreover, "Any person, from any place, may examine, within its walls, any book in its possession, and may do this without introduction or credentials".

IN vol. 25, part 3, of the *Transactions of the Mining and Geological Institute of India*, December 1930, there is a paper by Mr. C. H. McCale, headed "Suggestions Concerning the Utilisation and Conservation of Indian Coal". The two points especially stressed are the use of coal dust firing and low temperature carbonisation. It was, however, pointed out in the discussion that experience in other countries does not necessarily apply to India, where the conditions are very different from what they are in Europe. In the first place, the demand for power is limited, and therefore the amount of coal dust that can be consumed for the firing of boilers is also relatively small. Furthermore, distances in India are very great, and the transportation of powdered fuel over many thousands of miles is a doubtful proposition unless the fuel is of the highest possible grade, and this is scarcely likely to be the case in India. As regards low temperature carbonisation, although there is a number of companies working processes for this purpose in England, they are not yet commercial propositions, and in India there is the serious additional difficulty of the inability to dispose of the by-products, which are expected to contribute very largely to the commercial success of the undertaking in other countries.

A NEW aspect of Russian interest in her considerable Arctic territories is expressed in the publication of the periodical entitled *Bulletin of the Arctic Institute of the U.S.S.R.*, of which No. 5 has just appeared. The scope of this bulletin covers all polar regions, north and south, besides giving a more particular account of Russian activities. It also gives a useful bibliography from time to time. The greater part of the *Bulletin* is printed in Russian, but some of the matter is in English. During the present summer, various projects are on foot in Russian Arctic regions,

including visits to the meteorological stations in Franz Josef Land and the Kamenev Islands, oceanographical work in the Barents and Kara seas, and geological work in the Chukchee peninsula of north-eastern Siberia.

DR. A. F. JOSEPH has resigned from the deputy directorship of the Imperial Bureau of Soil Science, a post which he has held since the inception of the Bureau in May 1929. He brought to his task a full knowledge of soil problems in different parts of the Empire and a ripe experience in dealing with them; further, his personality helped greatly in smoothing over many of the difficulties of establishment and organisation. The purpose of the Bureau is to supply information to agricultural departments and soil investigators in different parts of the Empire, and the work is complicated by the widely varying problems which have to be attacked. Dr. Joseph has been eminently successful not only in sending out information of the kind that was wanted, but also in putting different workers in touch with one another and so economising time and effort.

THE Proceedings of the first Imperial Horticultural Conference have already been referred in NATURE (Sept. 6, 1930, p. 384). In a foreword to the published account of these proceedings now being issued by the Imperial Bureau of Fruit Production, East Malling, Kent, Sir Robert Greig, chairman of the Executive Council of the Imperial Agricultural Bureaux, remarks that many of the papers presented at this conference proved to be of exceptional technical interest. For this reason it has been decided to print the papers fully; they are being issued in three sections: (1) (issued December 1930) papers on the economic and administrative side of horticulture; (2) (issued February 1931) papers on the application of science to horticulture; (3) papers on the storage of fruit. Part 1 is issued at 1*s*., Part 2 at 2*s*. In Part 2 the papers are grouped under three headings: (1) field experiments, (2) the application of pure science to horticulture, (3) soil and climate as affecting horticulture.

THE Report of the Haffkine Institute for the year 1929 has recently been issued by the acting director, Major L. A. P. Anderson. Plague work necessarily occupies a considerable part of the Institute's activities and of the Report. The demand for Haffkine's plague prophylactic vaccine has been well up to the average, some million and a half doses having been dispatched, and several problems relating to this vaccine have been investigated. A study of the immunising and curative power of various anti-plague serums suggests that a serum prepared in the sheep or ox has greater potency than one prepared in the horse. Inquiries have been made on maternal morbidity and mortality and on stillbirths in Bombay, and on tuberculosis by Dr. Soparkar in this Presidency. In this part of India it would seem that the bovine type of tubercle bacillus plays a negligible part in the causation of this form of tuberculosis. In the Anti-Rabic Department, 685 cases were treated with only 5 deaths, a mortality of 0·73 per cent.

THE Medical Research Council announces that it has awarded Dorothy Temple Cross Fellowships for 1931–32, under the terms of the benefaction in that name for research fellowships in tuberculosis, to Dr. C. A. Birch, senior medical registrar and tutor in the Royal Infirmary, Liverpool, and to Dr. R. L. Vollum, demonstrator in pathology in the University of Oxford. Dr. Birch will study problems of tuberculosis at industrial centres in the United States; and Dr. Vollum will investigate recent developments in methods for the investigation of tuberculosis, in Germany and Austria. The fellowship awarded last year to Lieut. S. M. Burrows, formerly clinical assistant in the Tuberculosis Department, St. Thomas's Hospital, has been renewed for a further year.

THE Ministry of Agriculture and Fisheries announces that the fee charged for the blood test of bacillary white diarrhœa in poultry has been reduced from 3*d*. to 2*d*. This disease is of considerable importance to poultry keepers, and the blood agglutination test is the most practicable means of identifying the carrier hens which transmit the disease through their eggs to the chicks.

MESSRS. Wheldon and Wesley, Ltd., 2 Arthur Street, W.C.2, have just circulated a 'clearance list' of about a thousand second-hand books dealing with zoology, mathematics, chemistry, geology, etc. Most of the prices asked are very low.

IN view of the approaching centenary celebration of Clerk Maxwell, the Cambridge University Press announces a book of essays written to commemorate the event by Sir J. J. Thomson, Dr. A. Einstein, Dr. Max Planck, Sir Joseph Larmor, Sir James Jeans, Sir Ambrose Fleming, Dr. W. Garnett, Sir Richard Glazebrook, and Sir Oliver Lodge. The same publishers will also issue shortly a new work by Mr. T. Whittaker entitled "Prolegomena to a New Metaphysic".

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant pathologist at Ancoats Hospital, Manchester—The Gen. Supt. and Secretary, Ancoats Hospital, Manchester (Aug. 12). A graduate assistant in electrical engineering at the Dartford Technical College—The Principal, Technical College, Dartford (Aug. 14). A "Wander" scholar for diseases of children at Westminster Hospital—The Secretary, Westminster Hospital, S.W.1 (Aug. 14). An assistant resident medical officer and resident clinical pathologist at the Manchester Royal Infirmary—The Chairman of the Medical Board, Royal Infirmary, Manchester (Aug. 19). A full-time teacher for mining courses under the Education Department of the County Council of the West Riding of Yorkshire—The Education Officer, County Hall, Wakefield (Sept. 1). A demonstrator in agricultural botany and a demonstrator in agricultural bacteriology in the University of Leeds—The Registrar, University, Leeds (Sept. 1). A full-time assistant master to teach practical metal and woodwork, and engineering subjects at the Victoria Institute Science and Technical School, Worcester—The Secretary for Education, Tudor House, Worcester. A civil engineering assistant for general drawing office and field work at H.M. Dockyard, Portsmouth—The Civil Engineer-in-Chief, Admiralty, S.W.1.

## 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.*]

### Acromegaly among the old Northmen.

I HAVE read with great interest the description of the Gardarene skull given by Sir Arthur Keith in his "New Discoveries relating to the Antiquity of Man". No pathologist will, I think, doubt that the skull is acromegalic, and this raises the interesting question: Was there anything in the terribly hard life of the Icelandic and Greenland colonists that led to pituitary disorder and so to acromegaly?

There has recently been published a good English translation by Mr. E. R. Eddison of the Egil Saga, and this I think suggests that Egil himself suffered from pituitary disease culminating in definite acromegaly. First as to Egil's personality and appearance. Egil Skallagrimson, the hero of the Saga, lived about a thousand years ago; his activities were not limited to the northlands—Norway and Iceland—for he fought in the battle of Winaheath under Athelstane against Olaf, the half Danish king of Scotland. It is after the victory, as he sat in Athelstane's hall, that the following account of his appearance is given:

"He sat upright, but his head was much bent. Egil was great of face, broad of forehead, with great eye-brows; the nose not long, but marvellous thick; that place wide and long where the moustachios grow: the chin wonderfully broad, and so all about the jaw: thick-necked and great-shouldered beyond the measure of other men: hard-looking and grim-like whensoever he was wroth. He was of goodly growth and taller than any man else: his hair wolf-grey and close of growth, and become early bald" (p. 111).

Here, even in Egil's prime, there is the suggestion of some overgrowth of parts of the face, and the bent neck may be significant. In his old age, that is, between seventy and eighty, he became dull of hearing and blind. There is an episode in which, being sightless, he lies about in front of the fire in the way of the kitchen wenches; later he is warned not to put his feet too near the fire. He was, however, still sufficiently vigorous to kill with his own hands two thralls who had helped him conceal the treasure that Athelstane had given him. After his death, there was an expectation or legend that his bones were particularly long and strong, for later—that is after his bones had been moved—in the churchyard "were found men's bones. They were much greater than other men's bones: men think they know from sayings of old men that they would have been the bones of Egil. There was then Skapti Thorarinson the mass-priest, a wise man. He took up the skull of Egil and set it in the church-yard. The skull was wonderfully great; yet that seemed more beyond all likelihood, how heavy it was. The skull was all wavy-marked on the outside, like a harp-shell. Then would Skapti find out about the thickness of the skull. Took he then a hand-axe, great enough, and swung it with one hand at his hardest and smote with the hammer on the skull and would break it; but there where the blow came it whitened, but dented not nor split. And one may mark from such things, that that skull would be nought easy-scathed before the hewings of small men, while skin and flesh followed it" (p. 222).

Here then we have the skeleton of Egil with especially thick, strong bones and heavy skull with irregular growth of bone on the surface. Two conditions immediately come to mind—acromegaly and osteitis deformans (Paget's disease). Taken alone, the description of the skull might well suggest the latter, but we may be sure that some mention would have been made of the crippling deformity of this disease had Egil suffered from it; moreover, he could scarcely have overcome his two thralls. There remains acromegaly, and here the blindness, and thickness of the skull, seem almost conclusive; indeed, as already indicated, it seems likely that even in his prime Egil had been to a slight degree acromegalic.

At this stage of my hypothesis, I went to the Royal College of Surgeons and, in Sir Arthur Keith's absence, was shown a number of acromegalic skulls by Dr. Beadles. It then appeared that acromegalic skulls could be either thick or thin, and might even be thick in some parts and not especially thick in others. No. 36.1 of the general pathological series is an acromegalic skull with a capacity of 1650 c.c., suggesting some degree of giantism; it is not specially thick, but there is little diploe and the bone is hard. In skull 3861.1 of the special pathological series, that of a modern Roman with no history and with a normal capacity (1500 c.c.), the skull is 2 cm. thick in places; and in another skull, that of a woman (3862.1), the frontal is much thickened. Allowing for a little exaggeration, the Roman skull might, I think, well give something approaching the result obtained on Egil's skull with the hand-axe.

Now, Sir Arthur Keith quotes Prof. Hansen to the effect that several skulls from the same cemetery presented traits resembling those found in the Gardarene skull, "of a similar kind but in a lesser degree" (p. 488). There is, then, evidence of a considerable amount of pituitary disorder among a group of men living a particularly hard life, exposed on their voyages to extremes of cold, to hunger, thirst, and malnutrition, enduring hardships such as only the fittest can have survived, and I would reiterate the question with which I began this letter, but in a more definite form: Was acromegaly—a somewhat rare disease among ourselves—relatively common among the Icelandic colonists and their descendants? If so (and here I would particularly invoke the help of our Scandinavian colleagues), do the circumstances of its occurrence among these adventurous Northlanders offer any hint as to the underlying causes producing alterations in the pituitary gland?

C. G. SELIGMAN.
Court Leys, Toot Baldon,
Oxford, July 16.

### New Isotopes of Strontium and Barium.

APPLICATION of high resolution to accelerated anode rays has now provided improved mass-spectra of these two elements. Strontium shows a third isotope 87 in addition to those already observed. Results with barium were only obtained with great difficulty. In addition to the main line 138, they indicate the presence of no less than three of the lighter isotopes expected from the chemical atomic weight 137·36. The positions and intensities of these new lines explain the failure to observe them with the older apparatus, for with inadequate resolution their general effect would be indistinguishable from the ordinary penumbra of the strong line 138. Quantitative estimates of relative abundance will be published later. The following are the mass numbers in order of intensity:

| | | | | | |
|---|---|---|---|---|---|
| Sr | 88 | 86 | 87 | | |
| Ba | 138 | 137 | 136 | 135 | |

It will be noticed that $Sr^{87}$ and $Ba^{136}$ form isobaric pairs with rubidium and xenon respectively.

F. W. ASTON.
Cavendish Laboratory, Cambridge, July 21.

## Age of Certain Gravels in the New Forest Area.

ALTHOUGH the researches of Dr. Longstaff, Mr. H. Bury, Mr. R. A. Smith, and others have thrown much light on Quaternary problems in the New Forest area, a good deal still remains obscure. For sometime past a former pupil of mine, Mr. J. Preston, has been examining the gravel exposures which lie to the east of the Hampshire Avon, and recently we studied together these sites and the various stone tools which have been found. Especially interesting

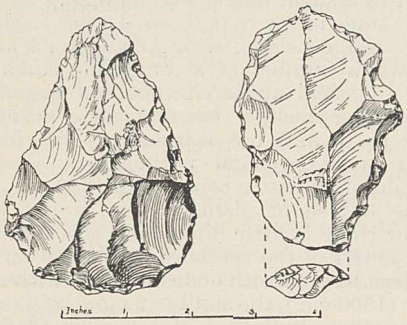

FIG. 1.

is a pit near Hordle. It lies about 100 ft. above sea-level and opens on the side of a small valley, debouching on the Solent a short distance away. The section in the pit is as follows :

(*a*) Surface soil and sub-soil.

(*b*) Thick deposit of coarse gravel, certainly never laid down by river action, and recalling in many ways the main plateau gravel spread which is found all over the New Forest area. This has yielded what appear to be rolled late Chellean and lower Acheulean tools at Stoney Cross and at a site near Picket Post. At the Hordle pit an unrolled *coup de poing* of latish Acheulean type and a but slightly rolled Levallois II flake have been found (Fig. 1).

(*c*) Sand, similar in every way to that found to-day on the beach at Barton.

(*d*) Evenly-bedded gravel, certainly laid down by river action. A slightly rolled example of a late Chellean *coup de poing* has been found, as well as a more rolled specimen of earlier date (Fig. 2).

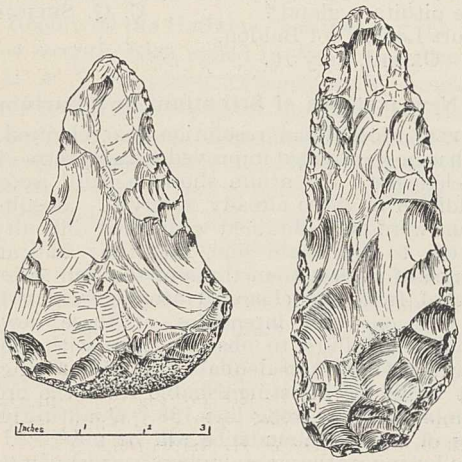

FIG. 2.

Deposit (*c*), taken in conjunction with the general height of the pit above sea-level, suggests that we are dealing with the effects of the same earth movement which formed the 100 ft. raised beach at Brighton, lately discussed before the Geological Society of London by the Rev. J. Fowler. Is it too rash to suggest that the following may have been the sequence of events in this part of Hampshire ?

I. Chellean tools were incorporated in fluviatile gravels along the margins of rivers close to the coast-line. The date, judging by the slightly rolled specimen cited in (*d*), must have been towards the end of Chellean times.

II. Submergence of the land to a depth of at least 100 ft.

III. Incorporation of middle Acheulean *coups de poing* and Levallois II flakes in a gravel spread which crept over the whole area, reaching down from what to-day is a height of some 350 ft. at Stoney Cross to nearly sea-level at the Solent. This gravel is to all appearance an outwash gravel, being probably due to glacial conditions beginning to occur to the north of the district. Its age would seem, judging from the archæological data available, to have been late Acheulean. At no very different date, uplift took place and the formation of the existing valleys by the denuding action of the rivers Avon, Stour, and Blackwater. That these valleys, though probably shallower, existed previously is shown by the fact that the gravel spread, mentioned in III, sags a little way down the sides of the modern valleys—clearly, at anyrate in the case of the Avon above Fordingbridge, forming a sort of pseudo-terrace, though always at a high level. At the beginning of the uplift the sea may have helped in the excavation of these deep valleys, and it should always be remembered that the underlying ground is composed of soft Barton Sands.

IV. Formation of low-terrace gravels along the bottoms of the modern valleys. In these a local archæologist (Mr. J. B. Calkin) has found one or two Mousterian tools ; mammoth bones have also been found. The age of these gravels is probably Würm. The archæological evidence, therefore, suggests that the uplift just postulated, with the probably simultaneous valley cutting, cannot have occupied any great length of time.

It is obvious that much further work is needed in this interesting area. We can only hope that Preston and other investigators in the district will continue to find further important and interesting material.

M. C. BURKITT.

Merton House, Grantchester,
Cambridge.

## Condition of Sparingly Soluble Substances in Gelatine.

IN a recent letter to NATURE,[1] Mr. Nabar and Dr. Desai write: "It is considered that the results obtained from a study of the precipitation of sparingly soluble substances, such as silver chloride, which do not form Liesegang rings in gelatine, should not be applied to explain the condition of sparingly soluble substances, such as silver chromate, which do form Liesegang rings in gelatine. There is a difference in the function of the gelatine in the two cases."

The writers appear to have overlooked some experiments of Bolam and Mackenzie,[2] in which Liesegang rings of silver chloride in gelatin were actually obtained. Moreover, while the observations of Nabar and Desai on the behaviour of the silver electrode in gelatin-silver chromate systems appear to be in agreement with those of Bolam and Mackenzie,[3] their statement with regard to gelatin-silver chloride systems, that " whatever fall in the contact potential is to take place occurs as soon as silver nitrate in gelatine and potassium chloride in gelatine are mixed", is not in accord with the results of Langdon.[4]

The conclusion that the gelatin functions differently in the two cases does not appear to be justified.

T. R. BOLAM.
Chemistry Department, The University,
King's Buildings, Edinburgh,
May 5.

[1] NATURE, April 25, 1931, **127**, 628.
[2] *Trans. Far. Soc.*, **22**, 159; 1926.
[3] *Trans. Far. Soc.*, **22**, 166, 167; 1926.
[4] *Trans. Far. Soc.*, **19**, 285; 1923.

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WITH reference to the letter by Mr. G. M. Nabar and Dr. B. N. Desai in NATURE of April 25, p. 628, I should like to direct attention to the theory of banded precipitates that I published in various journals as the result of a series of experiments from 1916 to 1922, and summarised in a paper on "Adsorptive Stratification in Gels, V".[1] In these papers the rôle of the ionic product and the metastable limit is fully discussed.

The authors also appear to be under the impression that silver chloride does not form Liesegang rings in gelatin; but this is not quite correct. The phenomenon is the same whatever the medium in which the precipitate is formed; and as I have stated, "No serious attempt to obtain a sufficiently insoluble precipitate in the stratified form has failed. . . . There appears to be no evidence to show that stratification will not occur, provided a precipitate can be obtained in a suitable state of subdivision from solutions of sufficient dilution." Actually the formation of bands of silver chloride in dilute solution in gelatin is recorded by W. M. Fischer,[2] bands of this substance in water in capillary tubes were obtained by Brodersen,[3] and I obtained good bands in U-tubes in agar agar.[4] The formation of banded precipitates of silver chloride, as with any other insoluble substance, for example, silver chromate in agar agar, depends primarily on adjusting the supersaturation produced so that a suitably finely divided precipitate will be obtained.

S. C. BRADFORD.
Science Museum, South Kensington,
London, S.W.7.

[1] *J. Soc. Chem. Ind.*, **7**, 78; 1929.
[2] *Z. Anorg. u. Allg. Chem.*, **145**, 311; 1925.
[3] *Kolloid Z.*, **35**, 21; 1924.
[4] *Biochem. J.*, **10**, 170; 1916.

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BY the courtesy of the Editor of NATURE, I am able to give the following reply to the comments of Drs. Bolam and Bradford on our letter on "Condition of Silver Chromate in Gelatine Hydrolysed and Electro-Dialysed to Different Extents", published in NATURE of April 25, 1931, p. 628.

Drs. Bolam and Mackenzie[1] have not given any experiments in which silver chloride rings in gelatine were obtained in the absence of silver chromate. In our experiments, the contact potential of the silver electrode reached its final value as soon as the solutions of silver nitrate in gelatine and potassium chloride in gelatine were mixed, a result which does not agree with the observations of Langdon.[2] Using the same sample of gelatine, it was, however, found that with silver chromate the fall in the contact potential of the silver electrode was gradual. The contact potential measurements show that, in our experiments, silver chloride in gelatine was not in ionic condition, but that silver chromate was. We hold that, in the first case, gelatine acts as a protective colloid, and in the second case, as an inhibiting agent; and that it is the inhibitive power of gelatine which is responsible for the formation of Liesegang rings.

We agree with Dr. Bradford that serious attempts to obtain a sufficiently insoluble precipitate in the stratified form will prove successful. We also believe that just as bands of silver chloride in gelatine can be obtained by taking the former substance in sufficient dilution, the bands of the same substance in gelatine can be obtained even in slightly stronger solutions, provided the *p*H of gelatine is decreased sufficiently. We have found experimentally that the inhibitive power of gelatine towards silver chromate can be altered considerably even by slight changes in its *p*H value. We are at present studying the effect of changing *p*H of gelatine on its efficiency in giving banded precipitates (rings) of different sparingly soluble substances.

All the points raised in the communications of Drs. Bolam and Bradford are dealt with in detail in a paper which will be sent shortly for publication.

B. N. DESAI.
Physical Chemistry Laboratory,
Wilson College, Bombay, 7, July 3.

[1] *Trans. Far. Soc.*, **22**, 159; 1926.
[2] *Trans. Far. Soc.*, **19**, 285; 1923.

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### Oxidation Reduction Potential of Complex Iron Compounds in Yeast.

WHEN an alkaline extract of yeast is saturated with ammonium sulphate there is precipitated, with the protein, cytochrome 'C' and a complex iron compound giving no visible spectrum. The latter can be separated from the proteins slowly by ultra-filtration. It remains in solution when the protein, with the cytochrome 'C', is precipitated by trichloracetic acid.

This iron compound is of interest because its oxidation potential ($E_0$, referred to the normal hydrogen electrode, $= +0{\cdot}02$ at *p*H 7·1) lies very close to that at which the spectrum of cytochrome 'C' appears and disappears—a potential near which a variety of aerobic organisms appear to function. In quite low concentration it prevents the hydrogen electrode from giving correct values in buffered solutions—a property which makes it seem likely that it can act as a catalyst.

That the iron is complexly bound and not in the form of simple ferrous or ferric ions is shown by the fact that even in a large excess of such a buffer as a concentrated borate–tartrate mixture, the oxidation reduction potential of this compound lies about 0·25 volt above that of ferric chloride added to the buffer. The iron of the compound does not react with sulphocyanide when oxidised, but does react slowly with *aà* dipyrridyl when reduced.

An attempt to isolate the compound is now in progress. Because its oxidation potential is close to that of cytochrome 'C', and because it is apt to accompany the latter in attempts to obtain the pure pigment, there is some danger of confusing the effects and properties of the two substances.

THOMAS B. COOLIDGE.
Converse Chemical Laboratory,
Cambridge, Mass., U.S.A., July 7.

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### Measurement of Ultra-Violet Radiation.

WE are interested in the photographic method of recording the ultra-violet light of the sky, which has been described by Dr. J. R. Ashworth.[1]

With reference to the criticisms of Dr. Cunliffe[2] the objection to the step-wedge does not appear to be important; it is probable that the logarithmic 'law' is approximately correct and in any case the wedge can be calibrated. It is, of course, well known that the photographic effect of an exposure is not a simple function of the time integral of the intensity

and that an intermittent exposure does not give the same effect as a continuous exposure for the same total time. It is pertinent, however, to point out that the physiological response to radiation is somewhat analogous and that a photographic measurement may, therefore, be particularly valuable.

A further point for consideration appears to be the quality of the radiation recorded. It is generally agreed that little benefit is derived by man from ultra-violet radiation of wave-length greater than about 3200 A. and we note that Dr. Ashworth's filter transmits radiation between 3400 and 3700 A. Possibly the thin silver film transmitting radiation of wave-length 3130 A., described two years ago by Mr. Lamplough in a paper to the Royal Society of Arts, could advantageously be substituted.

The methylene blue method developed by Messrs. Webster, Hill and Eidinow shares with Dr. Ashworth's method the disadvantage of response to the longer wave-lengths; in addition, the sensitivity appears to be affected by temperature changes.

A. F. DUFTON.
H. E. BECKETT.

Building Research Station,
Garston, Herts, July 6.

[1] NATURE, June 13, p. 893.
[2] NATURE, July 4, p. 35.

### The Forbidden Lines in the High Frequency Discharge of Mercury, Cadmium, and Zinc.

IN addition to the observed results of the intensity modification of spectra in the high frequency discharge in mercury, we have found the forbidden lines $1S - 2p_1$ of mercury and $1S - 2p_1$ and $1S - 2p_3$ of cadmium with moderate intensities. The quartz tube was 15 cm. long and 2 cm. in diameter, and the pressure of vapours was kept at about 0·001 mm. mercury. The spectra were excited with external electrodes by a 10-metre oscillator, and observed in it, end on. Heating the tube caused the discharge

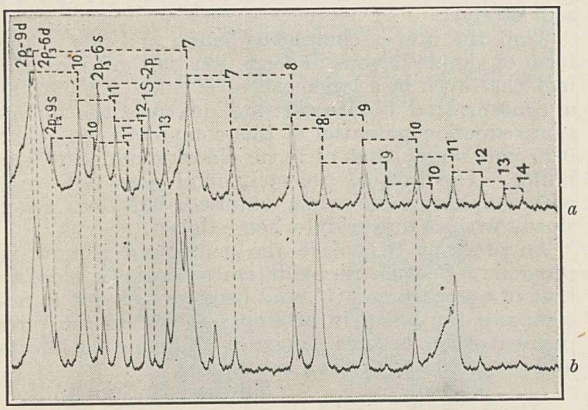


FIG. 1.—Photometric curves of the spectra of mercury, (*a*) at 70° C., (*b*) at room temperature.

to become brighter, and a remarkable intensity modification was observed in mercury, as is seen from the reproduction of the microphotometric records of the spectra at 70° C. and at room temperature (Fig. 1). It can be seen that the effects of a slight rise of temperature are: (1) the vapour emits only the series lines, while spark lines appear at room temperature; (2) the intensities of the series lines decrease quite regularly with the increase of the number of the members; (3) the forbidden line $1S - 2p_1$ enhances more than the neighbouring triplet lines $2p_2 - 12d$ and $2p_2 - 13d$.

In cadmium, in consequence of the strong concentration of atoms excited in *D*-levels, it was possible to observe 12 members in the singlet diffuse series and 8 members in the *p*-*D* intercombination lines. Intercombination lines which begin on the triplet levels are less affected, and the *pp'*-combinations which are emitted strongly in the arc are lacking in this discharge. In zinc, the singlet sharp series are strengthened and it was possible to observe 10 members, and the triplet series was slightly affected. It is to be regretted that we could not find the forbidden line in this vapour.

According to W. Hanle's work on the excitation function (*Anregungsfunktion*) of the spectral lines of helium, neon, and mercury, the maximum of the excitation function of the triplet levels is sharp in form and lies at about 10 volts, while that of the singlet levels is flat and at about 30 or more volts higher than the former. If it is assumed that electrons which have velocities of about 20 volts predominated in our exciting condition more than that of lower volts, the strengthening and weakening of the lines will be explained with reference to the observation of W. Hanle. As the pressure of vapours is very low, the interatomic field due to ionised or excited atoms will certainly be very weak, and this will also be a favourable condition for the emission of the forbidden lines. In the case of mercury, a slight rise of temperature favours the condition, probably in consequence of the increase of the frequencies of the collisions between atoms and electrons, the number of slower electrons becoming greater.

A full account of these experimental results will shortly be published elsewhere.

J. OKUBO.
E. MATUYAMA.

Physical Laboratory,
University, Sendai, June 10.

### Part-Absorption in X-Rays.

IN connexion with the experiments of one of us (B. R.) on the part-absorption in X-rays,[1] the results of other workers on the same subject are conflicting. While Cork,[2] Lindsay,[3] and Van der Tuuk [4] report negative results, Bhargava and Mukherjee [5] confirm our results so far as the part-absorption lines are concerned. It seems to us that the conflicting results obtained by different authors are simply due to the thickness of the absorption screens used by them in their experiments.

In the first experiment, described in NATURE of May 17, 1930, the copper $K\alpha$-radiation was allowed to pass through carbon powder lightly pressed in a slit of about half a millimetre thickness. The modified line appeared to be very feeble. Later on, the carbon powder was replaced by goldbeater's skin, which contains nitrogen and oxygen in addition to carbon. By trial, it was found that five pieces of goldbeater's skin when pressed on the slit of the spectrograph produce modified lines beautifully on the photographic plates.[6] We have further found that the increase in thickness of the absorption screen does not necessarily increase the intensity of the modified lines; or rather, on the contrary, if the absorption screen is too thick, the modified lines disappear completely.

Further investigation on the variation of intensity with the different thickness of the absorption screen is still in progress. It appears that the negative results of Cork, Lindsay, and Van der Tuuk may be due to the large thickness of the absorption screens used by them. In this connexion it may be mentioned that Bhargava and Mukherjee obtained the modified line of carbon by passing the copper $K\alpha$-radiation through only four pieces of ordinary black paper used for

wrapping the photographic plate. Later on they obtained a line of type Ag$K\alpha$ – Ni$K_{abs.}$ (Prof. M. N. Saha, in a private communication, has written to us that Messrs. Bhargava and Mukherjee have also found a line of the type Ag$K\alpha$ – Cu$K_{abs.}$)

Cork (l.c.) reports a line Cu$K\alpha$ – Be$K\alpha$ by passing copper $K\alpha$-radiation through Lindeman glass, which contains beryllium (0·9 per cent) among other constituents. As we have found in our experiments in carbon screen, Cork also finds that the intensity of this line does not increase by placing a beryllium screen in the path of the incident radiation. Further, non-appearance of any line modified by boron (which is another constituent of the Lindeman glass) might be due to the higher percentage of boron in the glass.

Lindsay (l.c.) has suggested that sometimes false bands appear on the photographic plate, due to the imperfection of the crystals. In our experiments the modified lines were obtained with both fixed and rotating crystals on a large number of plates. Generally, the crystal was rotated by hand about 2° on each side of the expected line. The rate of rotation of the crystal was 0·1° in every five minutes. In some plates this rate was varied. The modified line appeared as usual in every case, and thus the question of rotation of the plate does not affect our results so far as the modified lines are concerned.

The intensity estimate [7] is wrong, owing to an unfortunate mistake in comparing the blackness with a wrong plate. We have re-estimated the intensity of the modified lines and it appears to be of the order of 1 in 1000 (or even less) in comparison with the parent line. Agfa-Röntgen film is found to be more suitable for this type of investigation than ordinary plates.

B. B. RAY.
B. B. DATTA.

University College of Science,
92 Upper Circular Road, Calcutta,
May 1.

[1] NATURE, May 17, June 7, Sept. 13, 1930.
[2] *Comptes rendus*, Jan. 1931.
[3] NATURE, Feb. 28, 1931.
[4] *Naturwissen.*, April 3, 1931.
[5] NATURE, Feb. 21, Feb. 28, 1931.
[6] NATURE, June 7, 1930; *Zeit. f. Phys.*, Bd. 66.
[7] *Zeit. f. Phys.*, Bd. 66.

## Fine Structure of Raman Lines in Liquids.

I HAVE investigated the Raman spectra of several liquids with a spectrograph of high dispersion specially built for this purpose. The spectrograph was placed in a thermostat in order to allow very long exposures without losing anything in definition, owing to variation in the refractive index of the glass prisms.

With this apparatus I have observed, for the first time, so far as I know, the isotope effect in Raman spectra. I have succeeded in measuring the isotope effect in carbon tetrachloride and in stannic chloride, among other substances. The observation confirms the analysis of the infra-red absorption spectra of this substance proposed by Cl. Schaefer.[1] The work will appear in detail in the *Zeitschrift für Physik*.

I have also obtained beautiful Raman spectra of a number of different liquids. The plates show that the Raman lines have a characteristic structure, resembling unresolved vibration-rotation bands. This confirms the suggestion recently proposed by A. Kastler [2] that the rotations of the molecules in liquids are quantised.

Concentrated ammonia liquor gives a strong Raman band which is due to the $NH_3$-molecule. This band shows a distinct rotation structure. It is composed of a strong, unresolved $Q$-branch, surrounded on both sides by a succession of lines, of which the strongest have a spacing corresponding to the formula

$$\nu = 3317{\cdot}4 \pm 19{\cdot}87 \times J.$$

Further, there is a number of weaker lines with an average spacing of 9·7 cm.$^{-1}$. The rotation structure of the band consists obviously of a strong $Q$-branch and two positive branches, a strong $R$- and a weaker $S$-branch. Of the negative branches, the $P$-branch is rather strong, while the $O$-branch seems to be very weak. The intensity of the lines has a maximum at $J = 4$–5, as in the infra-red absorption spectrum.

The Raman band of water has a very complicated structure which, on addition of an electrolyte, becomes more distinct. In collaboration with Mr. Hugo Fredholm, I am extending systematic work in this direction.

I might finally mention a result which implies the possibility of a partial rotation of a molecule, as suggested by Bonino and Cella [3] in the case of pinene. Toluene, $C_6H_5 . CH_3$, gives a number of Raman lines of which two, commonly ascribed to the vibration C – H, show rotation structure. The Raman band $\nu_0 = 3056{\cdot}3$ cm.$^{-1}$, has the simplest structure. It is composed of a strong, unresolved $Q$-branch, a strong negative and a weaker positive branch, corresponding to the formula

$$\nu = 3056{\cdot}3 \pm 7{\cdot}0 \times J.$$

If these branches are interpreted as $P$- and $R$-branches, the spacing leads to a value for the moment of inertia, $I = 7{\cdot}9 \times 10^{-40}$ gm. cm.$^2$, which is in excellent agreement with the value to be expected for a rotating methyl group. Further details will be given elsewhere.

A. LANGSETH.
Chemical Laboratory of the University,
Copenhagen, July 14.

[1] *Zeit. f. Phys.*, **60**, 586; 1930.
[2] *Compt. rend.*, **192**, 1032; 1931.
[3] NATURE, **126**, 915; 1930.

## Occurrence of *Lithothamnion* in the South Indian Cretaceous.

WHILE examining some micro-sections of rocks from the Trichinopoly Cretaceous (South India), I have recognised the presence of *Lithothamnion* in several of the sections. This form has not been

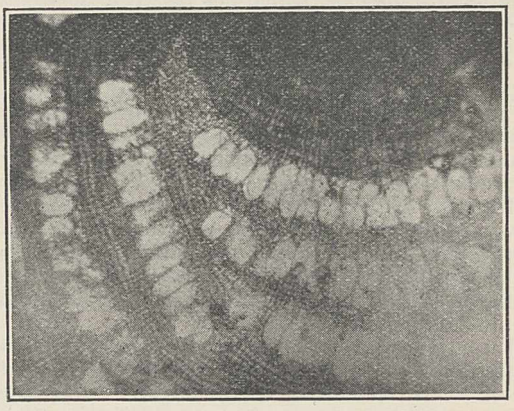

FIG. 1.—Archæolithothamnion sp ? ×about 25.

reported before from this area; and except for a passing reference by Hayden [1] to the occurrence of *Lithothamnion* in certain Cretaceous (?) beds of the Kampa system in Tibet, I believe the present find is the first of its kind to be reported from the Cretaceous of any part of India.

In view of the great interest attached to this

discovery, some of the sections were sent to Dr. Julius Pia, of the Natural History Museum, Vienna, and he has identified the form as *Archæolithothamnion* (Fig. 1), and some of the sections appear to be identical with *A. torulosum*, which he has figured in his chapter on Algæ in Hirmer's "Handbuch der Paläobotanik". The form has been recognised in quite a large number of sections, and it is certain that a detailed study of these will reveal not only more than one species of *Lithothamnion* but also the presence of several other types of Algæ. As regards the age and locality of these rocks now under study, they all belong to the Niniyur stage, which is the youngest subdivision of the Trichinopoly Cretaceous and corresponds to the Danian of the European stratigraphical scale.

L. RAMA RAO.

Department of Geology,
Central College,
Bangalore, South India.

[1] *Mem. Geo. Sur. Ind.*, vol. 36, pt. 2, p. 45.

### The Energy of Horizontal Atmospheric Motion.

WITH reference to my note on atmospheric structure in NATURE of June 27, it should be remarked that for any part of a horizontal field of isobars at which the velocity of the air is in geostrophic accord with the gradient the energy of a layer of air of uniform thickness contained within a square lying between a pair of consecutive isobars is the same for any part of the field, due allowance being made for variation of density and latitude. Hence the energy of the field can be estimated by counting the number of squares which are accommodated in the field.

The proof of this assertion is as follows:

Let the isobars be drawn for intervals of $b$ millibars; let the distance between a pair of consecutive isobars be $l$, and let $h$ be the thickness of the layer for which the geostrophic equation holds.

Let $V$ be the velocity of the air, $\rho$ its density, $\phi$ its latitude, $\omega$ the earth's angular velocity.

Then the mass of the layer of air within the square of which the side is $l$ is $\rho l^2 h$, and the velocity $V$ is $\frac{b}{2l\omega\rho}\operatorname{cosec}\phi$.

Hence the energy is $\frac{1}{8}\frac{hb^2}{\rho\omega^2}\operatorname{cosec}^2\phi$.

It is consequently the same for every square, whatever its size may be, which lies between isobars with the same pressure interval. If we take as our unit of energy $\frac{1}{8}\frac{hb^2}{\omega^2}$ and denote it by $N$, the energy for any square within the layer is $\frac{\operatorname{cosec}^2\phi}{\rho}N$. If any portion of the field be made up of such squares and their number $n$ counted, the energy of that portion of the layer, expressed in terms of the unit $N$, is $n\operatorname{cosec}^2\phi/\rho$.

The value of the unit $N$ for a layer 100 m. thick with a pressure interval of 2 mb. is about 26,000 kilowatt-hours, worth £100 at a penny per B.T.U.; or with $\rho$ 1000 gm./m.$^3$ (nearly normal at 2 km. height) the energy is 35 million kw.-hr. in latitude 60°, 104 million kw.-hr. in latitude 30°.

The number $n$ can be obtained by inscribing successive circles tangent to the pair of isobars and to each other and counting their centres.

When isobars are curved, computation is still possible, but the formula requires modification.

This reasoning enables us to compute the energy of the horizontal motion of a 100-metre layer, shown on the maps of isobars at various levels in the troposphere. The energy between 30° N. and 60° N. clearly increases with height up to 8000 metres at least.

NAPIER SHAW.

July 4.

### Jubilee Celebrations of the Society of Chemical Industry.

PLEASE allow me to amend that portion of the account of the jubilee celebrations of the Society of Chemical Industry, published in NATURE for July 25 (p. 157), which refers to the development of the chemical autoclave as illustrated by "a series of drawings and exhibits by the National Physical Laboratory". The actual origin of these illustrations and specimens is entirely otherwise. The drawings were made by Mr. H. Tongue, principal technical assistant of the Chemical Research Laboratory, Teddington. The collection of autoclaves included representative examples of various types constructed at my suggestion over a period of fifteen years, first at the Finsbury Technical College, then in the University of Birmingham, and recently in the Chemical Research Laboratory, the cost of production having been met in all cases by the Department of Scientific and Industrial Research.

The account also refers to "reduction products of fluorine compounds"; the substances exhibited were reduction products derived from the hydrocarbon, fluorene.

Full particulars regarding the exhibits from the Chemical Research Laboratory are given in a very serviceable handbook to the Exhibition, published by the Chemical Engineering group of the Society of Chemical Industry.

About forty members and guests of the Society of Chemical Industry visited both the Chemical Research Laboratory and also the Departments of Metallurgy and Metrology in the National Physical Laboratory, this being the first occasion on which the former institution has been inspected by a large party of visitors.

G. T. MORGAN.

Chemical Research Laboratory,
Teddington, Middlesex.

### Control of Prickly Pear by the Cochineal Insect.

As a result of a long series of tests carried out in Australia under the Commonwealth Prickly Pear Board, it was ascertained that the cochineal insect, *Dactylopius tomentosus*, could only live on certain species of *Opuntia*, among which was *O. dillenii*. As this species was reported to be a pest in India and Ceylon, I was authorised to offer strains of this cochineal bred in the laboratory free from parasites to the Government entomologists of those countries. The offer was accepted by Ceylon, and the insects were successfully established there in 1924 or 1925. In India, the offer was considered at a conference of the entomologists of the various provinces, and it was decided not to accept it, on the ground that prickly pear was largely used for hedges, and that, where it threatened to become a pest, it could easily be eradicated, as abundant cheap labour was available.

It appears from his letter in NATURE of July 18, p. 117, that Mr. C. T. Jacob has introduced the insect from Ceylon to South India "to destroy clumps of *O. dillenii* in which dangerous snakes were harbouring around business premises".

The last sentence of the leading article in the same issue of NATURE, p. 86, "that more may be involved in the thoughtless importation of strange animals than the importer can possibly conceive", seems appropriate to this instance.

W. B. ALEXANDER
(Officer in charge of Prickly Pear Investigations in Australia, 1923–25).

University Museum, Oxford,
July 21.

## Research Items.

**Age of the Giant Tortoises of Galapagos.**—In 1928 a number of giant tortoises, all belonging to the species *Testudo vicina*, were brought from the Galapagos Islands by the New York Zoological Society and deposited at different stations where their development might be watched. At the stations the rate of growth differed, the three individuals in Arizona showing only a 66 per cent increase, while in Florida and Texas more than 200 per cent increases were attained (C. H. Townsend, *Zoologica*, vol. 9, p. 459; June 1931). The author states that the differences are traceable chiefly to climate and treatment, but it is obvious that size is also an important factor, smaller specimens on the whole showing the larger growth percentage. The age of the giant tortoises while comparatively young seems to be traceable in the striations of the horny plates of the carapace. Where age is definitely known up to twelve or even twenty years, the striations agree in number with the years, but in larger and older individuals the ridges tend to flatten out and become illegible. The author states that the common notion that large Galapagos tortoises must be of extremely old age is unwarranted, though he adds that the real length of life is unknown. Under favourable conditions they reach a large size in a few years, when the rate of growth becomes slow. Nevertheless, there are records of giant tortoises from both Galapagos and Aldabra which lived under observation in tropical climates for more than 150 years, dying upon their removal to cold climates.

**Hairs and Wools.**—Begun as a study in the significance of human and other hair in the detection of crime, Dr. John Glaister's researches have led him to make a comparative investigation of the hairs of a vast number of mammals. The results appear as an imposing quarto volume of 187 pp. and 145 plates, "A Study of Hairs and Wools", published by the Faculty of Medicine of the Egyptian University, where the author is professor of forensic medicine. The author concludes that a critical examination of hair will always reveal the mammalian order or suborder to which it belongs, in a very large number of instances will betray the family, and in many cases the species. If it be a human hair, in an appreciable number of cases it is distinctive of sex, in most cases it can be allocated to its site on the body, and in "a very approximate manner" may decide the age of the possessor, as very young, adolescent, adult, or aged, provided a number of hairs are available. Such identifications can only be made by an expert, however, and that after a laborious comparison with a large series of authentically identified human and animal hairs. It is a pity that in the reproduction by half-tone process the finer markings of the hair surfaces are often lost, for obviously the blocks have been made from a very fine series of photographs; but we are thankful to have this handsome and costly work, the publication of which was made possible by the generosity of the Egyptian Government.

**Echinostomes from Rats.**—Rats trapped in the city of Manila for routine bubonic plague inspection, are also examined for intestinal and other parasites. A. Tubangui (*Philippine Jour. Sci.*, 44, March 1931) reports that, of 109 rats, one brown rat harboured in its small intestine twenty-one specimens of an echinostome fluke that is believed to be identical with the human intestinal fluke *Euparyphium ilocanum*, and another brown rat yielded more than a hundred specimens of an apparently new species of the same genus. *E. ilocanum* was first recovered by Garrison (1908) from the stools of Filipino (Ilocano) prisoners in Manila, and was afterwards recorded from natives of the neighbouring province of Zambales. Its presence in a Manila rat may mean that this human parasite has a wider field of distribution than has formerly been supposed, and that rats are a factor in its dissemination. Descriptions and figures of the two flukes are given. The number of species of flukes now recorded from the brown rat is fourteen.

**Polymorphic Characters in Rotifers influenced by Feeding.**—Polymorphic characters expressed in the number of lateral spines occur in the rotifer *Brachionus pala*, which has four anterior and two posterior spines, while the variety *amphiceros* has two lateral spines in addition, which vary in size in different individuals. The effects of temperature and feeding upon the two forms has been tested by Kenzo Kikuchi (*Jour. Fac. Sci., Imp. Univ. Tokyo*, Sect. 4, vol. 2, p. 163; 1931). It was found that change of temperature had scarcely any effect upon the spines of *Brachionus pala*, but when it was fed with the green alga *Scenedesmus*, lateral spines characteristic of the variety *amphiceros* were produced. The progeny of the variety fed on *Polytoma*, however, had no lateral spines. So also when examples of *B. amphiceros* were fed upon *Polytoma* they lost their lateral spines, but when the progeny of this deficient form were fed with *Scenedesmus* they grew spines and became *amphiceros*.

**Tetraploid and Triploid Petunias.**—A tetraploid *Petunia* with twenty-eight chromosomes has been described by Dr. Kostoff. It was larger and more succulent, with larger flowers and broader leaves; it also developed faster than the diploid, but was self-sterile. The offspring from pollinating this plant with the diploid is now described by D. Kostoff and James Kendall (*Jour. of Genetics*, vol. 24, No. 2). Sixteen tetraploid plants (with twenty-eight chromosomes) were produced, as well as two hypotetraploids with twenty-seven chromosomes, one triploid (twenty-one chromosomes) and one hypotriploid with twenty chromosomes. The meiotic chromosomes of the tetraploid hybrids were usually found associated in rings or chains of four during diakinesis. Their reduction processes were almost regular and there were only 2 per cent of abortive pollen grains, the plants setting good seed when selfed. In the original tetraploid mother-plant, however, there were many meiotic irregularities and only half the pollen was good. The tetraploid hybrids are believed to have arisen either from both male nuclei uniting with the diploid egg, or from the union of the latter with a diploid male nucleus from a pollen dyad. The triploids and hypotriploids showed many meiotic irregularities and were self-sterile, but could be pollinated successfully by the tetraploids.

**Building of the Northern Appalachians.**—From Alabama to New York the Palæozoic formations of the Appalachian geosyncline were folded into mountains shortly after the beginning of the Permian, and it has been commonly assumed that this orogeny continued from New Jersey to Newfoundland, notwithstanding the clear demonstration by the pioneer geologists of Canada that the northern section of the Appalachians was folded in the main during the Devonian, with minor deformations in the late Ordovician and late Carboniferous. Prof. C. Schuchert has discussed the facts afresh in the *Bull. Geol. Soc.*

*Amer.*, **41**, pp. 701-724, 1930. He finds evidence for a four-fold deformation, progressing from the interior oceanward: (*a*) an arch-making movement at the close of the Cambrian which separated the St. Lawrence geosyncline into two seaways; (*b*) the Taconic isoclinal folding and overthrusting, with nappes, towards the end of the Ordovician; (*c*) the Acadian disturbance of Devonian time accompanied by the initiation of the Gulf of St. Lawrence; and (*d*) the Appalachian revolution of the Permian, which elevated the Maritime Provinces and refolded the Acadian geosyncline. Schuchert considers the crossing of earlier by later folds to begin in Nova Scotia, whereas Bailey placed the beginning of the crossing in south-east Maine.

**Deep-Focus Earthquakes.**—The occurrence of earthquakes of abnormal focal depth is a question on which opinion is not in complete agreement. The late Prof. H. H. Turner had put forward this hypothesis, but there is evidence both for and against it. The problem has been reinvestigated by F. J. Scrase, in a paper in the July number of the *Proceedings of the Royal Society*, from the point of view of reflection of the waves. In general, a number of supplementary reflected waves should occur, and if the focus is sufficiently deep, they should produce definite separate phases on the records; from an examination of a considerable body of data, it is found that these can be recognised and that the times of transit are in reasonable agreement with the calculated times. A corresponding feebleness of the surface waves which has been observed in many earthquakes also lends support to the deep-focus hypothesis. The results of the investigation favour the idea that the initial phase of an earthquake is a direct compressional wave and is not generated by reflection of a distortional wave (see also NATURE, **127**, p. 486, Mar. 28, 1931).

**Collision between Organic Molecules and Surfaces.**—It is now possible with modern vacuum technique to allow beams of molecules to impinge on a surface, and to collect the molecules leaving the surface, under conditions such that no interaction occurs between individual molecules in either the incident or the reflected beam. The July number of the *Proceedings of the Royal Society* contains an account of an investigation of this type by F. O. Rice and H. T. Byck, in which the molecular beams contained acetone or dimethyl mercury. These were allowed to impinge upon targets of platinum, tantalum, and tungsten, which could be heated, and an analysis was made of the products leaving the surfaces. The results of most significance were obtained with platinum. No decomposition whatever of the compounds could be detected as a result of their collisions with the metal, although the temperature of the metals was well above that required for decomposition under ordinary conditions, and it is concluded that the molecules must have left the surface very soon after reaching it: that is, that both adsorption and trapping in irregularities on the surface was of no importance. With tungsten and tantalum, some decomposition into hydrogen and carbon monoxide, and possibly other products, was detected, above 1085° for the former metal and 1400° for the latter, but in these cases surface reactions occurred with the formation of carbides.

**Nuclear Moments.**—A review of the work which has been done upon the rotation of the nuclei of atoms has been published by R. de L. Kronig and S. Frisch in the issue of the *Physikalische Zeitschrift* for June 15. In line spectra this manifests itself by the appearance of a hyperfine structure, which requires special sources and instruments of high resolving power for its study. It can be described formally by the introduction of a new quantum number, and has its origin physically in the various modes of quantised magnetic coupling which can occur between the nucleus and the valence electrons. The nuclei of isotopes may differ in their spin properties, and so introduce a fresh complication into the hyperfine structure. With molecular spectra the nuclear spin may control the intensities of alternate lines in certain bands, in some cases alternate lines being absent. The magnitude of the nuclear spin can be deduced from the intensity data. Although hyperfine structure was discovered by Michelson, it is only in recent years that any systematic study of it has been made, and Prof. Kronig's list of elements for which the nuclear spins have been investigated includes only thirty-one.

**Wave-Mechanical Models of Atoms.**—Some pictorial representations of hydrogen-like atoms which are published by H. E. White in the first June number of the *Physical Review* are of interest as giving probably as definite an idea as is possible of atomic structure on modern theory. They were obtained by utilising the fact that the Schrödinger equation for a hydrogen atom can be separated into three equations, the solution of one of which leads to an expression for the probability that the electron will be at various distances from the nucleus, and of another to the probability for various inclinations of the line joining the electron and nucleus to an external magnetic axis. A spindle was turned to the shape of the radial 'probability-density', and was photographed whilst rotating about the 'magnetic' axis, the angle between the axis of the spindle and the magnetic axis being changed at a variable rate to represent the corresponding part of the solution of the wave-equation. The resulting photographs are a set of symmetrical patterns, one for each atomic state, and are shown in the paper in white on a black ground. To obtain the closed *s*-states a slightly different procedure was followed. The pictures show clearly the approximate agreement between the wave-mechanical representation and the region swept out by a precessing orbit on the Bohr theory, and equally well, the existence of lobes in some of the wave-mechanical models which are not called for at all in the early quantum theory.

**The Arc Spectrum of Zirconium.**—An analysis of the arc spectrum of zirconium, the outcome of some ten years of work upon this element, is described by Dr. and Mrs. Kiess in the United States Bureau of Standards *Journal of Research* for April. The lines and terms of this spectrum are numerous, but more than twelve hundred of the sixteen hundred lines which have been measured have been classified and the terms of the spectrum assigned to definite configurations of the atom by the aid of Hund's theory. The spectrum has many features of interest. Several pairs of related states of the atom have almost the same energy, with the result that pronounced perturbations of the individual pairs occur, and cause both abnormalities in the intensities of lines which arise from transitions from these terms and Zeeman patterns for them which depart from their simple theoretical values. Lines of this spectrum also appear in the Fraunhofer solar spectrum, but, as has been found with the spectrum of singly ionised zirconium, certain of these have to be ascribed to transitions in the atom which are theoretically possible, and of which the magnitude can be predicted from other lines, but they are of small intensity or even absent with laboratory sources. The resonance lines and *raies ultimes* have been identified, and the ionisation potential of the neutral atom shown to be 6·92 volts.

**Anti-Neuritic Vitamin.**—Previous methods for the isolation of anti-neuritic vitamin have yielded only very small quantities of material which is probably still far from chemically pure. In the June number of the *Journal of the American Chemical Society*, Seidell and Birckner, of the National Institute of Health, Washington, describe experiments on the isolation of the vitamin from yeast, the process involving four stages. An 'activated solid' is first prepared by adsorption on fuller's earth of the filtered yeast extract made at 80°. Extraction of the solid is now made by agitating it violently for five minutes in 0·4–0·5 *n*NaOH and centrifuging. The clear liquid is rapidly acidified to *p*H 3·0 with sulphuric acid. On evaporation under reduced pressure to one-tenth, a brown solid separates, which has been shown to be very rich in the thermostable growth factor ($B_2$ or G) required as a supplement to anti-neuritic vitamin for normal growth. The clear liquid is cooled for deposition of sodium sulphate, and inorganic salts, impurities, etc., are precipitated with alcohol to approximately 50 per cent alcohol in the solution. This alcoholic solution contains the anti-neuritic ($B_1$) vitamin, but only about 15 to 20 per cent of that originally present in the yeast. The solution is distilled down to small volume, centrifuged, and benzoylated with sodium carbonate and benzoyl chloride, extracted with chloroform, and the aqueous layer poured slowly into 10–15 vols. of acetone. The precipitate is extracted with a mixture of propyl alcohol and concentrated hydrochloric acid, distilled down and poured into acetone. The precipitated solid is dissolved in methyl alcohol and added dropwise to a large volume of acetone. The white voluminous flaky precipitate is washed with acetone and dried in a vacuum. It is curative in 0·03 mgm. doses by the Smith rat method, or about one-fourth greater than the crystals obtained by Jansen and Donath in 1927.

**Aceto-acetic Ester Condensation.**—Since the discovery by Geuther in 1863 that aceto-acetic ester, $CH_3COCH_2COOC_2H_5$, is formed by the action of sodium on ethyl acetate there has been much discussion as to whether the metal itself is responsible for the condensation (Michael's theory), or whether the active agent is sodium ethoxide formed from traces of alcohol in the ester or from other side reactions (Claisen's theory). It was found by Michael that ethyl acetate from which all traces of alcohol have been removed reacts with sodium as readily as the ordinary ester, but it is possible, of course, that some alcohol might be produced by a side reaction. It has also been shown by Snell and McElvain that acetic and propionic esters are unique in not giving the corresponding acyloins when treated with sodium in presence of excess of ester, and a study of the reaction mechanism should therefore be confined to them. In the June number of the *Journal of the American Chemical Society*, these authors state that they have made a careful study of the reaction between sodium and ethyl acetate in which the amounts of aceto-acetic ester, alcohol and hydrogen produced have been determined. Similar determinations were made with sodium ethoxide as condensing agent, and the results obtained appear to constitute strong evidence in favour of Claisen's theory. The amount of alcohol found in the mixture when sodium is used is approximately the sum of that produced by the aceto-acetic ester condensation and that resulting from the reduction of the ester by the sodium used in the reaction. The action of the sodium thus appears to be the generation, by reduction of the ester, of sodium ethoxide, which is the real condensing agent. In contradiction to earlier investigators, but in agreement with the recent experiments of Kutz and Adkins, it was found that sodium ethoxide produces practically the same amount of condensation, and just as readily as metallic sodium does.

## Astronomical Topics.

**Nagata's Comet, 1931 *b*.**—This proves to be the brightest comet observed for several years. The following orbit and ephemeris have been circulated from the U.A.I. Bureau at Copenhagen. They are by Mr. Berman:

| | | |
|---|---|---|
| $T$ | 1931 June 15·140 U.T. | |
| $\omega$ | 324° 58′ | 1931·0 |
| $\Omega$ | 191 8 | |
| $i$ | 41 24 | |
| log $q$ | 0·03342 | |

EPHEMERIS FOR 0$^h$ U.T.

| | R.A. | N. Decl. |
|---|---|---|
| Aug. 7 | 12$^h$ 0$^m$ 24$^s$ | 10° 16′ |
| 11 | 12 14 56 | 10 9 |
| 15 | 12 28 56 | 9 58 |

The light on July 26 and Aug. 7 is 0·9 and 0·6 of that at discovery. The comet should be looked for in the evening twilight.

The two following positions of Nagata's comet are from photographs by Nicholson and Moore at Mt. Wilson:

| U.T. | R.A. 1931·0. | N. Decl. |
|---|---|---|
| July 18·1792 | 10$^h$ 40$^m$ 44·7$^s$ | 9° 51′ 3″ |
| 19·1861 | 10 45 6·0 | 9 54 47 |

The comet had a tail 4° long (*Harvard Card*, No. 161).

**Changes of the Corona in the Sunspot Cycle.**—It has for a long time been recognised that the type of the corona varies with the sunspot cycle, having polar streamers at spot-maximum and equatorial extensions with delicate 'polar plumes' at minimum. Dr. W. J. S. Lockyer reopens the subject and extends his study up to 1930, in *Mon. Not. Roy. Ast. Soc.* for May. He introduces statistics of prominences, and his discussion indicates that the correlation between prominences and the corona is much closer than between spots and the corona; and further, that the latitudes of prominences and of the coronal streamers are very closely associated. Prominences attain much higher latitudes than spots, and even reach the poles of the sun at the times of spot-maximum. Dr. Lockyer notes that the corona of the 1926 eclipse was of maximum type, although it was nearly two years before spot-maximum; but the prominences had already reached high solar latitudes. He refers to the corona of 1908, which, when the photographs were first published, appeared to have little connexion with the prominences; but it was afterwards found that the orientation marked on the photographs was wrong.

The research also indicates that the latitudes of prominences and coronal streamers are somewhat higher during increasing than during decreasing sunspot activity; in other words, maximum prominence latitude precedes maximum sunspot activity. Reference is also made to the 'coronal arches' that appear above prominences in many eclipse photographs. They afford further evidence of the close connexion between prominences and corona.

Dr. Lockyer anticipates that the 1932 corona will be nearly of minimum type; the sunspot minimum is expected to be about 1934.

## Centenary Meeting of the British Association.

### PROGRAMMES OF SECTIONS.

#### SECTION A (MATHEMATICAL AND PHYSICAL SCIENCES).

A CENTENARY meeting in London necessarily envisages a programme which differs in many details from the programme of a provincial meeting. The occasion is one for a certain amount of stock-taking, and nothing could more clearly demonstrate the remarkable progress of the physical sciences during the period that has elapsed since the jubilee meeting than a comparison of the topics that interest the Section to-day with those of half a century ago. The Section anticipates a specially large gathering of guests from foreign lands and from the overseas dominions, and the programme naturally reflects in some measure the interests of a number of these distinguished visitors.

The president of the Section, Sir J. J. Thomson, proposes to discuss the increase in the facilities for education and for research in physics that the last fifty years have seen.

A large number of discussions has been arranged, and perhaps that of widest general interest is a discussion which bears the not unambitious title of "Evolution of the Universe". This discussion will be held in the Great Hall of the University of London, and will be opened by Sir James Jeans. General Smuts (president of the Association), Prof. E. A. Milne, Sir Arthur Eddington, Prof. W. de Sitter, Sir Oliver Lodge, Prof. R. A. Millikan, and the Bishop of Birmingham will contribute. Of more immediate technical interest are the discussions on geophysical prospecting, with special reference to instruments, to be opened by Prof. A. S. Eve, and on the unit of atomic weight, when Dr. F. W. Aston, in opening the discussion, will review critically some of the more suitable suggestions for such a unit, for example, those of the proton, the neutral hydrogen atom, one quarter of the $\alpha$-particle, one quarter of the neutral helium atom, one sixteenth of the neutral oxygen atom. He will advance arguments in favour of (*a*) retaining the present chemical scale, (*b*) adopting one sixteenth of the neutral oxygen atom as standard.

Sir Napier Shaw will present a communication on meteorology through the century, and papers will be read before the main section by Profs. R. W. Wood, G. P. Thomson, J. C. McLennan, P. Zeeman, and others.

The mathematical subsection presents a comprehensive and technical programme. Titles such as "Asymptotic Partition Formulæ" and "Tesseral Matrices" are φωνᾶντα συνετοῖσιν, but even those whose interest in such subjects is passing small may find attractive Prof. J. B. S. Haldane's paper on some "Mathematical Problems of the Biologist".

The subsection of cosmical physics is organising a discussion on magnetic storms, which will be opened by Prof. S. Chapman. A programme of very wide interest has been prepared, which includes papers ranging over such diverse subjects as lightning, Nova Pictoris, stratified clouds, deep focus earthquakes, and radio research in the empire.

Sectional excursions have been arranged, through the kindness of the directors of these institutions, to Greenwich Observatory, to the National Physical Laboratory, to the G.E.C. Research Laboratories, to a Nelson Line steamship, and to Kew and Slough.

#### SECTION B (CHEMISTRY).

The coincidence of the Faraday Centenary celebration with that of the British Association is particularly happy so far as the Chemistry Section is concerned. Faraday's discoveries in many branches of chemistry and physics were so numerous and so fundamental that it is difficult to determine which is the most important from all points of view, and his eminence as the pioneer in physical chemistry will probably be emphasised in Sir Harold Hartley's presidential address, "Michael Faraday and the Theory of Electrolytic Conduction". The remainder of the programme will take the form of four discussions, and the first of these will immediately follow the presidential address. Profs. P. Debye (Leipzig), N. J. Bjerrum and J. N. Brønsted (Copenhagen), K. Fajans (Munich), J. C. Philip, S. R. Milner, and Sir Harold Hartley have promised to speak on "The Influence of the Medium on the Properties of Electrolytes".

The morning and afternoon of Friday, Sept. 25, will be devoted to the chemistry of the vitamins and related substances, which was also discussed at a recent meeting of the Royal Society. Those taking part in the discussion on the chemistry of vitamin A and the carotinoids include Profs. P. Karrer (Zurich), H. von Euler (Stockholm), R. Kuhn (Heidelberg), J. C. Drummond and I. M. Heilbron, and Drs. R. A. Morton and T. Moore. In connexion with the chemistry of vitamin B and related problems, the speakers are Profs. B. C. P. Jansen (Amsterdam) and R. A. Peters, while the chemistry of vitamin D and related sterols will be discussed by Profs. A. Windaus (Göttingen) and I. M. Heilbron, and Drs. R. Bourdillon and O. Rosenheim. Sir F. Gowland Hopkins will introduce the discussion, which will be summed up by Prof. R. Robinson.

On Sept. 28, the Section will hold a symposium on the British fuel problem, and on the following day the final discussion will be on the structure of simple molecules. This will be introduced by Prof. P. Debye, who will also quote the evidence from X-ray measurements. The other speakers will be—Prof. J. E. Lennard-Jones on evidence from molecular spectra, Mr. R. H. Fowler on the quantum mechanical theory of valency, Prof. V. Henri (Marseilles) on predissociation and the structure of some special molecules, Prof. F. G. Donnan and Mr. C. N. Hinshelwood.

Special exhibits will be on view during the meeting; those already arranged are by Dr. R. C. Menzies (illustrating the chemistry of thallium), Prof. C. S. Gibson (illustrating some recent investigations of the chemistry of gold), and Prof. H. V. A. Briscoe (illustrating the chemistry of rhenium).

#### SECTION C (GEOLOGY).

The proceedings of Section C (Geology) will open with the address of the president, Prof. J. W. Gregory, in which he will review to some extent the last hundred years of geology. This will be followed by an account of the geology of the London district by Mr. H. Dewey, of the Geological Survey, and Dr. S. W. Wooldridge, and two papers concerned with that area.

The principal business of the Section will be the discussion of certain phases of the science that are of interest at the present time. The first, on "The Evidence of Palæontology with Regard to Evolution", will be opened by Sir Arthur Keith; other speakers will include Dr. R. Broom, of South Africa, Dr. W. D. Lang, Profs. Hawkins, Swinnerton, Trueman, and D. M. S. Watson. The pronouncements of the opener have been so provocative of late that this discussion may be of the greatest interest.

Prof. O. T. Jones will introduce a subject of more importance perhaps to the practising geologist, "On

Earth Movements in Relation to Stratigraphy". In this discussion Prof. E. B. Bailey and Mr. J. Weir will consider "Submarine Faults as Boundaries of Facies". Prof. H. A. Brouwer, of Holland, and Dr. E. O. Ulrich, of the United States, will carry the discussion far beyond the limits of the British Isles.

The other subjects are of greater economic interest and will show how the purely scientific and the practical are connected. As the Section meets in the Royal School of Mines, it is very appropriate that Prof. G. C. Cullis should introduce there the subject of "The Genesis of Ores in Relation to Petrographic Processes", and here it is probable that its economic importance will be stressed. Prof. P. Niggli, of Zurich, and other petrologists can be expected, however, to explore thoroughly its relation to petrogenesis.

The place that oil and oil products have in the world to-day should make the fourth and last discussion, on "The Genesis of Oil Pools in the Sedimentary Cycle", of the widest interest. The first speaker will be Prof. V. C. Illing, and representatives of the great producing companies have promised to contribute.

As these discussions will necessarily occupy most of the time available, other papers will be given before appropriate sub-sections. Of these, one by Dr. C. A. Matley should be of great historic interest, for in his account of the Harlech Dome the author will deal fully with Lapworth's work on that area. Dr. Matley has also arranged to have an exhibit illustrative of Lapworth's maps and papers in the Imperial College of Science.

A full programme of excursions has been arranged for the week of the meeting, and during the week preceding a party will visit East Anglia under the guidance of Profs. Boswell and Kendall.

### Section D (Zoology).

The programme this year of Section D (Zoology) is on quite novel lines, as there are no papers upon individual topics. Each of the six mornings is being devoted to special subjects, and is occupied by a discussion, a symposium, or a mixture of the two. Prof. E. B. Poulton's presidential address, "A Hundred Years of Evolution", opens the sectional meetings, and the rest of that morning will be filled by a series of short papers on particular aspects of the evolution question, followed by a short general discussion. The authors of the short papers are Prof. Julian Huxley, Prof. H. Fairfield Osborn, Dr. F. A. Dixey, and Mr. E. B. Ford.

On the following day the topic is vertebrate embryology. Prof. E. W. MacBride is opening this discussion and Dr. J. H. Woodger and Mr. C. H. Waddington are to follow him, so we may look forward with certainty to a lively general discussion of the subject. The Saturday morning is to be devoted to the population problem. The names of Profs. Carr-Saunders, Crew, J. B. S. Haldane, Hogben, Huxley, and MacBride, Dr. R. A. Fisher, and Mr. J. R. Baker, are a guarantee of a stimulating three hours' discussion.

Monday is the systematists' day, but the subject, "Classification with Reference to Phylogeny and Convergence", upon which Dr. Tate Regan (opener) and Drs. F. A. Bather, W. D. Lang, Hugh Scott, and John Stephenson have promised to speak, should provoke a ready response from other members of the Section in the open discussion towards the end of the morning. The Tuesday programme concerns variation and genetics, the particular subjects to be dealt with being induced mutations, local races, study of lineages, and the mathematical side of evolution, by Prof. J. W. Heslop Harrison, Drs. W. R. Thompson, W. H. Thorpe, and O. W. Richards, Prof. D. M. S. Watson, and Prof. J. B. S. Haldane respectively. Finally, on Wednesday the applied side of zoology is to the fore. Prof. W. Garstang and Drs. A. Bowman and E. S. Russell are discussing the various aspects of the 'over-fishing problem'; and then Drs. A. D. Imms, Ll. Lloyd, C. B. Williams, J. C. F. Fryer, and P. A. Buxton are contributing to a symposium on insects and human welfare.

In the afternoons, visits have been arranged to most, if not all, the places of special interest to zoologists within easy reach of South Kensington; and on the Sunday there is to be a whole-day excursion to Tring and Whipsnade.

### Section E (Geography).

The programme arranged for this Section includes a series of topics representative of the field of geographical studies at the present day. In addition, it is fitting that on this occasion the evolution of the subject as indicated by successive British Association meetings should be traced, and very appropriately such a review is to be given by Dr. H. R. Mill, who has had such a long connexion with the Section.

A former president, Sir Halford Mackinder, will again preside over the Section, and his address will be on "The Human Habitat". The Section will also have the advantage of its president's leadership in the Saturday excursion which has been arranged to the south-east coast, an area rich in its illustrations of so many phases of our historical geography.

A subject of special interest at the present day, that of the establishment of national parks, will be considered by Dr. Vaughan Cornish, with particular reference to "The National Park of Northumberland, a Shrine for Hadrian's Wall". The London area will be dealt with in two papers, of which the first, by Dr. Wooldridge, will analyse the physical setting, while the second, by Mrs. Ormsby, will consider various aspects of the evolution of the Metropolis, with particular reference to the growth of its population.

Papers of imperial interest will form an important element at the centenary meeting, and the Section is fortunate in having guests from both Australia and South Africa. Dr. Fenner, of Adelaide, is to deal with some problems of South Australia, while Prof. J. H. Wellington, of Johannesburg, is to review the important question of land utilisation in South Africa. A paper which is certain to arouse considerable interest has also been promised by Prof. Griffith Taylor—whose name is inevitably associated with that of Australia—under the title of "The Geographer's Aid in Nation-Planning". Some recent agricultural developments in the Empire will be considered by Sir John Russell, while Lord Lugard will deal with the profoundly significant problems of tropical Africa in an address which he is to give on Africa in transition.

Among the foreign guests of Section E will be Prof. W. Werenskiold, of Oslo, who is to give a résumé of his researches into the variations of glaciers and of climate in Norway.

Finally, a day is to be devoted to a symposium on geographical problems of the earth's crust. The opening paper in this series will be by Mr. A. R. Hinks, and others who have promised to contribute include Prof. J. W. Gregory, Prof. A. Holmes, and Dr. G. C. Simpson.

### Section F (Economic Science and Statistics).

A varied programme, in which the main feature is a number of papers dealing with important economic problems of current interest, has been arranged for Section F (Economic Science and

Statistics). The president of the Section is Prof. Edwin Cannan, and he has selected for his presidential address the subject of "Internationalism in Economic Theory". Mr. J. H. Morris will discuss the important but difficult problem of "The Rationalisation of the Cotton Industry". During the past few years, the difficulties of primary producers in all parts of the world have been very prominent, and in this connexion the papers of Mr. J. W. F. Rowe on "The Artificial Control of Raw Material Supplies" and of Mr. R. R. Enfield on "The World's Wheat Situation" are of special interest. Another interesting session should be that in which Mr. Maurice Dobb is to read a paper on "Some Economic Problems connected with the Five-Year Plan in Russia". Prof. J. H. Jones is to give a lecture on "Wages, Prices, and Employment", and this should lead to an important discussion of the much-debated question of the interrelation of these factors and of the causes of the present grave unemployment problem.

A new feature of the Section's activities is the formation of a group dealing with industrial co-operation. In connexion with other sections, a wide range of papers and discussions has been arranged to deal with these industrial problems, including means of co-operation between industry and educational institutions in promoting the training of managers; the physiology and psychology of work; the utility of trade barometers, and patents and the protection of scientific discovery.

### Section H (Anthropology).

Section H (Anthropology) will profit very much from the centenary meeting, since it is attracting many field workers from overseas. Following upon the presidential address by Prof. A. Radcliffe-Brown, of Sydney, a session will be devoted to papers from field workers in Oceania. Field workers from South Africa, including Dr. R. Broom, will also speak.

Special interest is attached to a morning given up to reports of work in the Mediterranean region carried out by Misses Caton-Thompson and Gardner, Miss D. A. E. Garrod, and Mr. W. A. Heurtley. Problems of British archæology, including accounts of work at Avebury, of Upper Palæolithic finds in north Lincolnshire, and of Early Iron Age finds in Monmouthshire, will also be discussed. Among papers by distinguished foreign guests are the Huxley Memorial Lecture by Dr. Thilenius, suggestions for studies of ethnic pathology by Dr. Suk, of Brno, an account of Neanderthal man in Italy by Dr. Sergio Sergi, and a discussion of the possibilities of determining the geological age of fossil man by comparison with the teeth of contemporaneous Proboscidea, by Prof. Henry Fairfield Osborn. A lecture to which the public are invited will be given at 5.30 P.M. on Monday evening, Sept. 28, by Prof. Elliot Smith, on the now famous Peking man.

An almost untouched subject, the psychological origins of law, will be opened up by His Honour Judge Dowdall, and will, it is hoped, lead to further research into this important aspect of man's social activity. Social phenomena among various primitive peoples will be discussed by field workers, including agriculture and land ownership among the Hopi, the economic factor in primitive life, birth dances, the magical significance of tattoo designs, and a general paper on the social organisation of the Nilotes by Prof. C. G. and Mrs. Seligman. Prof. Seligman will also deal with heredity in modern human hybrids. The complex problem of the relation between Canaanites and Hyksos will be raised by the veteran field worker and archæologist, Sir Flinders Petrie, while Nineveh and its origins will be discussed by Dr. Campbell Thompson, who has carried out three seasons' work there.

An interesting feature will be exhibitions arranged by courtesy of the Director at the Wellcome Museum, including a collection of crania from South Africa brought over by Dr. Broom, and photographs of native South African life taken by Mr. Duggan-Cronin. The afternoons will be devoted to visiting the museums and private collections in which London is so rich, and the Section is deeply grateful for the special facilities which curators and keepers are arranging for its members.

### Section I (Physiology).

The first morning's proceedings in Section I (Physiology) are to be devoted to a discussion on the "Physiological Basis of Sensation", which will be opened by Prof. E. D. Adrian, Foulerton professor of the Royal Society. He will be followed by (among others) Dr. C. S. Myers, Sir J. Herbert Parsons, and Prof. Frank Allen, of Winnipeg.

On Friday morning (Sept. 25), Prof. E. P. Cathcart, of Glasgow, is to speak on the relation of rations for children to those of the 'standard' adult man, Prof. A. V. Hill is describing the lost place of lactic acid in the study of muscular contraction, and Prof. Charles Heymans is speaking on the control of the circulation, to which his researches have contributed so much. At the end of the morning, Prof. J. Barcroft will discuss the physiological problems entailed by such an expedition as that of climbing various Himalayan summits. It will be interesting to hear the opinions of Mr. E. N. Odell, who was on the 1924 Everest expedition, and of Dr. Raymond Greene, of the 1931 Kamet climb, on Prof. Barcroft's opinion that climbing is dependent almost entirely on an appropriately designed apparatus for the supply of oxygen.

Dr. H. H. Dale is using his presidential address to open a discussion on the "Biological Nature of Filtrable Viruses", while the rest of Monday morning (Sept. 28) is to be devoted to a discussion on the same subject. Among those speaking are Dr. T. M. Rivers, of the Rockefeller Institute, New York, Dr. Alexander, of Onderstepoort, and Mr. J. E. Barnard.

The morning of Sept. 29, which is the last business meeting of the Section, is devoted to a discussion on "Methods and Problems of Resuscitation". The opening address will be given by Sir Edward Sharpey Schafer, and among those who will follow are Prof. Yandell Henderson, of Yale, Dr. J. S. Haldane, Dr. C. K. Drinker, of Harvard, Sir Bernard Spilsbury, and Sir Francis Shipway. This is probably one of the problems in which applied physiological methods have been of most interest and value in practical work.

The afternoon and evening arrangements of the Section include visits to the Royal College of Physicians and to the Wellcome Historical Museum.

### Section J (Psychology).

Section J (Psychology) is fortunate in having as its president this year Dr. C. S. Myers, for he was largely responsible for its formation as a subsection of I (Physiology) in 1913 and as a separate section in 1921, and is one of the pioneers in the development of experimental psychology and its application to the problems of industry. The subject of his address will be "The Nature of Mind".

The programme for the Section is a strong and varied one; most of the past presidents of the Section—Profs. Bartlett, Brown, Drever, Pear, and Valentine—will figure in it. Among the distinguished foreign guests who will contribute papers are Prof. Köhler of Berlin, Prof. Piéron of Paris, and Dr. Frank Allen of Toronto. Prof. Köhler will speak on "Recognition and Reproduction", Prof. Piéron on "The

Theoretical and Practical Aspects of Intelligence", and Dr. Allen on "The Function of Induction in Colour Vision".

An intra-sectional discussion has been arranged on "Mental Defect", at which papers will be read by Dr. E. O. Lewis on "The Social Aspects of Mental Deficiency", by Prof. F. A. E. Crew on "The Genetic Background of Mental Defect", by Dr. R. G. Gordon and Dr. Norman on "Some Psychological Experiments of Different Types of Mental Defectives", and by Dr. F. C. Shrubsall on "The Classification of the Mentally Defective and the Relative Frequency of Different Types".

The organising committee of the Section decided to restrict the meetings to the morning sessions, hence, as the programme is very full, two sets of papers will run concurrently on two mornings. Visits have been arranged to the psychological laboratories of King's, University, and Bedford Colleges, to the Tudor Lodge Child Guidance Clinic, Islington, the Jewish Child Guidance Clinic, the Bethlem Royal Hospital, and the National Institute of Industrial Psychology.

### Section L (Educational Science).

Sir Charles Grant Robertson has chosen for his presidential address to Section L (Educational Science) a subject in full accord with the special nature of the centenary meetings of the British Association, namely, "Educational Development: 1831 and 1931: A Centenary Retrospect and a Forecast". The address is to be delivered in the Great Hall of the University on the morning of Sept. 24. Dr. E. Deller will follow with a paper on "London as a Pioneer in University Education", and in the discussion afterwards, Sir Frank Heath, Sir Robert Blair, Sir Philip Hartog, Sir William Beveridge, Sir John Gilbert, and the Rev. Scott Lidgett will take part.

On the second morning two subjects, Imperial in nature, will be considered: "The Establishment of a Central Institute for Imperial Education" and "The Education of Backward Peoples". Lord Eustace Percy, Prof. F. Clarke, and Mr. F. H. C. Butler will give papers on the former, and Sir Michael Sadler, Dr. Maxwell Garnet, Sir Percy Nunn, and Major A. G. Church will speak in the discussion. Papers on the latter subject will be read by Mr. S. Rivers Smith, Major H. A. Harman, and Dr. A. R. Paterson, and in the discussion the Hon. Hugh A. Wyndham, Lord Raglan, Mr. A. Victor Murray, Mr. C. W. Hobley, and Miss M. F. Perham will speak.

The next session is to be devoted largely to problems connected with school clinics and child guidance. Three papers are to be given: Dr. G. A. Auden will deal with "The Maladjusted Child", Dr. W. Moodie will follow with "Environmental Factors in Maladjustment", and Dr. A. Macrae will give the third paper on "Psychological Examination as an Aid to Vocational Adjustment". Dr. C. W. Kimmins, Dr. Emanuel Miller, Dr. J. R. Rees, Dr. C. L. C. Burns, Dr. R. G. Gordon, and Mr. D. T. John will also state their views. The session will close with a paper and discussion on "Eugenics in Education". Prof. R. Ruggles Gates is reading the paper, and Prof. Julian S. Huxley, Prof. E. W. MacBride, and Sir Arthur Thomson will take part in the discussion.

At the final session "School Broadcasting" will be dealt with by Mr. Frank Roscoe and Lord Eustace Percy. There will be an appropriate demonstration, and Sir Walford Davies will open the discussion and Miss Mary Somerville will answer questions. A paper on "Adult Education Broadcasting", by Prof. Winifred Cullis, will follow, and Mr. C. A. Siepman will take part in the discussion and questioning.

The reports of three special committees will be presented during the meeting. Sir Percy Nunn and Mr. G. W. Olive will report on "General Science in Schools with special reference to Biology"; Sir John Russell and Mr. C. E. Browne will present a report on "Education for Life Overseas"; and Sir Richard Gregory and Mr. J. L. Holland will deal with the report of the Committee on Educational and Documentary Films.

### Section M (Agriculture).

Sir John Russell's presidential address to Section M (Agriculture) on "The Changing Outlook in Agriculture" gives the keynote for the whole sectional programme. Each session treats a single aspect of agriculture and selects representative products or problems to illustrate how the application of science has influenced the development of practice, how current problems are being attacked, and in what directions developments may be expected.

The first two sessions are devoted to crop production, the next three to animal production, animal health, and the utilisation of animal products, and the final session to the economic aspects of agriculture in Great Britain and the Empire.

The application of genetics to the improvements of varieties of cereals and to fodder plants will be considered by Dr. E. S. Beaven and Prof. R. G. Stapledon, who, whilst emphasising the importance of breeding from the material indigenous to any area, will direct attention to the danger that the present movement to pedigree strains may defeat its purpose by the development of an international trade in pedigree seed without reference to its merits for the particular purpose required. On the animal side, Prof. F. A. E. Crew will raise the question whether attempts at animal improvement in newer areas by the importation of specimens of improved European breeds possess any advantage over the less favoured one of selection towards a desired type amongst the animals already existing in any particular locality.

Dr. S. G. Barker will examine the scientific and economic aspects of methods of sheep breeding to produce wool suitable for specific manufacturing processes. On the veterinary side, Sir Arnold Theiler will carry his well-known work in South Africa a step further by his demonstrations that 'stiffsickness' may be identified with true rickets or osteomalacia, and that it is caused by a deficiency not of calcium but of phosphorus.

Dr. D. J. Hissink will give an account of the reclamation of the Zuider Zee, whereby the cultivated area of Holland will be increased by one-tenth; he will discuss especially the way in which the original infertile magnesium and sodium clay is converted into a fertile calcium clay by the removal of sodium salts by drainage. Industrial crops are represented by surveys of the present position of the production and research on rubber and cotton, and for the utilisation of animal products, milk and the cold storage of meat will be treated.

Probably the widest interest will be aroused by the discussion on the economic aspects of agriculture, which will begin with reviews of the present position and outlook for cereals by Sir A. Humphries, and for meat by Sir William Haldane. Possible changes in the organisation of farming will then be considered by Sir Daniel Hall, who will discuss the units for farming, and Mr. C. S. Orwin, who will put forward the claims for a higher degree of specialisation.

Excursions have been arranged to the Rothamsted Experimental Station, the laboratories and farm of Imperial Chemical Industries at Jealott's Hill, and the Dairy Research Institute at Reading.

## Birthdays and Research Centres.

Aug. 13, 1872.—Prof. RICHARD WILLSTÄTTER, For.Mem.R.S., professor of chemistry in the University of Munich.

In recent years I have been occupied chiefly with such different things as silicic acid, that is true monosilicic acid, and with the enzymes of leucocytes. With regard to these, I began with studying the protein-splitting enzymes, trypsin and kathepsin, their occurrence and behaviour in the colourless blood-cells of herbivores and carnivores. At the present time I am engaged in analysing the glycogen-splitting enzyme of leucocytes. Concerning the peculiarities of amylase, it is surprising how much information can be obtained from observations with blood-cells. In the muscle, where the metabolism of carbohydrates is being studied so thoroughly, things must be so much more intricate.

In connexion with my problem I should like to raise a question. Is it to be taken for granted that glands are producing enzymes, or are they disintegrating the blood-cells and selecting and storing the enzymes ?

Aug. 14, 1861.—Sir RICHARD THRELFALL, G.B.E., F.R.S., chairman of the Fuel Research Board.

I regret that for the past year my health has not permitted me to live continuously in England, and consequently the amount of work I have been able to do has been but small. My main occupation has been the investigation of the decolorising power of charcoal which has been activated by partial combustion in sulphur vapour, and I am looking forward to continuing this work as soon as my health permits me to do so.

I have also had on hand for several years the study of a gravity balance (Threlfall and Pollock, *Phil. Trans.*, 1899), with the assistance of Mr. Dawson. This instrument gave very promising results in Australia so far back as 1898, but there are indications that, after more than thirty years, some slipping is beginning to take place at the joints where quartz is soldered to metal. There is, however, another possibility which I am now investigating, but in the meantime the behaviour of the instrument has become unsatisfactory.

I am also engaged in attempting to bring out a new edition of a small book on " Laboratory Arts " which I published during the 'nineties, and which now, of course, requires very copious revision. The proposed changes are mostly in MS., but I am unfortunately short of the kind of assistance required to enable me to get it through the press.

Aug. 15, 1871.—Prof. G. ELLIOT SMITH, F.R.S., professor of anatomy in University College, London.

The results achieved by recent research in comparative neurology now for the first time open the way for a comprehensive synthesis of our knowledge of the brain, and suggest the possibility of new and fruitful methods of studying the factors which were responsible for the attainment of the growing powers of skill and understanding in vertebrates and the making of the mind in man. If this great scheme of research is to be realised, the most urgent need is the correlation of the information acquired by comparative anatomy and physiology, by clinical investigation and experimental psychology, as well as by palæontology and anthropology, with properly critical attention to considerations of phylogeny and chronology, so as to define the means whereby the drastic revolutions which occurred in the central nervous system—and, in fact, the whole organism—when each of the different classes of vertebrates came into being, made possible new modes of locomotion and new possibilities of behaviour, and how the refinement of sensory discrimination eventually made the acquisition of higher degrees of skill attainable.

My aim at the present time is the study of the means whereby these general biological principles found expression in the process of conferring upon man's ancestors the higher powers of understanding and skill which transformed them into men.

## Societies and Academies.

PARIS.

Academy of Sciences, June 15.—**Adolphe Lindenbaum**: Regulated ensembles.—**Francesco Severi**: Biharmonic functions and the theory of analytical functions of two complex variables.—**Gaston Julia**: Conformal representation of multiple associated areas.—**Gr. C. Moisil**: The use of generalised vector potentials in the integration of a class of partial differential equations.—**R. Gosse**: Equations $s=f(x, y, z, p, q)$ which admit of an invariant of the second order.—**G. Cerf**: The characters of systems in involution of partial differential equations.—**S. Mazurkiewicz**: The problem of Lusin.—**F. E. Myard**: Closed chains with five rotoid couples deformable at the first degree of freedom.—**E. Chausse** and **J. Baubiac**: The secondary vortices produced below an obstacle immersed in a liquid.—**Fernand Baldet**: The Raffety bands and the spectra of comets. The radiations from the nuclei of comets cannot be identified with the Raffety bands given by the flame of an oxyacetylene blowpipe.—**Ch. Racine**: Contribution to the study of the static problem in the theory of relativity.—**L. Goldstein**: The application of quantic mechanics to chemical kinetics. **Maurice Robert**: Application of the oxymetal rectifier to the measurements of the maximum potential difference.—**Stanislas Teszner**: Recording mobile waves with a modified Dufour cathode ray oscillograph.—**Louis Leprince-Ringuet**: Relation between the path of a rapid proton in air and the ionisation which it produces. Application to the study of the artificial disintegration of the elements.—**F. Margand**: The damping of the oscillations of polyphase synchronised machines in the theory of two reactions.—**Georges Fournier**: The translation of light intensities into sound intensities. By means of the apparatus described, by listening at a telephone a blind person can distinguish the position of a window or source of light, the surface occupied on a table by a sheet of white paper, and other phenomena of light.—**P. Waguet, A. Stampa**, and **J. Dourgnon**: The rôle of irregularities of the profile of reflectors for motor car projectors and their photographic control.—**Daniel Chalonge**: The variations of the energy distribution in the continuous spectrum of molecular hydrogen.—**Henri Grenat**: The identification of the Raffety spectrum.—**Marcel Laporte**: The chemical reactions of ionised gases. The synthesis of nitric acid.—**Cazaud**: The influence of the magnitude of the micrographic grain on the resistance to fatigue of mild steel. The effects of cold-hardening, of annealing, and of overheating.—**Marcel Godchot** and **Mlle. G. Cauquil**: The viscosities, surface tensions, and parachors of some cyclo-hydrocarbons.—**A. Portevin** and **A. Sanfourche**: The attack of the common metals by solutions of phosphoric acid. Twelve metals were submitted to the attack of solutions of phosphoric acid of different origin and of varying concentrations. The results are given in a diagram.—**L. Bert**: The action of 1, 3-dichloropropene on the sodium phenols.—**P. Carré** and **P. Mauclère**: The transformation of the polyatomic alcohols into

mono- and polychlorhydrins by means of thionyl chloride.—E. Calvet: Velocities and heats of saponification of the amides. The heats of saponification of the amides of the fatty series vary but little from one term to the next, but the saponification velocities vary rapidly, especially for the first terms.—Lespieau and Reginald L. Wakeman: The preparation of the trimethylene hydrocarbons: 1-methyl-2-propylcyclopropane. Starting with β-bromopropaldehyde, methylpropyltrimethylene has been prepared free from its ethylene isomer, as shown by its Raman spectrum.—Raymond Paul: Some derivatives of 1, 4, 5-pentane triol.—Paul Gaubert: The diffraction rings produced by spherolites with helicoidal structure.—Robert Lami: The saline heterogeneity of rock pools on the sea coast during rain.—A. Guilliermond: New researches on the microchemical characters and the mode of cytological formation of the anthocyanin pigments.—Henri Coupin: An unrecognised factor of the momentary variation of plants.—A. Ch. Hollande and Mme. G. Hollande: Cytological study of the different stages of the Eberth bacillus (*Bacterium typhi*).—Charles Richet, Jr., and Jean Dublineau: The effects of the puncture of the fourth ventricle on the combustion of protein materials.—Fernand Mercier and Léon J. Mercier: A new sparteine salt, neutral sparteine valerianate.—G. Champetier: The formation of the alkali celluloses.—P. Carneiro and W. Kopaczewski: The nature and specificity of antigens. The experiments described lead to the conclusion that immunity appears to be an electrocapillary phenomenon.—A. Trillat: Experiment on infection by air. The case of chicken cholera. The practical conclusion from the results obtained by the author is that chicken cholera can be transmitted by the air, especially confined air: hence poultry houses should be well ventilated in order to free them from the moisture accompanying the gaseous products of respiration.—C. Levaditi, P. Ravaut, P. Lépine, and Mlle. R. Schoen: The affinity of a virus isolated from inguinal granulomatosis (Nicolas and Favre's disease) for the lymphatic system of the ape.

CRACOW.

Polish Academy of Science and Letters, March 20.—G. Bouligand: An application of the paratangent to a problem of superficial measurement.—Mlle. M. Charpentier: A topological problem arising out of the theory of the differential equations $\acute{y}=f(x, y)$.—S. K. Zaremba: The trend of the integrals of an ordinary differential equation of the first order in the neighbourhood of the singular integral supposed to exist.—L. Infeld: The constitution of the wave associated with free electrons.—W. Kessel: The complexity of the resonance spectrum of selenium vapour.—M. Kamieński: Researches concerning the movement of the periodic comet, Wolf I. Part 12. Disturbances of the path of the comet by Uranus from 1884 to 1919.—M. Centnerszwer and J. Szper: The electrolysis of fused alkaline nitrites. The products are nitrogen and alkaline oxide at the cathode, nitrate and a mixture of $NO_2$ and NO at the anode.—K. Dziewoński and J. Moszew: The synthesis of diethyl-α-α-acenaphthyldiketone (αα-dipropionylacenaphthene).—K. Dziewoński and J. Spirer: Syntheses and transformations of two diketones: αα- and ββ-derivatives of acenaphthene.—K. Konior: The tectonic of the border of the Carpathians between Biala and Andrychów.—St. Macko: Two peat bogs in the neighbourhood of Zamość, studied by means of pollen analysis.—St. Maziarski: Genetic studies of the genus *Ægilops*. The morphology and cytology of interspecific hybrids.—J. Jarocki: The Mycetozoa of Czarna Hora (Polish Eastern Carpathians).—J. Zaćwilichowski: The innervation and the sensorial organs of the wings in insects (2).—F. Górski: The action of weak electric currents on chlorophyll assimilation in *Elodea canadensis*.—M. Konopacki: The micromorphology of the eggs and embryos of the frog (*Rana fusca*) submitted to centrifugation.

April 13.—G. Bouligand: The regular and positive solutions in the whole plane of the equation $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=u$.—A. Rosenblatt: The movements adjacent to plane radial movements of incompressible viscous fluids.—G. Giraud: Certain non-linear problems of Neumann and certain non-linear mixed problems.—M. Centnerszwer and J. Szper: The electrolysis of fused sodium metaphosphate.—K. Dziewoński, Mlle. J. Krasowska, and Mlle. J. Schoenówna: Researches on the acenaphthene sulphonic acids.—R. Malachowski: The equilibrium in aqueous solutions of aconitic acid.—Cz. Kuźniar: The origin of the mirabilite in the deposits of potassium salts at Holyń and at Siwka.—L. Marchlewski and A. Boryniec: The absorption of ultra-violet rays by certain organic substances.—J. Wlodek, C. Strzemieński, and E. Ralski: Researches on 'Czerwone Wierchy', Tatra and Bielsko soils in which mixed plant associations are developed.

GENEVA.

Society of Physics and Natural History, Mar. 19.—P. Rossier: The nature of Purkinje's phenomenon. In an earlier study, the author has shown that the intensity of the source and the acuteness of the maximum of the eye sensibility curve vary in the same sense. A more complete calculation enables the conclusion to be drawn that this variation of sensibility is insufficient to explain the observed phenomena: the known diminution of the wavelength of maximum sensibility with the intensity ought to be preserved.—Ed. Paréjas: Results of the Harvard University geological expedition in the Canadian Rockies (Jasper National Park), 1929. Note No. 3. The Trias of the Athabaska Valley. The Upper Trias (Norian to Pseudomonotis, cf. subcircularis) has been recognised in the valley of Vine Creek, a tributary of the Athabaska, to the north of Jasper. The underlying formations of Cold Sulphur Spring, Corral Creek, and Fiddle River, attributed to the Trias, are also marine. They have a pronounced detrital character marked by the abundance of the mica grit, the presence of conglomerates and of magnesian breccia of alpine type. The Trias of Jasper Park, about 200 metres in thickness, rests on the Rocky Mountain quartzite formation (Upper Palæozoic).—E. Joukowsky: The phreatic sheet of Soral (Canton of Geneva). A well showed the following in section, from top to bottom: post-glacial deposits, 5 m.; Würmian end moraine, 20 m.; fluvio-glacial gravel, 10 m.; stratified clays and sand, 14 m.; fluvio-glacial gravel, 17 m. The water table was at a depth of 58·5 m. The thickness of the water-bearing layer is at present 9·3 metres. The variations of level recorded with the limnigraph during a month, show a direct relation with the pressure recorded on the barograph. Between February 1930 and March 1931 the level has risen more than two metres.

April H. 23.—Saini and J. Weiglé: A possible transformation of maleic acid into fumaric acid. The authors tried to see if a magnetic field could convert maleic acid into fumaric acid. The results of experiments in a magnetic field of intensity between 5000 gauss and 8000 gauss show that this transformation does not occur.—E. Briner, A. Demolis, H. Paillard: The ozonation of aldehydes and the theory

of active molecules. Studying this ozonation, the authors have proved an intense activating action exercised by the ozone on the molecules of oxygen. This action markedly increases the yield of oxidations carried out with ozone.—R. Wavre: From the human scale to the terrestrial scale. The author discusses a remark of Helmholtz which the Wegener hypothesis makes of current interest. He shows that the duration of certain phenomena of hydrodynamical order increases as the square of the dimensions. For example, the large but very slow currents in the midst of the terrestrial magma have quite well been able to last for millions of years, even although this magma were very viscous. Care is necessary in passing from the laboratory scale to the terrestrial scale.—G. Tiercy: Silvering telescope mirrors. The method of E. Schaer employed at the Geneva Observatory. The author describes the composition of the baths and gives the characteristics of the Schaer method adopted for silvering the Observatory mirrors.

## Official Publications Received.

### BRITISH.

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 19, Part 5, July. Pp. 219-258+plates 26-29. (London: Dulau and Co., Ltd.) 10*s.* net.

Department of the Interior: North West Territories and Yukon Branch. Report of the Director of the North West Territories and Yukon Branch 1929-30. (Fiscal Year ended 31st March 1930.) Pp. 28. (Ottawa: F. A. Acland.)

Proceedings of the Society for Psychical Research. Part 121, Vol. 40, July. Pp. 59-104. (London.) 4*s.*

Memoirs of the Indian Meteorological Department. Vol. 25, Part 7: An Analysis of the Base Line Values of Autographic Instruments. By Dr. Sudhansu Kumar Banerji. Pp. 247-278. (Calcutta: Government of India Central Publication Branch.) 1.4 rupees; 2*s.*

India: Meteorological Department. Scientific Notes, Vol. 3, No. 25: Heights of Base of Clouds in India as determined from Pilot Balloon Ascents. By the late M. V. Narayanan and M. P. Manna. Pp. 77-82. (Calcutta: Government of India Central Publication Branch.) 5 annas; 6*d.*

Proceedings of the Edinburgh Mathematical Society. Series 2, Vol. 2, Part 4, June. Edited by Prof. H. W. Turnbull and Dr. E. T. Copson. Pp. 181-283. (London: G. Bell and Sons, Ltd.)

Harper Adams Agricultural College, Newport, Shropshire. Report of the Advisory Department, 1930-1931. (Advisory Report No. 6.) Pp. 31. The Work of the Harper Adams Pig Feeding Experimental Station during 1930. By Dr. Charles Crowther. Pp. 7. (Newport.)

Technical College, Bradford. Diploma and Special Day Courses, Session 1931-32. Pp. 232+19 plates. (Bradford.)

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1931. Pp. 58. Bulletin No. 37: A Disease-resisting Turnip. By Wm. M. Findlay. Pp. 12. (Edinburgh.)

Indian Journal of Physics, Vol. 6, Part 1, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 20, Part 1. Conducted by Sir C. V. Raman. Pp. 80. (Calcutta.) 1.8 rupees; 2*s.*

Geological Survey Department: Tanganyika Territory. Short Paper No. 8: Some Salt Lakes of the Northern Rift Zone. By Douglas Orr and Dr. D. R. Grantham. Pp. 23. (Dar es Salaam: Government Printer.) 4*s.*

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1382 (Ae. 507—T. 2918): Some Cases of Flow of Compressible Fluids. By Prof. G. I. Taylor. Pp. 16+5 plates. (London: H.M. Stationery Office.) 1*s.* net.

Eton College Natural History Society. Annual Report 1930-31. Pp. 106+12 plates. (Windsor.) 5*s.*

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. (No. 28, 1931.) Edited for the College by Dr. S. Graham Brade-Birks. Pp. 313. (Wye.) 8*s.* 6*d.*; Residents in Kent and Surrey, 4*s.* 6*d.*

Board of Education. Educational Pamphlets, No. 85 (Industry Series, No. 10): Report by H.M. Inspectors on the Provision of Instruction in Applied Chemistry in Technical Schools and Colleges in England and Wales. Pp. 55. (London: H.M. Stationery Office.) 1*s.* net.

The Scientific Proceeding of the Royal Dublin Society. Vol. 20 (N.S.), No. 8: Award of the Boyle Medal to Sir John Purser Griffith. Pp. 85-87. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.)

Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd., Turner's Hill, Cheshunt, Herts. Sixteenth Annual Report, 1930. Pp. 92. (Cheshunt.)

British Museum (Natural History.) Picture Post-cards. F32: British Trees—Holly. 2 cards in colour and 2 in monochrome. F33: British Trees—Larch. 2 cards in colour and 2 in monochrome. F34: British Trees—Hornbeam. 2 cards in colour and 2 in monochrome. F36: British Trees—Common Lime. 2 cards in colour and 2 in monochrome. F38: British Trees—Juniper. 2 cards in colour and 2 in monochrome. F44: British Trees—Aspen. 2 cards in colour and 2 in monochrome. F45: British Trees—Wild Service. 2 cards in colour and 2 in monochrome. F46: British Trees—Hawthorn. 2 cards in colour and 2 in monochrome. (London: British Museum (Natural History).) 6*d.* each set.

University of Bristol. The Annual Report of the Agricultural and Horticultural Research Station (The National Fruit and Cider Institute), Long Ashton, Bristol, 1930. Pp. 231. (Bristol.)

Joint Board of Research for Mental Diseases: City and University of Birmingham. Annual Report of the Laboratory for the Year ending March 14th, 1931. Pp. 10. (Birmingham.)

Empire Cotton Growing Corporation. Report of the Executive Committee to be submitted to the Meeting of the Administrative Council on July 23rd, 1931. Pp. 10. (London.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 20 (N.S.), No. 9: A Study of Bacteria belonging to the Sub-genus *Aerobacter*. By M. Grimes and A. J. Hennerty. Pp. 89-97. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6*d.*

Norman Lockyer Observatory. Director's Annual Report, April 1, 1930-March 31, 1931. Pp. 8. (Sidmouth.)

### FOREIGN.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 6, No. 6, June, R.P. Nos. 314-328. Pp. 917-1158. (Washington, D.C.: Government Printing Office.)

Smithsonian Miscellaneous Collections. Vol. 85, No. 3: Addenda to Descriptions of Burgess Shale Fossils. By Charles D. Walcott. (Publication 3117.) Pp. 46+23 plates. (Washington, D.C.: Smithsonian Institution.)

U.S. Department of Commerce: Bureau of Standards. Research Paper No. 325: The Waidner-Burgess Standard of Light. By H. T. Wensel, Wm. F. Roeser, L. E. Barbrow and F. R. Caldwell. Pp. 1103-1117. (Washington, D.C.: Government Printing Office.) 5 cents.

The Memoirs of the Imperial Marine Observatory, Kobe, Japan. Vol. 4, No. 2, February. Pp. 53-226. Vol. 4, No. 3, April. Pp. 227-271. (Kobe.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 305: Raman Effect for Liquid Hydrazine. By Sunao Imanishi. Pp. 7. 20 sen. Nos. 306-309: Researches on Hypoglycemia producing Substances, 2: pseudo-Thiourea, Amidine and Urea Derivatives, by Sin'iti Kawai, Tatsuo Hosono, Yoshio Shikinami and Shunychi Yonechi; A Contribution to the Character of Triarylcarbinal Derivatives (1), by Sin'iti Kawai and Kunisaburo Tamura; On the Reaction between 2·4·6-Trichloropyrimidine and Dimethylaniline, by Sin'iti Kawai and Takashige Miyoshi; β-Hydroxy-ethylguanidine and its Condensation with Acetoacetic Acid, by Sin'iti Kawai. Pp. 9-28. 40 sen. (Tōkyō: Iwanami Shoten.)

U.S. Department of Agriculture. Farmers' Bulletin No. 1665: The Silverfish as a Pest of the Household. By E. A. Back. Pp. ii+6. (Washington, D.C.: Government Printing Office.) 5 cents.

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 83. African and Malagasy Blattidae (Orthoptera), Part 1. By James A. G. Rehn. Pp. 305-387+plates 31-35. (Philadelphia.)

Transactions of the San Diego Society of Natural History. Vol. 6, No. 23: Notes on the Worm Snakes of the Southwest, with Descriptions of two New Subspecies. By Laurence M. Klauber. Pp. 333-352. Vol. 6, No. 24: *Crotalus tigris* and *Crotalus enyo*, two little known Rattlesnakes of the Southwest. By Laurence M. Klauber. Pp. 353-370+plate 23. (San Diego, Calif.)

Agricultural Experiment Station, Michigan State College of Agriculture and Applied Science. Circular Bulletin No. 136: Hardy Perennials for Landscape Planting in Michigan. By C. P. Halligan. Pp. 80. Circular Bulletin No. 137: Pests of Apple and Pear in Michigan. By R. H. Pettit and Ray Hutson. Pp. 63. Special Bulletin No. 211: A Comparison of Alfalfa Strains and Seed Sources for Michigan. By C. R. Megee. Pp. 8. Technical Bulletin No. 112: Residual Effects of Fruit Thinning with the Lombard Plum. By J. H. Waring. Pp. 36. Technical Bulletin No. 114: Fertilizers and Soils in relation to Concord Grapes in Southwestern Michigan. By N. L. Partridge and J. O. Veatch. Pp. 42. Technical Bulletin No. 116: The Fruiting Habit of the Peach as influenced by Pruning Practices. By Roy E. Marshall. Pp. 58. Technical Bulletin No. 117: Experiments with the Tuber Index Method of Controlling Virus Diseases of Potatoes. By J. E. Kotila. Pp. 26. (East Lansing, Mich.)

Zoologica: Scientific Contributions of the New York Zoological Society. Vol. 13, Nos. 1 and 2: Bermuda Oceanographic Expeditions, 1929-1930. No. 1: Introduction; No. 2: List of Nets and Data. By William Beebe. Pp. 36. (New York City.)

Bulletin of the Michigan College of Mining and Technology. New Series, Vol. 4, No. 4: Announcement of Courses, 1931-1932. Pp. 145. (Houghton, Mich.)

### CATALOGUES.

Zeiss Field Glasses. (List T 500 £.) Pp. 58. (London and Jena: Carl Zeiss.)

Thermo-electric Pyrometers for Indicating and Recording Temperatures to 1400° C. (2552° F.) (List No. 194.) Pp. 24. (London: Cambridge Instrument Co., Ltd.)

Apparatus for X-Ray Therapy. (Bulletin T.1.) Pp. 24. Diathermy. (Bulletin W.1.) Pp. 16. (London: Watson and Sons (Electro-Medical) Ltd.)

Liver Extract B.D.H. for the Treatment of Pernicious Anæmia and Allied Conditions. Pp. 13. Elixir Valibrom B.D.H. and Elixir Valibrom Compound B.D.H. Pp. 4. (London: The British Drug Houses, Ltd.)

McGraw-Hill Books on Business and Economics. (List 4.) Pp. 64. (London: McGraw-Hill Publishing Co., Ltd.)

Catalogue of Important Natural History, Botanical and Horticultural Works. (No. 17.) Pp. 32. (London: John H. Knowles.)

Respice-Prospice: Lewis's 1844-1931. An Illustrated Account of its Foundation and Development, with a Description of the Services offered to the Medical, Scientific and Teaching Professions. Pp. ii+30+5 plates. (London: H. K. Lewis and Co., Ltd.)

A Clearance List of Books on Zoology, Mathematics, Chemistry, Geology, etc., with an Appendix of Valuable and Interesting Books (Clearance List "A".) Pp. 28. (London: Wheldon and Wesley, Ltd.