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"*To the solid ground*
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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SATURDAY, JANUARY 1, 1927.

CONTENTS.

River Pollution and Fisheries.

ANGLING in the slow-running rivers of England affords recreation for an ever-increasing number of artisans and other responsible citizens of our large industrial centres. Inexpensive opportunities of health-giving open-air amusements in the limited time they have available are becoming fewer as the population increases and greater distances have to be traversed before arriving beyond the outskirts of the cities. Since it is upon the health and contentment of the city and industrial workers that the prosperity of the country has come to rest, it has become a duty of the nation to conserve the facilities for this tranquil and pleasant pastime quite as much as to conserve the more valuable salmon and trout fisheries, all of which suffer from the effects of pollution by industrial and other effluents more and more as time goes on.

With these objects in view, the Standing Committee on River Pollution was appointed in 1921, and, with the help of local sub-committees, and a growing weight of public opinion, it has already accomplished a great deal towards checking an increase in pollution, and in some cases in ameliorating the existing conditions. The problem with which the Committee is faced is not a simple one; it is not obvious how, in many cases, an industrial effluent can be rendered harmless, or sufficiently non-toxic and clear, so as not to damage life in the river or the amenities of the country-side. Every such effluent must go somewhere or the industry be dislocated; its satisfactory treatment in the space available at reasonable cost frequently provides matter for research.

An interesting problem of the moment is the satisfactory treatment and disposal of the large volume of water used for washing and transportation in the new beet-sugar factories. This wash water, besides dirt, contains organic matter in solution and suspension

which, although comparatively harmless to fish life on leaving the factory, may become harmful owing to the development of toxic substances during the decomposition of the organic matter.

It is often easy enough to determine whether a river is polluted, but quite another matter to gauge the extent to which life in the river will be damaged. Fish utilise as food a large number of organisms, animals as well as plants. The larger animals, such as the fresh-water shrimp and insect larvæ, which serve as food for many species of fish, in turn feed on smaller animals and plants. In many cases the dependence of one on the other is direct and obvious: in others less so. The presence or absence of vegetation, even of the smallest forms such as diatoms, may play a considerable rôle in determining the conditions of life in a river, quite apart from their actual food value, since they afford harbourage to animals and assist in the self-purification of the water. Hence it is clearly not the direct physiological effect of a polluting effluent upon fish alone which has finally to be determined, but its effect, if any, upon some necessary link in the food-chain and upon the flora.

The need for the solution of problems such as these before satisfactory legislation can be introduced to cope with river pollution is obvious, and has been felt in countries other than England. In 1920 the Dutch Government established a central institute at the Hague for experimental work in connexion with waste waters generally, from which advice is now sought by local authorities administering the law against pollution of the canals and waterways, and by industrial associations seeking the most economical means of treating their effluents. In the United States many rivers are grossly polluted; for example, the river carrying the Chicago sewage is stated to be devoid of dissolved oxygen for a distance of twenty miles. There the question of rational legislation is beginning to attract attention, and many specific problems are presenting themselves. Since the laws of the country have allowed the rivers to be treated as a public sink, and in consequence vested interests in them as such have developed, it will doubtless be a difficult and very expensive task to cope with their purification.

In Great Britain numerous surveys of rivers have been carried out and local pollutions investigated during the last five years by Dr. E. C. Jee, the technical adviser to the Standing Committee on River Pollution, and by several scientific workers resident in various districts. Upon the results of this work, action has been taken in a number of cases and has led to the abatement of nuisances, and the fact that sources of pollution are being investigated at intervals and reported upon undoubtedly acts as a deterrent against increased pollution in other cases.

Besides this necessary survey work and investigation of local problems, a small scientific staff at the Fisheries Experimental Station, Alresford, have begun several lines of research fundamental to a proper scientific attack of many existing problems. With the final object of undertaking a complete biological survey of a river with particular reference to the effect of various pollutions upon the normal fauna and flora, methods have been evolved which aim at providing a quantitative, or, at any rate, comparable, measure of the abundance of life in different rivers or in the same river at different times of the year. Preliminary work showed that by far the greater proportion of the animal life (in the upper waters of the Itchen) lived either on the bottom or among the weeds which clothe it; ordinary dredges did not yield a representative sample. To obtain a representative sample of the smaller animals a frame with gauze bottom containing stones, etc., similar to the river bottom, was left for a week in the river, and the organisms which had migrated into it were then picked out and counted. It is anticipated that the various methods evolved will be of service in the examinations of polluted rivers, and also that results obtained will finally provide a valuable basis for comparison.

Fish found dead are frequently posted to Alresford for examination, and as our present knowledge of fish disease is fragmentary and the fish often arrive after decomposition has commenced, giving rise to symptoms which may easily be mistaken for those produced in a fresh fish by poisoning, an attempt is being made to obtain further accurate knowledge of post-mortem conditions, particularly histological changes in the gills and alimentary canal due to poisoning.

The need for investigations of a general nature is amply borne out; the Standing Committee on River Pollution in its recent report[1] states that it is "constantly faced with the lack of scientific knowledge necessary to devise a method of dealing with a particular effluent," and advocates the appointment of sufficient technical staff to elucidate, not only in the laboratory, but also by experiments at the source of pollution, the scientific questions which at present have no answer.

The future of many rivers in Great Britain is clearly in the hands of the chemist and biologist, for it is upon accurate knowledge such as they alone can obtain that any satisfactory legislation must rest. The longer the necessary efforts to tackle the pollution

[1] "River Pollution and Fisheries. A non-technical report on the work during 1925 of the Standing Committee on River Pollution." Ministry of Agriculture and Fisheries, London. 1926. Price 6d.

problem in a comprehensive manner is put off, the more difficult and the more expensive will be the task and the greater the risk of failure.

To allow the serious pollution which exists at present in some British rivers to continue more or less unchecked and to grow, which it undoubtedly will tend to do as the population and industries increase, is an evil greater than can be expressed in terms of decreased monetary value of the fisheries. Increased demands on the water supply in towns and cities as they enlarge have also to be considered. From before the time of Isaac Walton the rivers of England have been part of the nation's playground, a playground put to greater use as the population becomes denser, a heritage to preserve—unpolluted.

The Origin of Civilisation in America.

La Esfinge Indiana: antiguos y nuevos aspectos del problema de los orígenes americanos. By Prof. J. Imbelloni. Pp. 399+19 plates. (Buenos Aires: Libreria "El Ateneo," 1926.) n.p.

ALTHOUGH there is no reference to W. H. Prescott in this book, its title, "The Indian Sphinx," and the author's frequent references to himself as the Oedipus who is solving the riddle, suggest that Prescott's famous book "The Conquest of Mexico," which was published in 1843, had made a stronger impression upon him than he is prepared to admit. Both in the introduction and the lengthy appendix, Prescott gave an impressive summary of the evidence which forced him to admit, although it is clear he was very reluctant to do so, "that the coincidences are sufficiently strong to authorise a belief that the civilisation of Anahuac was in some degree influenced by that of Eastern Asia." At the same time, perhaps from having read Robertson's History, he was puzzled to account for the scores of arbitrary likenesses between the customs and beliefs of ancient Mexico and Asia. Thus he wrote:

"Was it [the pre-Columbian civilisation of Mexico] indigenous? or was it borrowed in some degree from the nations in the Eastern World? If indigenous, how are we to explain the singular coincidence with the East in institutions and opinions? If Oriental, how shall we account for the great dissimilarity in language, and for the ignorance of some of the most simple and useful arts, which, once known, it would seem scarcely possible should have been forgotten? This is the riddle of the Sphinx, which no Oedipus has yet had the ingenuity to solve."

If there were any real scientific discipline in ethnology, one might have hoped that Prescott's two difficulties having now been removed by the advancement of knowledge during the intervening eighty years (which have also added a vast accumulation of evidence in corroboration of the clear implications of the statement in "The Conquest of Mexico"), the way would be clear for the frank admission of the diffusion of culture from eastern Asia. But in ethnology emotion still counts for more than reason: or perhaps it would be more explicit to say that the Newtonian principles of inductive reasoning, by basing theories on observed facts, have not yet penetrated into the subject, which is still under the sway of the deductive methods of Descartes. For in ethnology—and Prof. Imbelloni's treatise is a conspicuous illustration of the point—the dominating principle is still to force the evidence into conformity with certain catch-phrases that are called 'natural laws,' the *idées innées* of Descartes, the *Elementargedanke* of Bastian, the universal symbols of Freud, et cetera, from which a long line of philosophers, starting with Turgot in 1751, have been striving to rescue the study of mankind and make a real science of it.

For the introduction of confusion into the fascinating problem of the origin of the pre-Columbian civilisation of America, as indeed into all ethnological doctrine, the chief blame must be attributed to Dr. William Robertson, Principal of the University of Edinburgh, whose famous "History of America" was published in 1777. He seems to have been the first to give wide currency to the Cartesian ideas that are so popular in ethnology to-day.

"When the people of Europe unexpectedly discovered a New World, removed at a vast distance from every part of the ancient continent which was then known, and filled with inhabitants whose appearance and manners differed remarkably from the rest of the human species, the question concerning their original became naturally an object of curiosity and attention. The theories and speculations of ingenious men with respect to this subject would fill many volumes: but are often so wild and chimerical that I should offer an insult to the understanding of my readers if I attempted . . . to enumerate or refute them." After mentioning some of these speculations he adds: "though they rest upon no better foundation than the casual resemblance of some customs, or the supposed affinity between a few words in their different languages, much erudition and more zeal have been employed to little purpose, in defence of the opposite systems."

Hence, without bothering to examine the evidence, the Scottish historian fell back on the device of formulating a law. "Were we to trace back the ideas of other nations to that rude state in which history first presents them to our view, we should discover a surprising resemblance in their tenets and practices; and should be convinced that, in similar circumstances, the faculties of the human mind hold nearly the same course in their progress, and arrive at almost the same conclusions."

I have made these quotations from the work of this eighteenth-century divine because they represent the stock-in-trade of those who claim the independence of American culture to-day. Hence they shed some light upon the interesting psychological problem of why theories that are in such flagrant conflict with the evidence should continue to be respected. The explanation is provided by the history of these fallacies. Although Robertson wrote his book more than twenty-five years after Turgot (who had acquired the Newtonian discipline of reasoning from Sigorgne, his teacher of mathematics), Scotland, as Buckle pointed out in his "History of Civilisation," still remained under the influence of Descartes and the deductive method. These ethnological fallacies were floating about for another century without being taken seriously, until in 1871 Sir Edward Tylor adopted them from Adolf Bastian, the arch-enemy of biological evolution, and gave them a fashionable and attractive veneer by calling them "evolution." By this strange irony more than fifty years ago, ethnology was put into the fetters of Cartesian scholasticism. These historical facts help us to understand how such a book as "The Indian Sphinx" could have been written.

The problem of the pre-Columbian civilisation of America, with which the book deals, is of crucial importance. Not only was it responsible, as I have just indicated, for shaping ethnological theory in the past, but also at the present it is the supreme test of clear thinking. It is becoming a habit on the part of those who defend the principle of the independent development (in other words, spontaneous generation) of culture, to pretend that they do not deny the reality of diffusion. But the American problem demands a plain answer to the question whether or not any cultural influence was conveyed across the Pacific Ocean during the first ten centuries of the Christian era. Did Mexico, Central America, and Peru derive the germs of their civilisation from Cambodia and Java fifteen centuries ago, or was it a wholly indigenous creation of the Maya and pre-Inca peoples? That is the clear-cut issue.

In this large treatise the various theories, ancient and modern, that relate to the origin of American civilisation are submitted to critical examination. In the first two-thirds of the book the author pours scorn on all theories of diffusion, adopting the extreme form of Bastian's theory of psychic unity. When the resemblances between cultures in different areas seem to put too great a strain on this speculation, he falls back on the biological theory of convergence. Hence it comes as a shock to the reader when on p. 279 he throws the *Elementargedanke* overboard and becomes an out-and-out diffusionist. He has no doubt that the Quechua and Aymara languages and the culture of South America were derived from Polynesia. The magic wand that seems to have effected this wonderful transformation is the fact that the name for an 'axe' (*toki*) and the mode of fashioning the implements are essentially identical in Oceania and South America. But having convinced himself of this fact he then proceeds to discover identities in other arts, customs, beliefs, and languages, and adopts whole-heartedly the methods he has been ridiculing in the preceding 270 pages!

This admission, however, creates new difficulties for Prof. Imbelloni. If certain words in the languages of Tonga, Samoa, and Tahiti are identical with those used in Peru, much more definite affinities can be detected in the languages of Indo-China and India. The derivation of the cultures of Oceania from India is widely admitted. Hence he is committed to the linking up of pre-Columbian American culture with that of India, which in the light of recent discoveries is known to be genetically related to those of Elam, Sumer, and Egypt. These links are all now well established, as Prof. Breasted has recently pointed out.

After an incomplete survey of the discussions of the seventeenth and eighteenth centuries, more than a hundred pages are devoted to certain modern speculations regarding connexions between America and Mesopotamia by way of Siberia and Turkestan, in the course of which essays on the evolution of the horse and the geographical distribution of the grape vine are introduced. The author examines and severely criticises Posnansky's attempt to apply to the ancient American pyramids astronomical methods for estimating their age somewhat analogous to those used by Sir Norman Lockyer in the cases of Stonehenge and Egyptian temples. Posnansky's calculation for Tiahuanacos gives a date of A.D. 1200, which seems not unreasonable: but Imbelloni says it is based on a series of errors.

Prof. Imbelloni's most scathing denunciations, however, are reserved for Part iii. of his book, in which he pours ridicule on what he calls "the Manchester School" and upon the present reviewer in particular. The bulk of this criticism follows the lines with which readers of NATURE have been made familiar during the last fifteen years, in particular in the discussion of the conventionalised elephant-heads on the Copan stela (see NATURE, November 25 and December 16, 1925, and January 27, 1916; also the interludes by Dr. Forbes and Mr. Robson in August 2 and September 13, 1924). As Prof. Imbelloni is not acquainted with anything that I have written on these matters since 1922 (most of his knowledge of my work having been derived from Dr. Germain's review in *L'Anthropologie* of that year), I need only direct his attention to the full statement on

the elephant-problem in my book "Elephants and Ethnologists" (1924). But Prof. Imbelloni's indignation with me would be quite excusable if I had ever expressed the preposterous views he attributes to me when he says I pretend the Mayas and Peruvians came from Egypt! The confusion of race and culture vitiates in fact a large part of this entertaining book.

Prof. Imbelloni has rendered a very useful service in emphasising the remarkable identities between certain features of Mycenæan and Mexican architecture (Plate III.), Egyptian and Peruvian balsas (Plate XI.) (of which, unaware of the various memoirs I have written on ancient shipping, he seems to think I am ignorant), the monstrous figures (Plates XIV. and XV.) with projecting tongue in Italy, Polynesia, and Mexico (and he might have added India, Indo-China, and Indonesia), the wonderful terraces of the Philippines and Peru (Plate XVI.), et cetera. But it is very surprising that such striking illustrations of identity in arbitrary detail should be used as illustrations of convergence in that part of the book which is expounding the principle of the diffusion of culture from Polynesia to America.

At the present time scarcely any two believers in 'independent development' are in agreement as to the areas which are independent the one of the other. Prof. Imbelloni's book gives a new reshuffling. To illustrate the extent of these discrepancies I might mention that on the day his book came into my hands there also arrived a work by Prof. James H. Breasted, who admits the reality of diffusion from Egypt throughout the Old World, but refuses to admit any outside influence in America. Prof. Imbelloni denies diffusion in the Old World but admits that from the Pacific to America.

If we allow the negative parts of the two views to neutralise one another and admit the cases both writers have established by positive evidence, I think we shall arrive at the truth. G. ELLIOT SMITH.

Lignin and Lignification.

Die Chemie des Lignins. Von Dr. Walter Fuchs. Pp. xi+327. (Berlin: Julius Springer, 1926.) 18 gold marks.

THIS monograph on a subject of outstanding interest will commend itself under its sectional title to a wide circle of workers as an important and timely critical survey. The author's treatment of the matter, however, is much more comprehensive than might be inferred from the title, for it embraces the full perspective, and the work is consequently a contribution to natural history, and, beyond the phenomenal aspects of plant life, to general philosophy. The scope of the monograph, in fact, is first to set out the very considerable chemistry of lignin resulting from the investigations of some three hundred workers whose researches are critically reviewed in the text, and then to re-examine the scientific material thus accumulated, critically selected and co-ordinated by the author, in relation to the several sections of the science of botany, systematic (classification), physiology, structure and histology, to modern conceptions of the ultimate structure of the forms of matter, to the scientific technology of industry, and thus implicitly to the philosophy of the human story, intimately interrelated as it is with that of plant life and evolution.

The philosophic note is struck early in a critical discussion of the well-known methods of identifying lignin in plant tissues, and the resulting definition of "Das genuine Lignin" as distinct from the $N-1$ lignins isolated by chemical treatment, which are either synthetic derivatives or modified forms of the actual or original lignin, the degree of change associated with the reaction mechanism of the process of separation requiring to be estimated, but necessarily by a method which is inconclusive in respect of the actual relationship. It certainly leaves undefined the mode of union of lignone to cellulose in the ligno-celluloses; and the author's treatment of this problem in the later chapters will impress upon the chemist of objective mentality the obvious but much-ignored consideration that the synthetical operations of the plant in respect of its organised cell structures are not of the order of reversible reactions of his systematic text-books.

A short outline of the work in sequence of chapters is necessary to characterise more closely its scope. Chaps. i.-iii. are concerned with (1) the identification of lignin *in situ*; (2) the isolation by various methods, direct (conversion to derivatives rendered soluble) and indirect (breakdown of associated cellulose to soluble products); (3) analysis, that is, elementary composition and estimation of 'adjective' substituting groups, and a critical comparison of the numerous 'lignins' thus separated with the genuine or ideal lignin of the organism. Chaps. iv.-vii. deal with the further special chemistry of lignin: conversion to synthetical derivation involving reactions of OH, CH=CH, CO and COOH groups, esters, ethers, halogen derivatives, condensations with phenols, reactions with oxidants and hydrogenants: hydrolyses and alkali fusions.

This *exposé* of the 'pure' or rather detached chemistry of lignin, occupying the first two hundred pages, is the author's critical digest of the literature of the subject of the period 1900–1926 (January 1), a delimitation set out in the preface. It is accurate and exhaustive of the period though not of the subject matter, for the antecedent period (1875–1900) contributed quantitative methods of fundamental value as such, but of further

import when interpreted as establishing the conception of 'ligno-cellulose' by contrast with a cellulose extrinsically 'encrusted' with lignone matter. Moreover, it was clearly indicated, both *a priori* and on exact data, that the prototypes of the ligno-celluloses are the simpler structural forms of annual growths; whereas those of perennial structures are much more complex as such and by reason of secondary interior modification and condensations. The later research work dealt with in the present volume is largely devoted to the latter more complex types, which has inevitably complicated the treatment of the subject.

To resume on the author's sequence of subject matter: in Chaps. viii.-xi. the subject is developed in terms of biochemical science and illuminated by a sustained argument which shapes the matter, treated in all its related aspects, to the satisfactory issue of converging proofs of definite theory.

The subject of these chapters is lignification as an organic process: first, in relation to systematic botany; that is, to the grades of differentiated organic structure from the Thallophytes, with the first appearance of lignification in the Pteridophytes, to the most highly elaborated Phanerogams.

Histological investigation has already recognised an ascending series of types of lignification in close correlation with the evolution of structure; but the author points the way to a positive biochemical treatment of this enormous range of material, hitherto classified certainly without direct reference to lignification. As an illustration of such biochemical method, he briefly discusses the prolonged investigations of Carl Mez, applying his sero-diagnostic processes to the exploration of generic affinities (*Bot. Arch. Königsberg*, 1911 *et seq.*), pointing out, however, that the method is indirect and otherwise subject to error. It is clear that the body of exact knowledge of lignin, the subject of the preceding chapters, supplies a basis of re-investigation of the vegetable kingdom, by indirect method, which he predicts will establish *Ligninbildung* as a critical index of evolutionary development; and outside this objective of science such re-investigation promises a number of collateral developments.

In the next chapter, ix., under the sub-title "Entwicklungs-Mechanik," the organic process implicitly postulated is considered in relation to its factors. Lignification is a primary vital effect, but developed paradoxically *pari passu* with loss of vitality and cessation of growth. But the author refers to a 'post-mortem' activity which supervenes, a respiratory consumption of oxygen at the expense of elaborated cell-wall material; the removal of oxygen followed by complicated condensations, yields as a final product the lignin or lignone complex. It is suggested that the arena and basis of these transformations is the middle lamella of the cell-wall, and evidence of the contributing functions of its pectic components is afforded by the special chemistry of this group of carbohydrate derivatives established by later researches which are fully discussed.

In further development of the conception of the lignin-cellulose complex or ligno-cellulose as a biologic unity or individual, the author boldly grapples with the problem of cellulose constitution. While giving full value to chemical methods and results, attention is rather directed to the physical-biological interpretations of Röntgen spectrographs, to the ultimate configuration of an anisotropic colloid, as a 'cristallite' in evolution to organic form through micellar growth. This text definitely formulates a cellulose lattice and a penetration of the isotropic lignone so intimate as to represent a pseudomorph.

Chap. x. deals with the transformations of the ligno-celluloses and generally of cellulosic structures in fulfilment of ultimate natural functions.

In regard to lignone proper, this is characterised by its well-known extraordinary resistance to reaction, and the only change in living structures which can be traced is in contributing to the formation of phyto-melan. The enormous range of breakdown processes which result in humus, peat, and the various grades of coal, are discussed with general reference to lignin, and also the author's theoretical conceptions in the foregoing text, with reference both to cellulose, pectins and hemi-celluloses, and to the constitution of the lignone complex.

Chap. xi., under the title "Theorien über Lignin," is a concentrated summary; that is, the author's conclusions on the whole matter.

Chap. xii., and last, is particularly noteworthy. The subject is the technology of lignin and gives the author's scientific rationale of the leading industrial processes for the treatment of ligno-celluloses, such as destructive distillation, pulp manufacture by both acid and alkaline processes, partial resolution of ligno-cellulose structures (cereal straws) to serve as cattle food-stuffs, the production of sugar from wood and wood residues. Avoiding details of the manufacturing processes, the author applies his reasoned conceptions both of the proximate and of the ultimate constitution of ligno-cellulose matter to the elucidation of the reaction mechanism of the several industrial processes. This discussion has distinction as a critical illustration of the sound method of applying science to industry.

In applying, in effect, the most modern and apparently recondite principles of modern science, the text of this chapter should be extraordinarily stimulating to those engaged in industry; not merely in perfecting

routine operations but also in devising developments towards realising the progress inevitably suggested by discussion in relation to first principles.

It will be clear from the foregoing that the author has produced a work based on an unusual range of appreciative study of the sciences in their most recent developments contributing to the elucidation of the general theme, which, primarily indicated by its title, extends to the natural history of the vegetable kingdom.

We note in the text a considerable contribution of original investigations, which will probably be the subject of special publications in scientific journals. Lastly, the author is restrained in his criticisms of the researches of his fellow-workers; but a careful study of this work suggests that a notable proportion of the more speculative theories which they endeavour to establish will be excised from the student's memorabilia.

C. F. CROSS.

War Record of the Survey of India.

Record of the Survey of India. Vol. 20: *The War Record, 1914–1920.* (Published under the direction of Colonel-Commandant E. A. Tandy, R.E., Surveyor General of India.) Pp. xxv+155+27 plates +9 maps. (Dehra Dun: Survey of India, 1925.) 3 rupees; 5*s.* 3*d.*

SINCE its foundation in 1767, officers and surveyors of the Survey of India have accompanied every military expedition with which India has been connected. In order to provide a reserve of surveyors for war it has been the policy, as in most other countries, to employ army officers during peace time on the ordinary mapping of the country, so that they may be available at the outbreak of war to provide maps always required during the progress of military operations, though never so much as under the conditions which obtain to-day.

There is no essential difference between peace and war mapping except that in the former case the work is of a more deliberate character, while in war it has, of necessity, to adapt itself to the exigencies of military operations. Until the recent War, tactical topographical maps on a scale of a half or one inch to the mile sufficed, but now trench warfare imposes much larger scales. Artillery maps, also on large scales, require to be of the highest order of accuracy to be of any practical value, while accurate control is required for the location of enemy guns. These new duties have largely enhanced the importance of the surveyor's work in war.

On the outbreak of the War the Survey of India found itself in a position to provide, at once, officers and surveyors proficient in their art ready to take the field in accordance with its long-standing traditions. As the War went on, the call for officers became so insistent for survey and other duties that of the 54 regular officers employed in the Survey of India, 49 went on active service outside India. Of these eight were killed—all officers of the Royal Engineers—and eleven wounded. Of the 44 civilian officers who took part in the War, two were killed and two wounded. In addition, five Indian surveyors and 44 *khalasis* lost their lives in the service of the Empire.

The volume before us is a record of the operations carried out by the officers and surveyors in Mesopotamia, Kurdistan, Macedonia, Arabia, Persia, Palestine, East Africa, and Afghanistan. These explorations and surveys were accomplished in face of many difficulties and in every variety of terrain, from the icy highlands of Central Asia to the waterless deserts of Persia and Arabia. The total area thus explored by members of the department, often in unknown and unmapped regions, is almost comparable to that of Europe, while trustworthy new surveys, based on fixed points, covered an area more than twice that of Great Britain. In addition to a graphic description of the adventures that befell the surveyors in many lands, there is much valuable technical information to be found in the reports as to the methods of survey adopted, suitable to the different situations which presented themselves, and as to the climatic and political difficulties encountered.

The larger portion of the volume is naturally devoted to operations in Mesopotamia and Persia, where by far the greater part of the mapping was carried out. It is a record of intense devotion to duty on the part of officers and surveyors; nor must we forget the Indian survey *khalasi*, whose devotion to duty, whether in peace or war, though occupying but a humble sphere, ranks high among the servants of Government.

A roll of honour is included, and there are a number of photographs illustrating the different types of country concerned, as well as a series of index maps showing the areas actually surveyed. On the whole, this is a most interesting history of survey in war, and its production reflects the greatest credit on all concerned.

Our Bookshelf.

A Text-Book of Inorganic Chemistry. By Prof. Dr. Fritz Ephraim. English edition by P. C. L. Thorne. Pp. xii+805. (London and Edinburgh: Gurney and Jackson, 1926.) 28*s.* net.

PROF. EPHRAIM has written a very modern "Text-book of Inorganic Chemistry," in which the names of Rutherford and Bohr appear in the twelfth line of the text, whilst Laue and the Braggs appear on p. 12 of

Chapter i. This preliminary chapter on atomic structure is followed by three chapters on the properties of the elements. These deal with the periodic system and with allotropy in its various forms, including the colloidal forms of the elements and the special manifestations of allotropy as they are developed in individual elements. Two general chapters are then devoted to the preparation of elements, under the convenient headings of non-metals and metals. The succeeding groups of chapters deal with halogen-compounds, oxides of hydrogen and of the metals, compounds of sulphur, selenium, and tellurium, the nitrogen, phosphorus and arsenic group, and the elements of the fourth group (with boron), whilst a final section describes "The Rare Earths, Alloys and Radioactivity."

The author set out to write an inorganic chemistry which should be as systematic and as readable as a good book on organic chemistry. He has achieved his purpose, in the first place, by assuming that his readers have already reached a stage of development at which they can safely be 'thrown in at the deep end of the bath.' His second device is to omit all systematic treatment of the metals. This makes his task an easy one, since every teacher knows that the chemistry of the non-metals is no more difficult than the chemistry of carbon, and that the memory work and the inevitable dictionary treatment of the subject begin to be troublesome only when he passes from the tiny cluster of non-metals in the top right-hand corner of the periodic table to the vast array of metals which occupy the remainder of the table. It therefore appears likely that the author will be called upon to complete his task by adding to the present volume, which is virtually a text-book of the non-metals, a further volume on the metals.

If these limitations are borne in mind, there is no doubt that a student who has already reached the standard of a pass degree, and wishes to find a suitable book to read in preparation for an honours degree, will find Prof. Ephraim's text-book extremely useful and stimulating. The translation has been issued in a luxurious style, with beautiful print and on thick white paper with ample margins. The cost of the book is therefore not excessive, but it is possible that the student might prefer a less bulky volume, issued at rather lower price.

Institut International de Chimie Solvay. Deuxième Conseil de chimie tenu à Bruxelles du 16 au 24 Avril 1925. Structure et activité chimiques: Rapports et discussions. Publiés par MM. les Secrétaires du Conseil sous les auspices de la Commission scientifique de l'Institut. Pp. xiv+672. (Paris: Gauthier-Villars et Cie, 1926.) 96 francs.

AN account of the second conference of the Institut International de Chimie Solvay, held in Brussels on April 16-24, 1925, has already appeared in these columns (May 23, 1925, p. 817). It is therefore only necessary to note briefly the publication of the official report of the conference. This includes individual reports by Sir William Hardy, Sir William Bragg, Prof. W. L. Bragg, and M. Duclaux, on the structure of primary films, of crystals, and of solid colloids, and reports by Prof. Lowry, Prof. Swarts, M. Tiffeneau, Prof. Perrin, Prof. Job, Dr. Rideal, Dr. E. F. Armstrong, Prof. Moureu, Prof. Armstrong, M. Duclaux and Prof. Euler on various aspects of the mechanism of chemical change. These reports, with the somewhat lively discussions which followed them, make up a volume of nearly 700 pages, which will be read with interest by many of those who did not enjoy the privilege of attending the Conference. The publication of so full a report represents a vast amount of work on the part of the editors, and they are to be congratulated on the successful completion of their task. The only obvious criticism of their work is that in the index to the volume they have introduced two novel examples of multiple personality, by ascribing one report to MM. M. Eric et K. Rideal, and another to the triple authorship of MM. Thomas, Martin et Lowry.

One constructive suggestion may be made. Since the reports were first written in English or French, according to the nationality of the author, it would be a real advantage to be able to read them in the original language rather than in a necessarily imperfect translation. The printing of the final report in alternating French and English sections would surely not be a serious handicap to Belgian and French readers, whilst to English and American readers it would give a guarantee of authenticity and precision of phrasing that would be of even more value than the greater facility of reading in one's mother-tongue instead of in a foreign language.

L'Art et la religion des hommes fossiles. Par G.-H. Luquet. Pp. 231. (Paris: Masson et Cie, 1926.) 45. 4*d*.

M. LUQUET is a stern critic of facile theorising, and he will have none of the wholesale application of analogies from the practices of primitive people to the interpretation of the facts of palæolithic culture unless supported by internal evidence. Witness his treatment of the theory that the figures of animals carved, engraved, and painted were designed with the object of the magical increase and control of the game supply. This, he maintains, can only be asserted when the animal is represented as smitten by the weapon of the hunter. He leans definitely, therefore, to the view that while the magic employment of art may be predicated of the Magdalenian period, it scarcely exists, if at all, in the Aurignacian period. When once the possibility of representation had been grasped, it was practised for its own sake, it was purely æsthetic, and its magical uses were secondary. In the same way he refuses to accept the grosser form of female representations as evidence of a mother goddess cult, but regards them as erotic. The group of women encircling a male figure at Cogul, usually regarded as a ceremonial dance, is discussed at some length. Every aspect of palæolithic art, the cult of the dead and religion and magic, he touches upon in similar vein. M. Luquet's treatise is, with its cold logical outlook, certainly stimulating, though not always convincing. With no desire to dogmatise, it may very fairly be said that the weight of evidence as we know it at present is in favour of the magical rather than the purely æsthetic character of primitive and prehistoric art. As a corrective, however, to over-hasty enthusiasm, M. Luquet's book should be pondered by every student of prehistoric culture.

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.*]

The Origin of an Albino Mutation in *Limnæa peregra*.

THE normal colour of the head, mantle, and footsole of the pond-snail *Limnæa peregra* is a yellowish grey of variable intensity which is clearly visible through the horn colour of the shell. The eyes are black. During the course of our experiments with the sinistral form of this snail (*Jour. of Genetics*, 15, 113) a new mutant has appeared in which the head, mantle, and footsole are yellow and the body has no melanin anywhere. The eyes are visible as brownish specks, contrasting with the deep black of the normal specimens. The appearance is presumably a diffraction effect of the lens, for microscopically there is in young specimens no retinal pigment, though in snails that have grown up and bred a little brown-black pigment can be seen in the retina. We call this mutant 'albino-body.'

Albino-body first appeared in a sixth generation brood from a single isolated (*i.e.* self-fertilising) normally pigmented sinistral snail (brood 1629). This brood at the time of counting consisted of 65 normally pigmented, 22 albino-body, and 74 dead, which of course could not be classified. Clearly the parent snail was heterozygous for the albino factor. This snail was one of a normally pigmented brood derived from isolated singles for three generations back. Eight pairs and seven other isolated singles were carried on from among its sisters and gave broods totalling 4859 young. In none of these 15 broods were any albinos found. Three of these broods were carried on to the next generation and 721 young obtained: again no albinos were found.

In terms of chromosomes, if isolated single (self-fertilised) snails are used, any new recessive mutation must make its presence apparent in the brood given by the first animal to contain the mutant chromosome. It seems clear, then, that the mutation occurred in one chromosome of the germ cells responsible for the parent snail of brood 1629.

Thirty-three snails from this brood were used for further breeding and gave the results set out in Table I. The albinos, as would be expected, bred pure for albinism. For the 27 pigmented snails tested as parents the expectation would be 9AA to 18Aa; the results on the most favourable basis give 10AA to 17Aa, on the least favourable, 12 : 15 (according to the actual composition of the pairs 7596 and 7599). The total classified young from the 12 mixed broods given by Aa parents is:

	Pigmented.	Albino.
	1825	607
Expectation . . .	*1824*	*608*

There seems to be no differential infantile mortality, for whether the death-rate is 79 per cent. (7667) or 12 per cent. (7674) the agreement with expectation among the living remainder is equally close. Pigmented and albino snails come from the same capsule of eggs.

Accurate counts cannot be made with young that have only just hatched, but within a month or so the two types stand out remarkably clearly without any intermediates, and when spread out in the counting-dish give an excellent occular demonstration of the simple 3 : 1 ratio. The material might be useful to those engaged in demonstrating elementary Mendelism to classes. The technique of breeding the snails and counting the results is very simple, and, with only a few bottles, involves a negligible expenditure of time and money. Snails planted out in the spring will, under proper conditions, give broods that may be counted from August to November, and require no attention between planting and counting. There are large quantities of the albino strain at present available for distribution, if required. In the normal course of our experiments these will be thrown away in February.

TABLE I.

Snail used as Parent.	Paired or Single.	Resultant Brood. Pigmented.	Albino.	Dead.	Total.
7590 Albino . .	Pair	..	443	79	522
7591 ,, . .	,,	..	180	190	370
7592 ,, . .	Single	Failed to breed.			
7593 ,, . .	,,	..	173	142	315
7596 Pigmented . .	Pair	519	..	153	672
7599 ,, . .	,,	370	..	16	386
7594 ,, . .	,,	115	35	11	161
7595 ,, . .	,,	230	82	11	323
7597 ,, . .	,,	212	81	62	355
7598 ,, . .	Single	Gave mixed brood, but accurate count not made.			
7601 ,, . .	,,	190	..	2	192
7602 ,, . .	,,	244	..	114	358
7604 ,, . .	,,	307	..	14	321
7665 ,, . .	,,	311	..	83	394
7668 ,, . .	,,	293	..	38	331
7669 ,, . .	,,	248	..	335	583
7670 ,, . .	,,	215	..	445	660
7672 ,, . .	,,	210	..	684	894
7600 ,, . .	,,	196	59	50	305
7603 ,, . .	,,	184	64	104	352
7605 ,, . .	,,	154	44	477	675
7666 ,, . .	,,	131	40	18	189
7667 ,, . .	,,	109	36	537	682
7671 ,, . .	,,	69	21	..	90
7673 ,, . .	,,	142	49	102	293
7674 ,, . .	,,	218	74	40	332

A. E. BOYCOTT.
C. DIVER.

University College Hospital
Medical School,
Gower Street, W.C.,
November 17.

Active Nitrogen.

IN the Research Items in NATURE for September 18 and in correspondence in the issues of October 23 and November 20, attention has been directed to experimental work by Willey and Rideal (*Jour. Chem. Soc.*, July 1926) which led them to suggest that active nitrogen consists of metastable molecules having an energy of about 42,500 cal. per gm.-mol. (= about 2 volts).

Such a view is, however, difficult, if not impossible, to reconcile with spectroscopic data. Ludlam and Easson have pointed out one type of difficulty in the case of the production of such a line as that at λ2061 in the iodine spectrum, which requires an energy of some 150,000 cal. for its excitation. In reply to this, Mr. Willey has suggested that a quasi-stable molecule may first be formed (such as N_2I_2)—presumably by impact of an active nitrogen molecule and an iodine molecule—the energy of which may be released by a second active nitrogen molecule and the total energy should be adequate to excite the iodine line. This, however, is scarcely possible, for the maximum energy which the break-up of the above semi-stable molecule could yield is that of the active nitrogen molecule

which produced its formation. When this is added to the energy of the impinging active molecule it only gives as available energy of excitation twice that of a *single* active nitrogen molecule (which would, according to Willey and Rideal, be 85,000 cal.). In practice, the energy available for exciting the iodine line will be still less by the amount required to dissociate first the iodine molecule.

As an alternative Mr. Willey suggests that the excited NO molecules which yield the β and γ groups of the afterglow spectrum may be responsible for excitation of the line. In this particular case this is just possible, although it is near the limit which these molecules can possess. The (o, o) band of the β group requires almost 6 volts for its production, and even taking the extreme case that an excited NO molecule is loaded with vibrational energy up to the point of dissociation, its available energy would be only 7·9 volts or 182,000 cal. (*vide* Birge and Sponer, *Phys. Rev.*, vol. 28, p. 283, 1926). In general, therefore, activated NO molecules cannot account for all the spectra which active nitrogen is known to be capable of exciting.

In accordance with the views expressed by Birge, Sponer, and others, it seems highly probable that active nitrogen is really atomic nitrogen, which is equivalent to an energy of 11·4 volts (= 263,000 cal.), and this appears as radiation in the ordinary process of recombination. Contrary to the implication of Mr. Willey in his letter to NATURE (November 20), this evaluation of the energy is not based primarily on the ability of active nitrogen to excite *other* spectra but on the nature of its *own* spectrum (*i.e.* the α group). The peculiar limitation of the first positive band spectrum, which it comprises, receives a natural explanation on the assumption that about 11 quanta of vibrational energy (= 2·1 volts) in addition to the 9·3 volts of electronic energy, are sufficient to effect dissociation of the N_2 molecule. Consequences which follow from this have been verified by quite different lines of experiment (*vide* Birge and Sponer, *loc. cit.*).

In explanation of their theory that active nitrogen consists of metastable molecules excited to about 2 volts, Rideal and Willey write that " to effect this excitation it appears that the molecule has to be excited to a high level (11·5 volts) but the electronic energy rapidly disappears after departure of the gas from the discharge zone. . . ." This can scarcely be the case, for 2 volts energy are inadequate to account for the afterglow spectrum (α group), more especially as we now *know* that the final electronic state of the molecule after this emission is 8·0 volts above the normal.

R. C. JOHNSON.
Department of Physics,
Queen's University of Belfast.

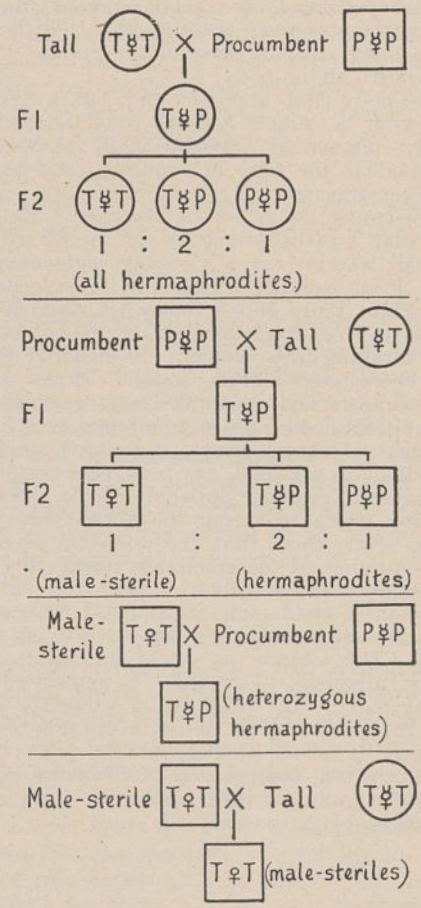
A Suggested Interpretation of Certain Cases of Anisogeny.

MANY cases are known in which the results of reciprocal crosses between green and variegated plants fail to agree. In all these cases the progeny reproduce the appearance of the female parent alone. Cases are also known in which a cross made one way between two true breeding green races results in variegation, whereas in the reciprocal cross the appearance of variegation is either deferred to a later generation or is absent. We know that the female contributes all, or the greater part, of the cytoplasm, and it has therefore been supposed that the cytoplasm, or its inclusions, is partly or wholly responsible for this difference in inheritance. Can this difference in the contribution of the male and female account for the dissimilar results of reciprocal crosses in other characters than variegation?

In crosses between the Tall and Procumbent races of *Linum usitatissimum* a peculiar abnormality (male sterility) occurs in the F2, and is inherited as a simple Mendelian recessive (Bateson and Gairdner, *Jour. of Gen.*, 11, 3, 1921). This character only appears when Procumbent is the female parent in the original cross. No male-steriles occur in F1 or F2 of the reciprocal cross of Tall by Procumbent. Male sterility, then, only appears when there is cytoplasmic continuity from Procumbent.

We suggest that this difference in inheritance is due to a dissimilarity in the cytoplasms of Procumbent and Tall. Individuals of the F1, and later generations resulting from the cross of Procumbent by Tall, would have cytoplasm contributed by Procumbent, whereas the progeny of the reciprocal cross would have Tall cytoplasm. Though a particular Procumbent gene, or group of genes, reacts normally in both cytoplasms, the corresponding factor, or factors, in the Tall, when homozygous in Procumbent cytoplasm, gives rise to male-steriles.

This may be shown diagrammatically thus:



O = cytoplasmic constituent of the Tall.
□ = " " Procumbent.
T = a gene, or group of genes, of the Tall.
P = a corresponding gene, or group of genes, of the Procumbent.

It will be noted that male-steriles crossed with the pure Tall race give only male-steriles. Hence the Tall race was considered by Dr. Bateson to be heterozygous for the element determining hermaphroditism, this element passing solely to the ovules, the pollen being devoid of it. Such phenomena of unlikeness

in the genetical constitution of pollen and ovules Dr. Bateson called anisogeny, in opposition to isogeny, the normal state in which they are equivalent. The example of anisogeny in flax he attributed to somatic segregation occurring at the formation of male and female organs. In the course of last year, however, he considered the possibility of applying a scheme similar to that above described and illustrated, but, owing to two or three inconsistencies in the experimental material, he was not wholly satisfied with it. The inconsistencies remain; but critical evidence is now available in flax, which, though incompatible with the original interpretation, is in perfect harmony with that now proposed. Additional evidence is also provided by a similar case of anisogeny in Geranium, observed here by W. C. F. Newton and Miss A. Sverdrup (unpublished).

It is perhaps needless to say that the present scheme does not apply to Matthiola, or at least does not do so in any simple form.

R. J. CHITTENDEN.
CAROLINE PELLEW.
The John Innes Horticultural Institution,
Merton, S.W.19,
October 29.

Chinese Alchemy.

IT is generally agreed that chemistry had its origin about the first century A.D. at Alexandria, where the Egyptian metallurgical and technical arts combined with speculative philosophy and theosophy to form a belief in the possibility of the transmutation of metals into gold. On the conquest of Egypt by the Arabs in A.D. 640 this knowledge passed to Arabia, largely through the intermediary of Syriac translations of the Greek treatises. Arabic chemistry is not earlier than the seventh-eighth century A.D. and appears to be greatly dependent upon that borrowed from Alexandria.

Berthelot ("Archéologie et histoire des sciences," Paris, 1906) considers that Chinese alchemy was derived from the Arabs. He relies principally on a correspondence with Terrien de la Couperiè, but the opinion of the latter is not quoted in detail. Since the late origin of alchemy in China which this implies is very definitely in contradiction to the Chinese accounts, Berthelot assumes that the latter are largely interpolated, and that the parts dealing with alchemy are additions made after about A.D. 700. He supports this theory by the statement that information about China is really comprised in eighteenth-century native editions of works not usually earlier than A.D. 1000, that is, after the best Arabic period.

There seems to be no evidence that Chinese alchemy is of Indian origin. The earliest treatises on alchemy in India are definitely later than the Arabic period and are probably based on Arabic sources, although if Chinese chemistry is earlier than this the possibility of Indian alchemy coming from China may be considered. Writers on Chinese science, except Giles, all claim its originality, but they do not seem to be acquainted with the activity of the school at Alexandria, and generally assume that chemistry began with the Arabs in the eighth century A.D., which was the usual idea until Berthelot's publication of the Greek treatises of the Alexandrian school, portions of which had been published by Hoefer. The earliest of these are about seven hundred years before any chemistry was known to the Arabs. Giles ("Encycl. Britt." art. China) states that Chinese chemistry is of Greek origin, but the date he gives for it, about 150 B.C. (in agreement with native accounts), is much too early for that source to be possible, unless there was a school of chemistry flourishing in Europe of which we have now no trace whatever. This is highly improbable.

The occupation of Taoist circles with the preparation of an elixir of life and the philosopher's stone is mentioned by Se-Ma-Tsien as prevalent in the reign of Wu Ti (140–86 B.C.). The accuracy of Se-Ma-Tsien seems to be unquestioned, and the account is nearly contemporary. Berthelot refers to this, but is forced to conclude that these Chinese accounts have been interpolated since A.D. 700. It is stated in Chinese sources which are available in translations that Hoei-nan-tsze was an alchemist, and a chapter of his works called "On Bodily Things" deals with alchemy. A translation of part of this has been published by de Harlez and seems to confirm this, but one cannot be sure unless the whole account is considered. Se-Ma-Tsien also reports that a magician Li Siao Kiun advised the Emperor Wu Ti to sacrifice to the alchemist's furnace so that he could call on supernatural beings who would help him to change cinnabar into gold. If the dates are authentic, this is before the earliest alchemy otherwise known.

The most celebrated Chinese alchemist is stated to have been Ko Hung or Pao Pu Tse, who lived in the fourth century A.D. This would be just about the period when the Alexandrian school was very active, and the possibility of his being influenced by it is rather important, but it is long before the Arabic period. He is said to have written a book called "Niu pien," part of which deals with alchemy. Berthelot refers to this text but doubts its authenticity. Extracts from Ko Hung are published by Edkins (*Trans. China Branch Roy. Asiatic Soc.*, Hong Kong, 1855, part 5, pp. 83-99), whose memoir is practically the only source of information on the subject, and they indicate an advanced theory and practice of alchemy.

My object in directing attention to this subject is to make it clear that any conclusions which may be drawn as to the dates of Chinese texts which are based on the belief that accounts in them of alchemy must have come from Greek or Arabic sources are highly doubtful, since the actual position is uncertain. A consideration of all the information on Chinese alchemy which is available to me in European languages has left me with the conviction that the matter is still quite open and that any other view, such as the one adopted by Berthelot, is doubtful. It is to be hoped that the attention of competent Chinese scholars may be attracted to what would be a most interesting and valuable period in the history of chemistry.

J. R. PARTINGTON.
Kingsbury Close, Kingsbury,
London, N.W.9.

Formation of Calcareous Tubes round the Siphons of Teredo.

AT the beginning of June 1926 a quantity of wood heavily infected with Teredo (probably all *Teredo norvegica*), taken from the experimental rafts moored near the Plymouth breakwater, was placed in one of the tanks in the Plymouth laboratory. It was left undisturbed for almost four months, and when examined at the end of September was found covered with fæcal deposits consisting of wood fragments cut away by the shell valves of Teredo and passed out by way of the exhalent siphons. These deposits were, on the average, rather less than half an inch thick, and when they were washed away there were revealed, projecting from the wood, great numbers of fine calcareous

tubes, which on closer examination proved to occur always in pairs and to project from the openings of the burrows formed by the shipworms. Plainly the tubes had been formed around the siphons of the Teredo. They were of varying length, depending presumably on the thickness of the deposits, the longest being some two-fifths of an inch. The general appearance of the wood is shown in Fig. 1.

Photo.] [*A. J. Smith.*

FIG. 1.—Portion of wood badly infected with *Teredo norvegica*. The white objects are the protruding calcarerous siphonal tubes which appeared after the fæcal deposits had been washed off. In several cases the paired tubes can plainly be distinguished.

Normally the external openings of the tubes of Teredo are very difficult to distinguish, consisting of a pair of minute openings ringed with calcareous matter out of which project the siphons and within which these are immediately withdrawn on stimulation. The presence of fæcal deposits, which had accumulated to an abnormal degree owing to the lack of water currents to remove them, would tend to obstruct the passage of the siphons and so endanger the life of the animals within. The response of the animals to this abnormal and dangerous state of affairs was to lay down calcareous tubes around the siphons, which by this means were able to maintain free contact with the water.

Dr. W. T. Calman has directed my attention to the fact that the giant shipworm, *Kuphus arenarius*, which lives vertically embedded in the mud of mangrove swamps in the Pacific, normally has the siphons encased in this manner, a fact which was known to Rumphius so far back as 1741, and was figured by him (as *Solen arenarius*) in his "D'Amboinsche Rariteitkamer." This animal lives normally under conditions in which the Teredo in the Plymouth tank lived for some four months, namely, in constant danger of being suffocated by accumulating deposits—in one case of mud, in the other of fæcal matter.

This accidental production of calcareous siphonal tubes in Teredo is therefore of some considerable interest, since it provides a very striking case of an immediate and highly successful response by an animal to changed environmental conditions; a response, moreover, which has taken the form of a permanent adaptation in related animals living under conditions very similar to those accidentally produced.

C. M. YONGE.

Marine Biological Laboratory,
Citadel Hill, Plymouth,
November 15.

Fluctuations in the Abundance of a Species considered Mathematically.

WITH regard to Prof. Volterra's interesting article, "Fluctuations in the Abundance of a Species considered Mathematically," in NATURE of October 16, page 558, I may be permitted to point to certain prior publications on the subject, of which Prof. Volterra seems to be unaware. The general theory as well as a number of special cases have been set forth in "Elements of Physical Biology" (published by Williams and Wilkins, Baltimore, 1925), in which work a considerable number of references to the journal literature are given. Among other things Prof. Volterra's diagram "Fig. 2" will be found on page 90 of the book cited; the expression for the period of isochronous small oscillations in the case of two species is also found on the same page. Prof. Volterra refers to certain applications of his analysis to problems of sea fisheries, to a passage in Darwin's "Origin of Species," to extinction of species, to pathogenic germs, and to parasitology. An application to sea fisheries is found in the book cited on page 95; to a passage in Herbert Spencer on page 61; to the extinction of species on pages 94, 95; to pathogenic germs on pages 77, 79, 147 *et seq.*; to parasitology on page 83.

The effect of introducing a third species into a system of two species is discussed on page 94; the effect on equilibrium of changing various factors is treated in Chap. xxii., "Displacement of Equilibrium," and, in particular, the effect on equilibrium between food and feeding species is analysed on page 289. The distinction between oscillatory and aperiodic systems, and its relation to certain quadratic forms, is referred to on pages 146, 148, and 159.

It would be gratifying if Prof. Volterra's publication should direct attention to a field and method of inquiry which apparently has hitherto passed almost unnoticed.

ALFRED J. LOTKA.

Metropolitan Life Insurance Company,
New York City, October 29.

In the above letter from Dr. Lotka, which is in accordance with our preceding correspondence, following upon the publication of my article in NATURE, he justly observes that he had obtained the differential equations in the case of two species, one of which feeds upon the other, that he had given, as well as myself, the same diagram of the integral, and also the period in the case of small fluctuations. In this I recognize his priority, and am sorry not to have known his work, and therefore not to have been able to mention it.

I did not even know other publications of the same kind by other authors, for example, the work of Sir Ronald Ross on malaria, which precedes the writings of Dr. Lotka, who has, however, found so many new and important results.

The other observations mentioned in the above letter refer to points which I have not treated; but as to the sea-fisheries, while I refer to the laws (which I believe to have been the first to formulate) and principally to the third law, which gives an easy way of calculating the maximum output of fisheries; he, on his part, considers the case of the addition of a third species, which seems to me a different problem.

I also think that the quotation of Darwin's acute intuition referring to my third law, and the quotation from Spencer, which touches only the principle of the existence of fluctuations, are essentially different.

I think that the study of the general case of the convivence of n different species, subject to the hypothesis which permits me to distinguish the case

of conservative association from that of dissipative association, and to obtain integrals and laws of fluctuation which form the essential and the greatest part of my memory, is absolutely new. To conclude, I recognize the existence of some common points in Dr. Lotka's work and my own, in which he has priority, but my work and his diverge in all the rest.

Working independently the one from the other, we have found some common results, and this confirms the exactitude and the interest in the position of the problem. I agree with him in his conclusions that these studies and these methods of research deserve to receive greater attention from scholars, and should give rise to important applications.

VITO VOLTERRA.

Via in Lucina, 17,
Rome, November 27.

The Polishing of Surfaces.

DR. HAMPTON of West Bromwich has directed my attention to Mr. J. M. Macaulay's letter on "The Polishing of Surfaces" in NATURE of September 4, p. 339.

In conversation with Sir Herbert Jackson, Mr. Twyman, and others, I have once or twice had occasion to point out that the energy available in practice for liquefying the surface layer of glass is many hundreds of times what is theoretically necessary. It is known that in polishing glass, the amount of glass removed corresponds to a solid layer of the order of ten wave-lengths in thickness. The total quantity of heat necessary to liquefy or even vaporise a layer of this thickness is not great in comparison with the energy expended in the actual process of polishing. The figure given by Sir George Beilby of four pounds per square inch as a pressure sufficient to start flow has no significance. In the process of polishing glass on a commercial scale, pressures very much less are the rule. In the polishing of plate glass, for example, they are of the order of half a pound per square inch; in the spectacle industry they are commonly of the same order; in the optical industry the specific pressures used become greater and greater as the surface becomes smaller.

There is every reason to believe that glass will polish with the most insignificant pressures that can be attained in practice; but of course the lower the pressure the longer the time required. The coefficient of friction which Mr. Macaulay takes as 0·3 is a long way out. In polishing with felt and similar materials the coefficient ranges from about 0·85 to 1·1, and is usually taken by designers as from 0·95 to 1·0. In polishing with pitch the apparent coefficient of friction fluctuates very widely, because the film of moisture between the pitch and the glass renders the interfacial pressure itself either very great or very small according as the quantity of moisture becomes less or greater. However, whatever assumptions may be made about the pressures and coefficients of friction, it may be taken that in the polishing of large surfaces of glass about ½ kilowatt hour is expended over a square foot of surface polished. In the optical industry, where surfaces are smaller and preliminary grinding is better, an expenditure of energy of about half this amount suffices. From this it may be calculated, I think, that the efficiency of the glass polishing operation is (on the assumption that the energy is required for liquefying a thin surface layer) not more than about one-half of one per cent.

I am not a great believer in the surface flow theory. In various papers to the Optical Society of England and elsewhere I have given reasons for believing that whatever part surface tension effects may play, the process of polishing is at bottom primarily one of abrasion.

F. W. PRESTON.

222 E. Clay St.,
Butler, Pa., October 26.

THE practical information which Mr. Preston gives is of considerable interest and value. His observations appear, on the whole, to support the view expressed in my previous letter, that glass surfaces are actually fused in the process of polishing.

One wonders whether the conception may not approximate in some degree to Mr. Preston's belief that "the process of polishing is at bottom primarily one of abrasion." One can imagine the surface molecules in the liquid state being, so to speak, picked off by the rouge particles, thus giving, so far as the resulting debris would indicate, an abrasion effect.

JAMES M. MACAULAY.

Natural Philosophy Department,
The Royal Technical College,
Glasgow, C.1,
November 24.

Origin of Yolk in the Eggs of *Luciola gorhami*.

THE eggs of the coleopteran fire-fly, *Luciola gorhami*, found in the plains of the Punjab, have proved to be objects of rare value for the study of the problem of the origin of yolk. There are two kinds of yolk in these eggs: albuminous and fatty. The former arises directly from nucleolar extrusions of a remarkable type. At a very early stage in the growth period the nucleolus shows signs of intense activity and buds off numerous round bodies of different sizes, which are thrown out in the cytoplasm. The nucleolus continues to throw out these extrusions until the very last stage in oogenesis. At the beginning of this process the extrusions migrate towards the periphery of the egg-cytoplasm, where they grow in size, perhaps at the expense of food materials derived from the follicle cells.

The whole process is reminiscent of what has been described in the cockroach and certain Hymenoptera by Hogben (*Proc. Roy. Soc.*, 1920, A, and 1920, B) and in Saccocirrus by Gatenby (*Quart. Jour. Micr. Sci.*, 1922). Nucleolar extrusions preceding the appearance of albuminous yolk have, of course, been described in some other eggs, *e.g.* Lithobius (King, *Scient. Proc. Roy. Dub. Soc.*, 1924, and Nath, *Proc. Camb. Phil. Soc. Biol. Sci.*, 1924) and Buthus and Euscorpius (Nath, *Proc. Roy. Soc.*, 1925), etc., but in Luciola it is noteworthy that the process of nucleolar budding lasts practically throughout oogenesis, and the process of the growth of nucleolar extrusions into the albuminous yolk spheres can be studied with diagrammatic clearness.

The origin of the fatty yolk from the Golgi elements is no less clear. The latter exist in the form of rings and crescents. The rings might also be appropriately described as vacuoles (cf. 'vacuome' theory of Parat), with a sharp chromophilic rim and a central chromophobic substance (idiosome). When the solid osmicated fat spheres are decolorised in turpentine they also show a chromophilic rim and a central chromophobic substance, exactly like the Golgi rings. On further decolorisation they appear like clear vacuoles.

We emphasise this morphological similarity between the Golgi rings and the fatty yolk spheres. It seems clear that the fat spheres arise directly from the Golgi rings, in the interior of which free fat, not

miscible with the general cytoplasm, is deposited. In the undifferentiated germ cells the Golgi apparatus exists in the form of about four rings lying on the edge of the nuclear membrane, and we further emphasise the remarkable and unique fact that the Golgi rings of some germ cells are saturated with free fat long before the egg is differentiated from other cells.

A full account will be published later.

VISHWA NATH
(Bhupendra Research Laboratory, Patiala).
DEV RAJ MEHTA
(Government College, Lahore).

October 14.

Solar Radiation and Athermancy.

THE efficacy of a material in excluding solar heat is a complex function. For practical purposes, however, athermanous materials may be graded in terms of an empirical transmission factor,

$$F = (1 - R)/\{1 + (1 + E_2)[1/(1 + E_1) + 1/K]\},$$

where K is the conductivity (B.Th.U. per sq. ft. per degree Fahr. per hour), E_1 the emissivity of the inner surface, E_2 the emissivity of the exposed surface and R its reflecting power for solar radiation. Both surfaces are presumed to be in contact with air. Values for a few materials are tabulated below.

Material	Inner Surface	Exposed Surface	E_1	E_2	R	K	F
Metal sheet .	Silvered	Silvered	0·02	0·02	0·90	large	0·05
1 in. wood .	White or black paint	White paint	0·95	0·95	0·70	1·0	0·08
3 in. wood .	„ „ „	Black paint	0·95	0·95	0·05	0·3	0·11
1 in. wood .	„ „ „	„ „	0·95	0·95	0·05	1·0	0·24
Metal sheet .	Silvered	Blackened	0·02	0·95	0·05	large	0·33
Metal sheet .	Blackened	„	0·95	0·95	0·05	large	0·48

It would be of interest to know whether there is any anomaly in this grading.

A. F. DUFTON.
Building Research Station,
Garston, Herts, November 23.

An Amusing Conception of Scientific Discovery.

THE want of touch between politicians and science, at all events a score of years ago, is amusingly illustrated in the following extract from the official report of a speech made by the Marquis of Lincolnshire in the House of Lords on Dec. 6 last.

He was speaking on the Small Holdings and Allotments Bill, and was describing discussions which, when Minister for Agriculture in Sir Henry Campbell-Bannerman's Government, he had with the Prime Minister about the introduction of the Bill which emerged as the Small Holdings and Allotments Act of 1908.

The extract is as follows :—

" Sir Henry Campbell-Bannerman pricked up his ears and said : ' What a curious thing it is how the same wonderful sentiments and ideas sometimes simultaneously strike the noblest minds. I will give you an instance. When I was at Cambridge in the 'fifties there was a great big hulking undergraduate at St. John's College. He must have been very clever because, going one starry night for a ramble, he looked up at the firmament on high and discovered a planet. It was a wonderful thing to do, but it was absolutely true that that man discovered a planet, and, curiously enough, that very same night an old Frenchman, squinting through an opera glass or a telescope or something of that sort, discovered it too.' And that, Sir Henry Campbell-Bannerman said, was a very wonderful development and almost a precursor of the *entente cordiale*."

It required an effort, at all events on the part of one reader, to recognise this highly original account of the simultaneous discovery of Neptune by Adams and Le Verrier in 1846.

X. Y.

December 13.

An Unclaimed X-ray Spectrometer.

IN the hope that we may be able to restore a piece of lost property to its owner, we would greatly appreciate the publication of the following facts.

Recently the New York Central Railroad had an auction sale of unclaimed baggage. One of the pieces of baggage contained what appears to be a simple X-ray spectrometer with a fluorescent scale for visual observation. The purchaser brought the apparatus to us for identification, and he is willing to restore it to its owner if we can locate him.

The instrument was sent as baggage on the New York Central Railroad from Albany, N.Y., to Chicago, where it arrived at 10.00 A.M. on October 21, 1924, presumably on the Twentieth Century Limited. The date makes it appear possible that the apparatus may have belonged to someone who attended the meeting of the British Association for the Advancement of Science in Toronto. The instrument was manufactured by Schall and Son, of London.

Inquiries should be directed to the undersigned, who will take the necessary steps to have the instrument returned to its owner.

PAUL E. KLOPSTEG.
Central Scientific Co., Chicago, Illinois (U.S.A.).

The Oogenesis of Lumbricus.

I FEEL compelled, much against my own and Prof. Gatenby's feelings, to reply to his letter in NATURE of December 11. In the first place, I do not quote in my bibliography papers which I have not carefully read. In the second place, I have read the papers on yolk formation which Prof. Gatenby recommends. Hence my desire for an attempt at co-ordination of the divergent observations on this phenomenon in oogenesis. Lastly, may I record my agreement with him on the subject of Parat's work? I think his evidence is very strong, yet, at the same time, I would prefer to " add facts " and " avoid discussion " of work which is even yet in its infancy.

L. A. HARVEY.
University of Edinburgh,
December 15.

'Sun Circles' in Ritual Dances.

IN connexion with Miss Violet Alford's lecture on ritual dances, reported in NATURE of December 4, it would be interesting to know whether anthropologists familiar with ritual dances among tribes of the southern hemisphere, for example, the Australians, have noted in these the practice of dancing 'sun circles' in the reverse direction, which we should call 'widdershins.' As the apparent path of the sun in the southern hemisphere runs in the contrary direction to its path in our hemisphere, that is, from east through north to west, sun circles should surely be danced in this direction also.

W. E. F. MACMILLAN.
42 Onslow Square, London, S.W.,
December 6.

Regions of Compression.[1]

By Dr. J. W. EVANS, F.R.S.

I.

IT is usual to contrast the horizontal forces acting on the earth's crust with those that are vertical and to regard the latter as more fundamental and important. This attitude is apt to be misleading, although it rests on a foundation of fact, if it be true, as is generally believed, that most horizontal forces are ultimately to be attributed to the contraction on cooling of the earth's interior, which lets down the crust so that it has to accommodate itself to an area less extensive than that which it previously occupied.

The discovery, however, of the release of energy in the course of the atomic degradation of uranium and thorium and their products caused a reconsideration of the question. It is true that the amount of radioactive materials diminishes as the basicity of the rock increases, and there is every reason to believe that the deeper rocks are more basic than those nearer the surface, but it is contended that, even if this be allowed for, the energy given out by them in their disintegration, converted into heat, would cause a rise instead of a fall in the earth's temperature. Prof. John Joly believes that this has in the past led to catastrophic developments characterised by great outpourings of lava. But, although the whole of the energy given out by radioactive elements, when isolated, is converted into heat, it is probable that a considerable proportion of the energy liberated by such elements, when they occur as rock-constituents, is used up in effecting physical, chemical, or atomic changes in the surrounding minerals.

That much of the radioactive energy set free in the disintegration of radium and thorium is absorbed in other ways than in raising the temperature of the rocks is clearly shown by the formation in certain circumstances of 'pleochroic haloes' round radioactive minerals. This occurs especially in the case of zircon embedded in biotite mica. Such a halo is a sphere with a radius of about 30 microns, and has a minute zircon at the centre. It is of a darker and a deeper brown and far more pleochroic than the rest of the mica. The difference is usually assumed to be the result of ionisation by the radiations from uranium and thorium contained in the zircon. The possibility of atomic changes under the influence of the α rays must, however, not be ignored.

The formation of the haloes must involve a considerable absorption of energy, the magnitude of which will be realised when it is remembered that the mass of the halo may be some 15,000 times that of the zircon at its centre, and more than 300,000 times that of the uranium and thorium to which the halo owes its existence. Nor is it probable that this absorption is confined to the pleochroic haloes.

It is, therefore, doubtful whether there is any considerable excess of radioactive energy available for raising the temperature of the earth.

The zone in which appreciable cooling takes place must extend over only a small fraction of the earth's radius, and the question arises whether the contraction from cooling in this zone is sufficient to account for the folding that we know to have taken place.

Dr. H. Jeffreys estimates that the actual crumpling and overthrusting observed in the principal mountain-chains of the earth has resulted in a decrease in the area of its surface of 2,000,000 square kilometres. At the same time, he calculates that the cooling that is taking place in the earth's interior will, on the basis of the observed coefficient of expansion of the rocks of the earth's crust, result in a decrease in the area of the surface amounting to rather more than 4,000,000 square kilometres.

Now, the folding of the mountain ranges included in this calculation by no means represents the whole of the folding to which the earth's crust has been subjected. Many folded areas are no longer mountainous. They are the sites of ancient ranges which have since been planed down.

It is, therefore, probable that the contraction to which the folds and overthrusts bear witness exceeds that which Dr. Jeffreys believes to have resulted from the cooling of the earth's interior. There is, however, little doubt that far greater contraction has taken place.

The sedimentary and the acid igneous rocks of the continents, which constitute the sial, are apparently underlain, at a depth variously estimated at from 100 to 15 km. by the sima: that is to say, basic and ultrabasic crystalline rocks, or magmas of similar composition, except that they contain water and other volatile constituents.

Dr. Jeffreys bases his calculations of the amount of contraction on the coefficient of expansion of specimens of crystallised rocks which have, of course, lost most of the volatile constituents that they possessed when in the state of uncrystallised magma. Yet, judging from the amounts given off in the course of volcanic eruptions, such as those of Hawaii, volatile substances must form an important proportion of even a basic magma, which will accordingly have a much higher coefficient of expansion than the crystallised rock.

Dr. Jeffreys calculates, however, that the sima is crystalline down to a depth of more than 600 kilometres. This is because he takes the crystallisation point of a basaltic magma under atmospheric pressure at 1200° C. and that of a peridotite at 1400° C. These, however, are the temperatures at which the crystallised rocks that have lost their volatile constituents can be remelted. We know from the observations of T. A. Jagger that the basaltic magma at Kilauea, which retains some, though by no means all, of its volatile constituents, remains fluid at 750° C. It is true that he assumes that the magma was supercooled, but there is no evidence of this. There can be no doubt that the crystallisation point of a basalt- or even a peridotite-magma retaining its volatile constituents would be considerably less than that at which the crystallised rock can be remelted.

It is also assumed by Dr. Jeffreys that the crystallisation point is raised by 3° C. for every additional kilometre of depth, on account of the increase of pressure. This is a fair estimate of the rate of increase of the crystallisation temperature with increase of pressure

[1] From the presidential address delivered to the Geological Society of London on February 19, 1926. A large portion of the address in which illustrations are drawn from the Hercynian, Wealden, and Alpine folding, and all references, are here omitted.

near the surface; but P. W. Bridgeman has shown that the rate of increase diminishes rapidly as the pressure increases.

Allowing, then, for the fact that the temperature of crystallisation of a basaltic magma at the surface is much less than that assumed by Dr. Jeffreys, and for the lower rate of increase of the temperature of crystallisation with increasing pressures at great depths, there seems every reason to believe that a considerable portion of the cooling zone is in a non-crystalline condition, that it still contains a large proportion of volatile constituents, and that it has therefore presumably a higher coefficient of expansion than solid basalt. Nor would the substitution of a peridotite-magma, which Dr. A. Holmes believes to underlie the basalt-magma at a depth of 45 km., make any important difference.

It must be remembered, however, that, on one hand, the coefficient of expansion of all substances shows a marked increase with increased temperature, and, on the other, it diminishes with increase of pressure.

Unfortunately, we are without precise information as to the physical properties of magmas and still less as to the variations of these properties with changes of temperature and pressure. There is no insuperable obstacle to the determination of these data at temperatures and pressures up to those found at depths of about 35 miles (say, 56 km.), and they may reasonably be extended to considerably greater depths by extrapolation. In the meantime many of the problems that present themselves in geophysical research cannot be solved with any approach to certainty. It is earnestly to be hoped that a serious attempt to obtain the necessary data will be made.

There is another important consideration. In some part at least of the zone of cooling, amorphous magmatic material is passing into the crystalline state, not only as a result of the loss of heat, but also in places on account of the loss of volatile constituents. The process of crystallisation is accompanied by very considerable contraction in the case of all or nearly all silicates and mixtures of silicates, a contraction equivalent to that resulting from cooling through hundreds of degrees, whether in the amorphous or in the crystalline state.

Dr. J. A. Douglas has experimented on the increase in volume when crystalline rocks are melted and allowed to cool rapidly so as to consolidate without crystallising. The following were the results obtained with basic crystalline rocks, the composition of which approximated to that of the sima:

Name and locality of rock.	Sp.g. before melting.	Sp.g. of glass.	Percentage of defect of volume in the crystalline state compared with that of the glass.
Gabbro (Carrock Fell) . .	2·940	2·791	5·07
Olivine-dolerite (Clee Hills) .	2·889	2·775	3·95
Dolerite (Rowley Rag) . .	2·800	2·640	5·71
Dolerite (Whin Sill) . .	2·925	2·800	4·27
Average			4·75

The fourth column must represent the contraction which a glass of the same composition as the rock would undergo in crystallising. This contraction may be compared with that which would have taken place as a result of simple cooling in the crystalline state.

According to Prof. F. D. Adams, the cooling at a depth of 50 km. has been from about 1450° C. to 950° C. If, like Dr. Jeffreys, we adopt Fizeau's formula for the variation of the volume of rocks, with temperature, namely, $V_t = V_0(1 + et + e't^2)$, where V_0 is the volume at 0° C., V_t that at t° C., $e = 7 \times 10^{-6}$, and $e' = 2{\cdot}4 \times 10^{-8}$, we find that a cubic centimetre of basic rock at 0° C. will have a volume of 1·0606 c.c. at 1450° C., and 1·0283 at 950°. The contraction in cooling from the former to the latter temperature would accordingly amount to 3·05 per cent. of the volume at the higher temperature, about 62 per cent. of the contraction in crystallisation from a melt without volatile constituents. At a depth of 100 km. the cooling is estimated to have been from about 1770° C. to about 1290° C., corresponding to a decrease in volume from 1·08756 c.c. to 1·04897 c.c., a decrease of 3·55 per cent. At 200 km. the cooling is estimated to have been from about 2200° C. to 1900° C. with a decrease from 1·1316 c.c. to 1·0994 c.c., equal to 2·84 per cent. It is evident, therefore, that the contraction on crystallisation would, even apart from the presence of volatile constituents, be much greater than from the simple cooling of crystalline material.

The steam and other volatile substances, however, are eliminated on crystallisation; consequently, the decrease in volume will be far greater than that on crystallisation from a magma without volatile constituents. The volatile constituents may afterwards occupy for a time cavities, large or small, in the consolidated rock or elsewhere in the earth's crust; but by far the greater part will sooner or later escape into the atmosphere, with a corresponding decrease of bulk of the solid earth as a whole.[2] The expulsion of volcanic materials will naturally have a similar effect.

Contraction will also occur on a change of crystalline state from lighter to denser minerals of similar composition, and not improbably on a transformation of elements into others of less atomic volume. Both these changes may be determined by the heavy pressure of the earth's interior. It is, however, probable that most of such possible changes took place early in the world's history. It is only where the pressure has for some special reason been increased or where directed pressure (shearing stress) has intervened, that such changes may be expected to have occurred during the geological time of which we have any record in the rocks.

There is, nevertheless, one change in the terrestrial conditions which will result in a general and progressive increase in pressure, and thus cause an equally general contraction. The acceleration of the moon's position in the heavens is usually considered to be in great part attributable to the slowing down of the earth's rotation. This will result in a decrease in the centrifugal force, with a consequent increase of pressure in the interior of the earth and a corresponding contraction in its volume. These effects have been calculated by R. Stonely, who arrives at the conclusion that "diminishing rotation is a much less potent cause of the elevation of mountain-ranges than is cooling, but that it is sufficiently important to be considered as a large correction to the cooling theory."

[2] The latent heat evolved on crystallisation and changes in crystal structure must delay the processes of cooling and crystallisation, while that absorbed on the expansion of volatile constituents will accelerate them.

As I showed in my previous address, there are at least two opposing influences tending to modify the length of the day: the progressive contraction of the earth accelerating the angular velocity, and the tidal friction producing a contrary effect. At present, the latter seems to be more powerful; but it is possible that in the past the reverse has been the case, especially in the early stages of the earth's existence.

All the processes which have been considered will result in direct primary movement downwards towards the centre of the earth; but, on account of the fundamentally homogeneous character of the earth's material at deep levels (shown by the close similarity of the transmission of earthquake waves in different areas), the subsidence from this cause must everywhere be nearly the same, and will rarely result directly in appreciable *differential* vertical movements of the earth's crust.

There are, on the other hand, processes by which the surface of the earth's crust may locally be permanently extended. This can happen in regions of tension in two different ways. In the first place, temporary rifts, often of considerable size, may be filled by igneous magmas which afterwards consolidate, and by broken material from the sides and the neighbourhood. In the next place, movements of extension occur along the planes of normal faults. When, later, a period of compression supervenes, such movements will not be reversed unless the hade, the deviation from the vertical, is very great, that is to say, well over 45°; otherwise, the pressure at right angles to the fault-plane will increase the friction so much that movement will be impossible. The surface of the crust may also be increased by hydration, especially in the case of igneous rocks. These extensions of the earth's crust must in the long run tend to produce effects in the way of folding and thrusting similar to those resulting from the contraction of the interior.

There are other forces operating on the earth's crust, besides those due to the excess of the area of the crust over that of the surface of the interior, that must tend to produce horizontal movements.

In the first place, a slowing-down in the earth's rotation will be accompanied by a consequent change in the form of the solid earth, which on a large scale adjusts itself to the forces operating on it, but of course not so rapidly as do the aqueous and gaseous envelopes, though geologically the time required is relatively short.

Such a reduction of the rate of rotation of the earth will result in a decrease in the equatorial diameter and in an increase in the polar diameter, involving a movement in the substance of the earth. This will consist in a flow, at all levels, from the equatorial plane towards the poles, combined with a slight downward movement near the equator and a slight upward movement near the poles. The circumference at the equator will contract, but one must not expect contraction which is common to the surface and to all depths to have the same effect as a contraction affecting a portion of the interior, and not the exterior; and, as a matter of fact, there are no north-and-south folded mountains that can reasonably be considered to have been formed in this way. The crust at the equator would, therefore, seem not to have been folded from this cause, but to have been distorted horizontally—being contracted east and west, and extended laterally northwards and southwards. This will add to the effect of the simultaneous decrease in the meridional periphery of the earth, and a strong north-and-south compression in intermediate latitudes will result which cannot be relieved by lateral extension, except to some extent in high latitudes where there will be a small but appreciable expansion of the earth's surface.

It is, therefore, not surprising that in low to intermediate latitudes the compressive forces in the earth's crust arising from causes already discussed are intensified in a north-and-south direction so as to favour the formation of east-and-west folding.

Somewhat analogous effects would result from a change in the position of the poles relatively to the configuration of the earth's crust. This would probably be a result of the shifting of the earth's crust relatively to the core, rather than of a change of the axis of rotation of the earth as a whole from one position to another in its mass. Tidal action may result in an east-to-west movement of the earth's crust, but this alone would not directly affect the position of the pole relatively to the features of the earth's surface. But, if there were a locality such as that of a deeply-rooted mountain-mass where the cohesion between the earth's crust and the core was greater than elsewhere, there would be a tendency for the crust to rotate round it, and this would bring new tracts under the poles. There would then be a drifting-away of the continental masses from the new position of the pole on the earth's crust and towards the new position of the equator; this might appreciably affect the configuration of the earth's surface.

It has been suggested that the centre of gravity of the earth's interior does not exactly coincide with its centre of form, so that there is a point on the earth's surface where the force of gravitation is at a maximum, and towards which both the ocean waters and the continental masses tend to move. If this be the case, and the crust of the earth shifts relatively to the interior, the point of maximum gravitation will occupy a new position on the earth's crust, and the drift will be directed towards the latter.

There seems reason to believe that in late Palæozoic times the principal land-masses were united in one great continental mass collected round Africa as a centre, and that they have since drifted away eastwards, southwards, and westwards towards the centre of the Pacific. This would be only what one would expect if the points with the maximum force of gravitation were in Devonian and Carboniferous times in Central Africa, and in Tertiary and Quaternary times in the centre of the Pacific. But, although the forces, developed directly or indirectly as a result of tidal retardation and the resultant relative movement of the earth's interior and crust, must be taken into serious consideration, and may from time to time exercise decisive influence on the structure and configuration of the earth's crust, it is only the horizontal forces resulting from the contraction of the earth's interior, assisted by expansion of its crust in local and temporary regions of tension in the manner already explained, that are sufficiently powerful to account for the development of the folds and thrusts of the present mountain-chains and those that existed in former geological periods.

(*To be continued.*)

Two Oceanographical Expeditions.

I.—The German South Atlantic Expedition of the *Meteor*.

IN 1919 plans were formulated by the late Dr. Alfred Mertz for a national expedition to study the physical and chemical conditions of the South Atlantic. In conjunction with the Deutsche Seewarte at Hamburg and the Institut für Meereskunde at the University of Berlin, a very thorough programme was drawn up, a scientific staff gathered together, and the use of the gunboat 'C,' renamed *Meteor*, obtained. The vessel is of 1300 tons displacement, having a ship's company numbering 133, which includes the scientific staff of nine, exclusive of assistants, and nine ship's officers, exclusive of engineers and under-officers.

Whereas former oceanographical expeditions have been concerned very largely with the life in the oceans, the programme of this expedition is almost entirely limited to hydrographical and meteorological observations, to be made at numerous positions while crossing the South Atlantic fourteen times between the South American continent and Africa, the various positions being chosen so as to allow of the best use being made of Bjerknes' theory in calculating the currents at various levels and the consequent circulation of the water masses. Particulars of the objects, equipment and first fruits of the cruise, which commenced in January 1924, have been published by Dr. Mertz,[1] and in two later reports by Captain F. Speiss,[2] who succeeded to the leadership of the expedition after the unfortunate death of Dr. Mertz, which occurred shortly after the programme of work was commenced in the South Atlantic.

Fig. 1, taken from Captain Speiss's report, shows the tracks which have been followed and the 139 positions or stations where observations have been made at depths between surface and bottom. Besides these, numerous observations have been made at a number of other positions on the voyage out from Germany. The section from Cape Town to Buenos Aires shown in Fig. 2 indicates the nature and depths of the observations; considered in conjunction with Fig. 1 the intensity of this hydrographic survey is apparent.

With regard to the scope of observations, besides the distribution of temperature and of density, from which the probable circulation of the water in the ocean will be calculated, observations of hydrogen ion concentration, of the oxygen, carbon dioxide, gold, silver, phosphate and nitrate content of the water are provided for, and a method has been devised and used for measuring the rate of evaporation from the surface of the sea. Measurements are made of the waves encountered by a stereophotographic method, and echo-soundings are carried out by three different systems, from the results of which the production of a very complete bathymetric chart will doubtless be possible. Microplankton organisms collected at the various stations are being examined and their quantity measured on board. Regular meteorological observations are made on board and to a height of above 15 kilometres by means of pilot balloons and kites, while at the various ports visited the local geological formation has been investigated.

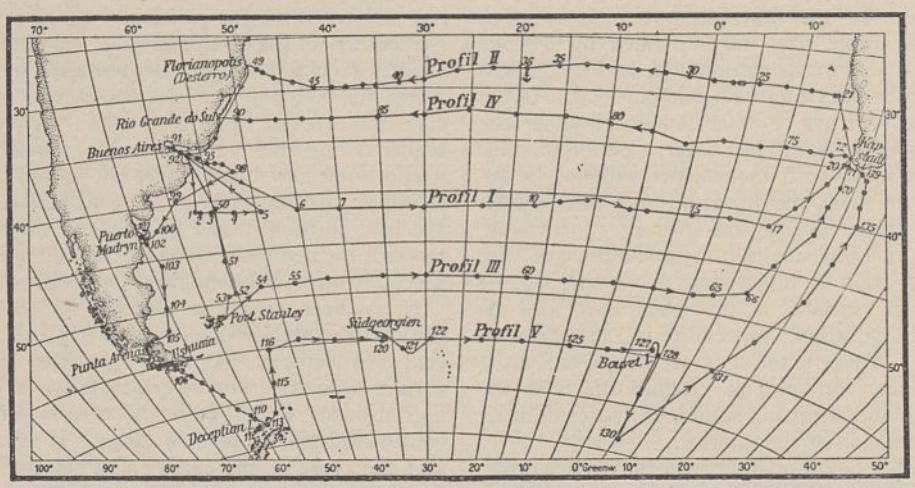


FIG. 1.—Course of the *Meteor*, with the 139 stations where observations between surface and bottom were made.

The reports give particulars of how the work is being carried out and of how it progresses according to the original plan, which the *Meteor* has been able to follow very closely in spite of bad weather experienced in the more southerly latitudes. When the observations are published and the data worked up and charted, they should present a more perfect picture of the observed conditions in this area than we have for any other ocean, and from such a survey there can be little doubt that several general principles will emerge of fundamental importance to the rapidly growing science of physical oceanography.

II.—The Cruises of the *Armauer Hansen* in the Eastern North Atlantic.

For a very considerable time it has been known that the British islands owe their warm climate, in comparison with that of Newfoundland in the same latitude

[1] "Die Deutsche Atlantische Expedition auf dem Vermessungs- und Forschungsschiff *Meteor*," by Prof. Dr. A. Mertz, *Sitzungberichte der Preuss. Akad. der Wissenschaften*, 31, 1925.
[2] "Die Deutsche Atlantische Expedition auf dem *Meteor*," *Zeit. der Gesellschaft für Erdkunde zu Berlin*, No. 1 and No. 5/6, Berlin, 1926.

to the Atlantic or European current which bathes our coast, and passes northward, and to the south-westerly winds which produce it. Towards the end of the last century the Scandinavian hydrographers found that the surface temperature of the Norwegian sea varied from year to year largely in relation to the amount of warm Atlantic water which passed into it over the submarine ridge which extends from the Shetlands to Iceland. This variation in temperature in turn affected the climate and several seasonal occurrences along the Norwegian seaboard, such as the annual growth of pine trees, the time of flowering of various plants and probably the seasonal fisheries.

As a natural result, more information was desired concerning the circulation of water in the eastern North Atlantic, and particularly of the fluctuations in the Atlantic current. Owing to the costly nature of investigations over such a wide area, the observations which it has been possible to make have been severely limited; nevertheless, considerable knowledge has been accumulated, notably through the active interest taken by Dr. Nansen. He found water of Mediterranean origin mixed with Atlantic water so far north as Ireland during an expedition made by him in 1910 in the *Frithjof*—a vessel lent for the purpose by the Norwegian Navy. In consequence of this and similar Norwegian and Danish investigations, a new set of questions were raised which made it especially desirable to carry on more extensive studies of the great Atlantic current off Europe.

In a recent publication [3] the scientific results are presented which were made during cruises of the *Armauer Hansen* in 1913, 1914, 1922, 1923 and 1924, extending so far south as Madeira and to Lat. 30° W. some 700 miles to the westward of Ireland. The ship was a small yawl of 56 tons burden, with auxiliary motor only used occasionally; that is to say, she is a vessel smaller than the trading ketches and Thames barges which ply around the British coast. The oceanographical observations were mainly made by Helland-Hansen at numerous stations to depths exceeding 2000 metres. This necessitated manœuvering the ship so that the line along which the instruments are suspended remained in a vertical position throughout the time of observations, even if there is a strong drift caused by wind or current. In this connexion they write: "Care has always been taken to make sure of the vertical position of the sounding line, and the determination of the depths may therefore be considered very trustworthy." No mention is made of the difficulties encountered in carrying out the work from the small vessel during these extensive ocean cruises, but the amount and nature of the scientific data obtained are in themselves a record of the skill, endurance and careful preparation involved. Certainly the cruises were made in summer, but nevertheless this record shows how much can be done with a small sailing vessel suitably equipped.

From the density of the water, the currents were calculated for different water layers by means of Bjerknes' theory and are shown on a number of charts. These show a strong current passing eastward over the submarine bank which extends roughly north and south down the centre of the North Atlantic. This current is in about Lat. 47° N., and on arriving at Long. 25° W., a position roughly five hundred miles north

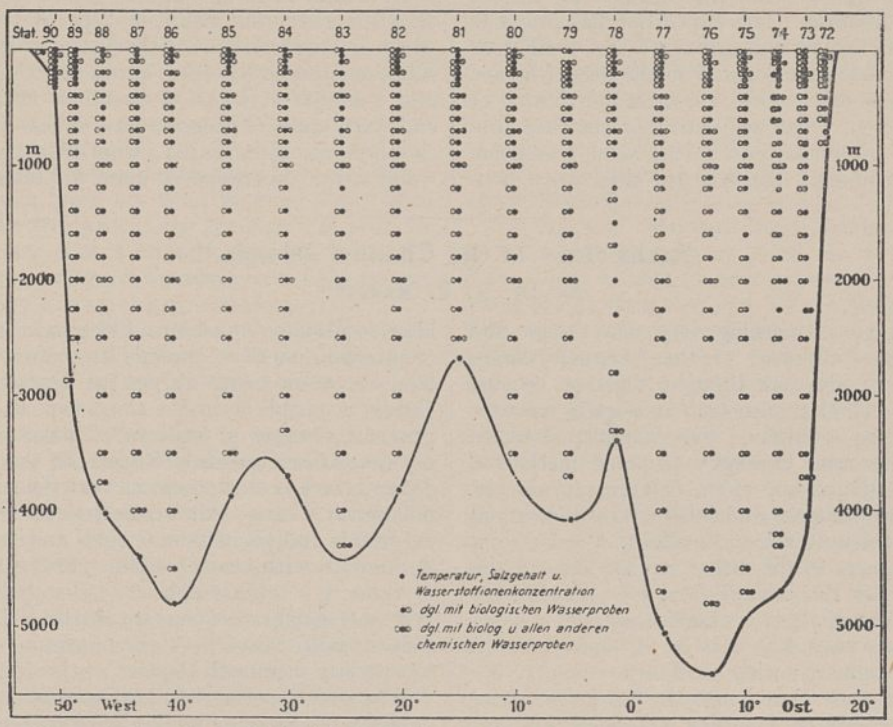


FIG. 2.—Section of the South Atlantic from Cape Town to Buenos Aires obtained from soundings by German South Atlantic Expedition in the *Meteor*.

[3] "The Eastern North Atlantic." By B. Helland-Hansen and F. Nansen, *Geofysiske Publikasjoner*, vol. 4, No. 2 (Oslo, 1926).

of the Azores, it divides, part turning northward and north-eastward and part turning south to the Azores and Canaries, where it divides again, part turning south and part turning northeastward towards Spain. The currents immediately westward of the continental slope between Ireland and Portugal indicate a number of eddies and a more involved system than that previously supposed; however, the northerly drift of highly saline water welling out of the Mediterranean as a warm undercurrent is shown extending certainly so far as the north of Spain. The existence of these calculated currents at the various depths is based upon the assumption that the movement of water at 2000 metres depth is negligible, for which evidence is presented.

There has been evidence for some time pointing to vertical oscillations of the water layers at a depth of fifty metres or more below the surface in various regions of the Atlantic. This expedition has provided further evidence which indicates that the oscillations may be considerable, particularly in the deeper layers. The oscillations show a more or less regular diurnal or semidiurnal period, which suggests that they are subsurface waves or undulations having some connexion with tidal phenomena; but how the tidal wave, producing in the open ocean oscillations of less than three feet at the surface, can produce vertical oscillations of the dimensions observed in the lower strata remains inexplicable. The desirability of further knowledge is manifest since a vertical series of observations cannot be expected always to represent the *average* conditions at any particular station; it is therefore of great importance for the discussion of the general conditions of a sea area to study how far the actual observations at the different stations and different depths may be regarded as representative.

During the course of the 1913 cruise some interesting current measurements at various depths were made from a boat moored on the bank around Rockall, an isolated rock some 200 miles north-west of Ireland. At a depth of two metres a rotary tidal stream was found, continuously varying and completely reversing in direction every six hours, a type of tidal streaming which is characteristic of the sea over isolated banks. A limited number of observations at greater depths suggest a similar variation in direction. During the fifth and sixth hours of observation a breeze sprang up and the observations indicated a wind drift of the uppermost water strata superimposed upon the tidal streaming.

Archæology of the Channel Islands.[1]

By Dr. R. R. MARETT.

THOUGH there is nothing very new to be said about the archæology of the Channel Islands, some brief notes are here brought together because well-attested facts relating to such an *angulus terrarum* are apt to escape attention. For example, in recent discussions concerning Depéret's proposed method of classifying the subdivisions of the Quaternary, namely, by giving weight primarily and chiefly to the indications afforded by ancient marine shorelines, I have come across no references to the rather striking data of this type provided by the islands (see, for example, my summary account of them in *Archæologia*, 62, 469-80). Thus, one Jersey cave, La Cotte de St. Ouen, exhibits a Mousterian industry with cordiform 'points,' *i.e.* belonging to a phase that is not the latest, as resting more or less directly on a marine deposit of sand and rolled pebbles forming the floor-bed of a cave at about 20 metres above present mean tide-level. On the other hand, another cave in Jersey, La Cotte de St. Brelade, contained the remains of a copious fauna, mammoth, woolly rhinoceros, reindeer, etc., conjoined with the later of two well-represented phases of the Mousterian industry; from which fact it is fairly safe to argue that Jersey was then freely accessible from more spacious lands.

Here, then, is almost crucial evidence that the later Mousterian culture coincided with a period of land elevation preceded by one of subsidence (to use such terms without prejudice to the question whether sea or land was the active factor responsible for the change of level). This would accord well enough with Depéret's Monastirian stage with its 20-metre shoreline marking the downward movement (from the point of view of a man as contrasted with that of a fish) and a later oscillation of at least a like extent in the opposite or upward direction; exactly 20-metres in the way of land elevation being at present necessary to render Jersey accessible from the Continent at low tide. Of previous changes of sea-level it must suffice here to say that at Le Cané de la Rivière, on the north coast of Jersey, there is clear evidence that the sea had time to hollow out a cave at the 10-metre level before it rose to 20 metres and plastered the sides and top of the cave in question with beach-pebbles. Still earlier, one may presume, is a solitary deposit of such pebbles at South Hill at a height of about 45 metres. Unfortunately, these various raised beaches contain no shell whereby to correlate them with Depéret's palæontological series.

When, on the other hand, we turn to post-Mousterian evidence of change of level, a section taken almost anywhere in the valley-bottom on which the town of St. Helier's stands (the level being about 10 metres above O.D.), reveals with remarkable uniformity beneath a few feet of modern alluvium, two peat-beds alternating with two underlying marine layers of sand and shells. In the upper peat-bed a mould for a spear-head has been found, giving it a Bronze Age horizon. From the lower peat have come several rough sherds, one characteristically decorated with punctured dots in rows, that proclaim the horizon Neolithic. Moreover, there can be little doubt that this lower peat-bed is to be correlated with the submerged forest so well in evidence round the islands down to low-tide level and beyond it, as notably at Vazon Bay in Guernsey, whence proof of Neolithic age is also forthcoming. Considerable land-elevation in this region in Neolithic times is thus indicated.

How far these facts have a bearing on the general history of the Channel is hard to say. As for Jersey in particular, its position at the end of a narrow spit of

[1] Substance of three lectures delivered at the Royal Institution on Nov. 18, 25, and Dec. 2.

the Continental shelf running westward between depressions hollowed out by ancient rivers would naturally impart to the island a certain tendency to isostatic movement of a more or less local character. Even so its oscillations are so sharply defined, and can be so closely correlated at several points with the archæological series, that they deserve more notice than they have got. If experts from England would face certain other oscillations likely to be encountered on the way across channel, they would be met both with a hearty welcome and with much to puzzle over.

As for the Palæolithic record of the islands, nothing of great importance has hitherto come to light apart from the two Mousterian caves already mentioned. The Lower Palæolithic is barely represented by sporadic implements of rather nondescript and doubtful type. Rough flints, in which some see signs of human workmanship, have been recovered from the clay capping certain rocks now disjoined from the land; and there can be little doubt that this clay is an æolian deposit of pleistocene age if only because it is distributed impartially between land surfaces of very various elevation. This loess, however, as it may be termed, affords no precise criterion of the age of the associated artefacts (if such they be) since it must have been forming steadily throughout the Ice Age. It is to be noted, by the way, that it extends some way below the present sea-floor, and must therefore have been in part laid down during a time of land-elevation.

Of the Mousterian caves, and more especially of La Cotte de St. Brelade, with its teeth of Neanderthal man, its fauna amounting to nearly forty species, and its flint implements of more than 5000 well-shaped pieces, with as many more showing signs of use, much might be said. Perhaps the most interesting result obtained from the latter site was the clear proof of two occupations separated by a considerable gap of time; a fact which, so far as it goes, would support the Abbé Breuil's recent attempt (*Man*, Oct. 1926) to establish a very long duration for the Mousterian.

The Lower Mousterian, associated with an elephant certainly not mammoth and provisionally identified by the late Dr. C. Andrews with *E. trogontherii*, occurred in four feet of indurated breccia, and was characterised by heavy coarse flakes and at least one core-implement. I could not on my own responsibility identify it with the horizon of La Micoque, but should welcome further light on the typological question. Above the breccia occurred a uniform layer, about a foot thick, of fine cave dust, and this bed was quite sterile. Evidently the cave was deserted by man for a very appreciable interval—long enough, in fact, for the fauna to have changed. Above it came six feet of loose rock rubbish, mixed with a light loam, and here occurred a large number of highly finished and beautiful implements of Upper Mousterian type associated with mammoth. The whole was sealed by a thick bed of banded lemming (*Dicrostonyx torquatus*), over which lay 30 feet of sterile clay and rock-rubbish of the type known as 'head.' Finally, the Upper Palæolithic is represented if at all by a well-marked industry occurring in several sites (mostly shallow deposits of peaty soil along the cliffs), which shows a predominance of small blade-like tools, in which a typologist might possibly discover Magdalenian affinities. In association with these has been found a needle which, if made of ivory, as seems to be the case, and not of bone, would decisively fix the horizon as Palæolithic.

Passing on to later times, one may speak comprehensively of the Megalithic period without prejudice to the question whether the monuments with which the islands teem are Neolithic in the sense of belonging to an age when, regionally at all events, polished stone without metal was in use, or are wholly or partly assignable to the Bronze Age. Nay, it may be just worth noticing that one Jersey passage-grave, Mont Ubé, contained specimens of the *pic* and the *tranchet* (figured by me in *Archæologia*, 63, 226), which look like survivals from a previous era, namely, the Campigny period. On the other hand, there are no signs of a local development (such as has been assumed both for the Iberian Peninsula and for Scandinavia) from the true dolmen with a single capstone; but seemingly the full-fledged passage-grave was introduced at the outset. Perhaps the term 'passage-grave' should, however, be reserved for the type of monument consisting in a narrow passage leading into a wider sepulchral chamber, the whole covered by a round tumulus. This, indeed, is the normal structure found in the islands, as also in Brittany and Iberia; but Mr. T. D. Kendrick in "The Axe Age" (Methuen, 1926) has directed attention to two *allées couvertes*, or 'cists,' as he prefers to call them, which he believes to be non-western in character. These are Le Couperon and Ville ès Nouaux in Jersey, both monuments showing the remains of peristaliths which suggest that they were surmounted by long barrows and not by circular mounds.

At Le Couperon occurs a 'port-hole' slab, a fact which affords Mr. Kendrick further reason for suggesting eastern influences, proceeding proximately from the Paris basin. In this connexion he likewise points to the complete resemblance between the statue-menhir of the Câtel, Guernsey, with its necklace and closely juxtaposed breasts carved boldly in the round, and certain wall-carvings adorning the cists of the Seine and Oise valleys. Meanwhile, it should be noted that if Ville ès Nouaux be of eastern type as regards structure, it nevertheless contained grave furniture of markedly western pattern such as bell-beakers—a fact chronologically interesting as proving that the cist culture had arrived before the beaker ceased to be in fashion. Further, as regards ceramic, several Jersey passage-graves have yielded a peculiar type of cup-like vessel with a hollow base and characteristic decoration; and some half a dozen more of these in excellent preservation have been found in the newly opened monument of La Hougue Bie. French archæologists have sometimes labelled this type 'supports,' as if other round-bottomed vessels had originally been set up upon them; but it is at least equally likely that they were self-sufficing receptacles of food-offerings to the dead. In any case, more important than the question of their function is that of their bearing on the origins of the megalithic culture-complex as met with in the islands. To judge by the distribution of the very few examples hitherto noticed in France, it would seem that this peculiar ceramic marks the track of a culture coming from east-central France down the Loire valley, probably at some time early in the Bronze Age, and thence turning northwards to Brittany and the islands.

Much might be said about the life of this period as deduced not only from the megaliths but also from humbler remains, such as notably the graves, with the associated cairn and midden of the islet of La Motte, Jersey—to which, by the way, the little island of Thinic, to the west of the peninsula of Quiberon, seems to offer a close parallel (see *Archæologia*, 63, 210).

It must be enough, however, in conclusion to direct attention to two megalithic monuments of special interest. One of these intrigued the dilettanti of the eighteenth century; and Horace Walpole's friend, Marshal Conway, actually removed it in 1787, two years after its discovery in Jersey, to Park Place, Henley, where no British archæologist should fail to pay it a visit. It is in several respects unique among island monuments. For one thing, the covered passage leads into an *enceinte* which is perfectly circular, unlike the normal passage-grave, which is shaped more like a tennis racquet than a jew's-harp. Mr. Reginald Smith (*Proc. Soc. Antiq.*, 1919, 143) compares the shape of a neolithic house with covered passage found at Pléneuf, Côtes-du-Nord. A similar house has recently been discovered at La Sergenté, Jersey. Again, the *enceinte* with its six trilithons, somewhat suggestive of a miniature Stonehenge, may well have been hypæthral as at first designed, though later by design or accident a mound of earth (or blown sand) was superimposed. As for the magnificent passage-grave of La Hougue Bie excavated in 1925, though doubtless its contents were disturbed at some time, it remains in the intact majesty of its structure a very masterpiece of art, unsurpassed whether in size or in the symmetry of its design by any monument of the kind in north-western Europe.[2]

[2] On the whole subject see three papers by the lecturer in *Archæologia*, vols. 62, 63, 67, and for full details the *Bulletins de la Société Jersiaise* and *Proceedings of the Guernsey Soc. of Nat. Hist.*, later La Société Guernesiaise.

News and Views.

WITH this issue we begin the publication of a weekly "Calendar of Discovery and Invention," in which, so far as possible, each day will be used to recall some event of importance in the history of science and its application. The notes are being compiled by Engineer Capt. Edgar C. Smith, of the Science Museum, South Kensington, who some years ago contributed to our columns the Calendars of Scientific and Industrial Pioneers. It is not to be expected that every event of importance in the history of science will be referred to; such would be clearly impossible within the limits of a weekly column in a year's issue of NATURE. It is also obvious, from the nature of the records available, that the physical sciences and engineering are likely to figure in the column more than the biological sciences, medicine, and similar subjects, in which it is often difficult to assign the announcement of a discovery to a particular day. Suggestions regarding events suitable for inclusion in the column will be welcomed.

BY invitation of the French Government, a meeting of the executive council of the International Institute of African Languages and Culture was held in Paris on Monday, December 13, instead of in London, as had been previously arranged. It was thus the first to be held outside England, and with it the work of the Institute, which was founded a little over a year ago, may be considered to be fairly launched. The initial difficulty of raising funds, it may be hoped, is well on the way to solution, especially as it was announced at this meeting that the Government of the Gold Coast has promised a donation of £500 a year for the next two years. It is to be hoped that this subsidy will be renewed at the end of that period, and that the example of the Gold Coast will be followed by other African dependencies, as well as by organisations and individuals interested in Africa and African studies. The programme already mapped out by the Institute covers most important fields of research, and its work of co-ordination in the study of African linguistics and ethnology will be especially valuable in promoting the development and education of the African native.

THE meeting was attended by representatives of Great Britain, France, Germany, Austria, and other countries. Among those present were Dr. Westermann, the distinguished German authority on African languages; Sir Frederick Lugard; Major H. Vischer of the British Colonial Office, to whose efforts the foundation of the Institute are largely due; and the Rev. E. W. Smith. Prof. Seligman, who represents the Royal Anthropological Institute in the Institute of African Languages and Culture, was unfortunately unable to attend. M. Labouret of the French Colonial Office was appointed joint Director of the Institute in succession to M. Delafosse, the announcement of whose death was received with much regret. A deputation of the delegates was received by M. Perrier, French Minister for the Colonies, who expressed great interest in the work of the Institute.

AT a meeting of the Newcomen Society on December 15, papers were read on two famous Swedish engineers. The first paper, by Mr. J. G. A. Rhodin, was on Kristofer Polhämmer, better known as Polhem, the name he took on being ennobled. Polhem was born in 1661 and died in 1751. Starting as a clerk on an estate, he was enabled to study science at Upsala, and became a mining engineer at Stora Kopparberget, where he built his famous "Machina Nova," a large water-driven headgear for handling the ore. His inventions relating to mining and metal working were numerous. He also made the dock gates for the dry docks at Carlskrona, then the largest in the world, and built the lock at Stockholm uniting the Malar Lake with the Baltic. He also began a system of locks to make the Trolhättan falls passable, but the work was discontinued on account of the death of Charles XII. Mr. Rhodin described Polhem as "one of the first engineers in this world with a thorough theoretical training, yet practical to a degree in spite of his bringing up at *Alma Mater Upsaliensis*."

THE second paper read before the Newcomen Society on December 15 was the outcome of a translation of the book by Triewald on the "Fire and Air Machine at Dannemora," undertaken by Mr. Are Waerland for the Newcomen Society. Triewald lived in England about ten years, was familiar with Newcomen, erected a Newcomen engine near Newcastle, and built the first steam-engine used in Sweden. His book contains the first complete description of the atmospheric engine of Newcomen, and is therefore of special interest to the Society. It is hoped to publish the English translation. Like many men of his time, Martin Triewald wrote on a great variety of subjects. Born in 1691, he early engaged in business, but becoming bankrupt, at the age of twenty-five years he came to England. He was befriended by the Dutch Minister and attended the lectures of Desagulier, became known to Newton, and then found employment with Ridley of Newcastle as an engineer. At the age of thirty-five years he returned to Sweden and at Dannemora built his great engine. He afterwards held various Government appointments, was the first to introduce the experimental methods of science into Sweden, and was one of the six founders of the Royal Swedish Academy of Sciences. He died in 1747. At the University of Lund is a fine collection of scientific apparatus collected by Triewald and used by him for his lectures.

To the panoramas illustrating various parts of the British Empire, several of which were brought to the Imperial Institute from the Wembley Exhibition, the Director, Sir William Furse, has recently added two. One, in the Falkland Islands Court, represents a whale, off the coast of South Georgia, being harpooned by a 'chaser' fitted with a modern harpoon gun. The mother ship, where the carcase will be cut up, is not shown in the picture. The sea is cleverly modelled and looks well from a distance, but on a nearer view betrays its plaster composition too obviously. It is a question whether the visitor should not be prevented from coming too close. In this, as in the previous models, the horizontal plane is tilted up, like the stage of a theatre, so that the line of sight approaches it at a greater angle than natural conditions usually permit. The evident advantage would be attained in a less forced and less perplexing manner if the models were placed a little lower.

THE other model referred to above depicts wild animal life in Tanganyika. The twin peaks of Kilimanjaro rise in the distance, while over a richly diversified foreground are scattered various members of the fauna, from monkeys and lions down to crocodiles and snakes. The exhibit is designed and executed by D. Y. R. Furse and R. T. Roussel for McCorquodale and Co., and we are told that most of the animals have been modelled by an artist who has almost daily acquaintance with them on his farm in East Africa. Even he, however, can scarcely have seen all these creatures at once. This familiar defect of such panoramas is to some extent remedied by the large extent of country shown in a width of about six feet and the small scale of the animal models. These in themselves are characteristic enough, but the same can scarcely be said of the flora. All the trees and shrubs are made of a curious material which looks like the skeleton of some antipatharian or gorgonid coral. If this really is the case, we may at least suggest that the needed variety might have been attained by using more than one species. The Director's attempts to interest the public by these models are heartily to be commended, but one has to guard against giving false impressions.

THE Institution of Chemical Engineers held a very successful conference on December 8-10 in the Science Museum, South Kensington, the subjects discussed including the measurement of mechanical power absorbed by driven machines, the uses and limitations of statistics in industry, air elutriation, and refrigeration. Although a few of the papers could be classed as specifically chemical, most of them introduced chemical subject matter by way of illustration. The practice of holding conferences at which a number of papers are read, appears to be growing in Great Britain. Multiple programmes have the advantage of making it worth while for country members to travel long distances, so that meetings are larger and colleagues are more certain of seeing one another. Secretarial work is also more concentrated and therefore more economical. On the other hand, papers are apt to crowd one another out, and discussions are thereby curtailed.

MESSRS. R. G. Parker and D. N. Jackman described a new form of recording torsion-dynamometer of the type that does not itself convey power, but is applied to a transmitting shaft. Such a shaft is very slightly twisted, and the twist, which is proportional to the power, is measured, the readings being recorded photographically. In a symposium on statistical methods in relation to industrial efficiency, Messrs. D. Ryder and T. C. Finlayson dealt with the control of chemical-plant operation by this method, mainly from the point of view of the works manager. The points discussed included the transference of material, production, reports by shift foremen, the plant manager, the engineer, and the laboratory; also the methods used by the statistical office in summarising the data concerning production, labour, and stocks. In his paper on some uses and limitations of statistics in industry, Mr. H. C. Marris deplored the paucity of statistical material for forecasting short-term trade movements.

ON the third day of the conference, Dr. Geoffrey Martin contributed a paper on the laws of air elutriation, pointing out that Stokes's law applies only for very small particles, and advancing other generalisations for particles of larger size. He emphasised the influence of temperature on particle-size, and expressed the view that there is great scope for research on the influence of particle-shape on lifting power. The concluding paper, on refrigeration in the chemical industry, by Mr. H. M. Dunkerley, contained many details concerning the construction of refrigerating plant and useful data on costs of the process. As the result of the study of a large number

of installations of different types, he concludes that their capital cost ranges from £70 per 10,000 B.T.U. per hour for plants with a capacity of 250,000 B.T.U. per hour, to £50 for plants with a capacity of 2-3 million B.T.U. per hour.

FURTHER official information on "The Wet November of 1926" is given in the *Meteorological Magazine* for December. The total for the month was above the average everywhere over the British Isles except along the north-west, north, and north-east coasts of Scotland. The excesses were largest in the south-west of England and Wales and in Connemara. More than twice the average was recorded in these areas as well as at Wetherby in Yorkshire and at Dundee. Falls of more than 250 per cent. of the average occurred in parts of Dorset, Hampshire, and Hereford, while at Ross the fall of 7·87 in. was so much as 311 per cent. of the average. The largest monthly totals were those reported from Llyn Llydaw on Snowdon of 19·50 in., and from Delphi in Connemara of 18·50 in. More than 5 in. of rain was recorded in one day, in Snowdonia on November 4 and in Connemara on November 18. At Camden Square the number of days of rain, 25, and the duration of rainfall, 85 hours, were the largest in November since records commenced, in 1858 and 1881 respectively. It was the wettest November over the British Isles as a whole.

IN order to illustrate some of the recent advances that have been achieved in British-made microscope object-glasses, Messrs. R. and J. Beck, Ltd., of 69 Mortimer Street, London, W.1, recently gave a demonstration of the results obtainable from apochromatic object-glasses of their own manufacture. During the past five years these lenses have been completely redesigned, and a method of testing by zones to the extreme margin has been introduced, with the result that the resolving power of the lenses attains the theoretical limit for their respective apertures. The specimens exhibited included a $\frac{2}{3}$-in. apochromat, 0·35 n.a., resolving the dots in *Pleurosigma formosum* (dot interspaces about 36,000 per in.); a $\frac{1}{3}$-in. apochromat showing resolution in dots in *Navicula rhomboides* (about 66,000 lines per inch); the resolution in dots of the *Amphipleura lindheimerii*, *styrax* (about 90,000 per inch), by a $\frac{1}{6}$-in. apochromat, 0·95 n.a., the theoretical resolving power being about 95,000 lines per inch; and the resolution of dots in *Amphipleura pellucida* (about 130,000 per inch) by a $\frac{1}{12}$-in. oil-immersion apochromat, 1·4 n.a., with a theoretical resolving power of about 140,000 lines per inch. Demonstrations were also given of methods of testing the general quality of an object-glass. These included the use of a podura scale, which is a good test of the central zones of a high-power object-glass, and of a silver film with pinholes, which provides also a sensitive method of adjusting the tube length to suit the objective. In the series of experiments dealing with illumination, the most interesting was one showing a portion of a diatom overhanging the strip on which it was mounted. While the image of the portion supported and covered by glass was obliterated by glare caused by multiple reflections from the glass surfaces, there was good resolution and complete absence of glare where there was no cover glass or slip.

THE Wellcome Bureau of Scientific Research and Museum of Medical Science, situated at 25-28 Endsleigh Gardens, London, have recently been enlarged, and we received, on the occasion of their reopening by the Minister of Health, a profusely illustrated booklet giving an account of the work of the Bureau and its affiliated institutions, the Entomological Field Laboratory and the Physiological and Chemical Research Laboratories, together with a description of the contents of the Museum. There are also included lists of the papers published from the Bureau and the research laboratories from their foundation to the present time. The Museum of Medical Science is arranged to afford a continuous demonstration of various diseases, their causes, effects, and treatment, so as to give a graphic picture of the more important features. On the ground floor are arranged exhibits of the diseases caused by the Metazoa, venomous beasts, insects, worms, etc. The first floor is devoted to diseases caused by protozoa and spirochætes, and a special section is given to leprosy and tuberculosis. The second floor has as its exhibit the diseases caused by bacteria, including the exanthemata, whilst the third floor demonstrates dietetic, metabolic, and blood diseases, a section being also given to new growths. The Bureau does no routine teaching, but is open to individual workers who wish to follow some particular line of investigation. The Museum is open to all medical men, health officers and students, and is available to teachers of medicine for the purpose of giving demonstrations to their classes.

WE learn from the *Bell Laboratories Record* that the John Scott medal, founded in 1816 by John Scott of Edinburgh and awarded from time to time by the Board of City Trusts of Philadelphia for outstanding inventions, has been awarded to Gustaf Waldemar Elmen for his invention of permalloy. This nickel-iron alloy, which is noteworthy for its high permeability for minute magnetising force, is widely used in transformer cores, certain telephone receivers, and in 'loading' submarine telegraph cables for high-speed transmission.

SHORTLY after the s.s. *William Scoresby* sailed from Hull to join the *Discovery*, the house magazine of Messrs. Reckitt and Sons published an account of those celebrated whalers and explorers, the Scoresbys. It was illustrated from one of the original log-books and other material in the Fisheries Museum at Hull, and Mr. Sheppard has now included it in the 'Record of Additions' to the Hull Museum, No. 69.

THE late Prof. R. Klebs, of Königsberg, who was the most distinguished student of the insects included in Baltic amber, himself formed a large collection of such objects. A large number of his specimens was purchased by the Trustees of the British Museum in

1892 to enrich the extensive national collection of *inclusa*; but he left to his heirs a still larger collection containing many specimens of historic importance. We are glad to learn that this collection has not been dispersed, but that it has been found possible to purchase it for the Geological Institute of the University of Königsberg, which already possesses a famous cabinet of these objects. Properly qualified research workers will now, as in the past, be accorded the utmost facilities for the study of these great collections.

MESSRS. Harold C. Urey and Arthur E. Ruark, writing from the Johns Hopkins University, Baltimore, Maryland, state that they are preparing a book of about 700 pages on atomic and molecular structure, embracing both the theoretical and experimental aspects of the subject, and that they will be glad to receive reprints of private communications as to results not yet published.

MESSRS. C. Baker, 244 High Holborn, London, W.C.1, have prepared a new issue (No. 88) of their Classified List of Second-Hand Scientific Instruments. The catalogue is divided into sections dealing with microscope apparatus, surveying, astronomical and other instruments, spectroscopes, physical apparatus, and so on. The present list contains offers of a number of students' microscopes and accessories, while the astronomical telescope section is also large and its contents varied. Among the larger instruments is an 8-in. Cooke equatorial which was the property of the late Dr. W. H. Maw. Surveying instruments, and field glasses and small telescopes are let out on hire. Nine volumes of NATURE (1885–1890) are also offered for sale.

MR. GEORGE C. SHERRIN has designed, and Messrs. George Philip and Son, Ltd., have produced, a set of apparatus for demonstrating popular experiments in dynamics (20*s*. net). The set is supplied in a wooden box and is accompanied by an illustrated handbook. The apparatus consists of nothing more than a series of small steel rods of varying thickness, of weights, pivots, and collars, the parts being assembled in much the same way as the parts of a 'meccano' outfit. The result is to produce a toy capable of demonstrating—and that very effectively—the relative movements of earth, moon, and sun, the action of centrifugal force, various gyroscopic effects, and the principle of Foucault's pendulum. In itself, this is no mean achievement for such a simple toy, but in reality its 'star' turn is intended to show the action of the Flettner rotary cylinder. If a criticism might be levelled against such a delightful toy for grown-ups, it is that the last demonstration fails to carry complete conviction, first because an artificial wind created by blowing from the mouth cannot be relied on to strike a moving rotating cylinder accurately in a specified direction, and secondly, the deviations from accuracy in this respect may themselves produce the actual effects to be observed. If the toy is to rank as a piece of scientific apparatus, certain of the parts will require to be more delicately made.

Our Astronomical Column.

OBSERVATIONS OF PROXIMA.—Union Observatory Circular, No. 70, contains some interesting notes on this star by Mr. Innes and Dr. van den Bos. The colour is orange or orange-red, the spectrum probably *K*, the visual magnitude 11·2, the photographic 13·0. The parallax is given as 0″·90, which is larger than that deduced from the assumption that parallaxes and proper motions are proportional when compared with α-Centauri. Dr. van den Bos makes the interesting, but rather improbable, suggestion that the sun, Proxima, and α-Centauri form a straight-line solution of the three body problem. The parallax of the centre of gravity of the system would be 1″·14. It is satisfactory that Dr. Alden will investigate the parallax of Proxima with the Yale Telescope at Johannesburg.

THE SOLAR PHYSICS OBSERVATORY, CAMBRIDGE.—The thirteenth annual report of the Director of the Solar Physics Observatory, Cambridge, has recently been received, describing the stellar and solar work carried out at the observatory during the preceding year. Amongst the published work on stellar spectroscopy, mention may be made of a paper by Mr. Baxandall on absorption lines in spectra of types *G*, *K*, and *M*. The wave-lengths, intensities, and probable origins of lines in typical spectra of these classes have been determined and compared, in order to investigate the nature of the changes that occur in this region of the stellar sequence. Preliminary experimental work is being done by Mr. Carroll on the photography of the extreme red region by means of hypersensitised panchromatic plates, and also in testing the theoretical effect of stellar rotation upon absorption lines by studying the same effect in the solar spectrum. In the department of solar physics, an important piece of work (begun in 1916) has now been completed by Mr. Baxandall in revising the chemical origins of Fraunhofer lines in Rowland's tables. This work has been completed for the region λλ3900-5900, and the results sent to Mount Wilson for incorporation in a revision of Rowland's tables by the International Astronomical Union. Spectroheliograms of the sun's disc have been obtained on 118 days, and these, augmented by 326 spectroheliograms from Kodaikanal, have been studied by Mr. Butler. An investigation by the Director, assisted by Mrs. Beech, on the distribution of outbursts of sunspots, now covers four complete 11-year cycles, and a summary of the results is being prepared.

THE DISTANT COMPANION OF CASTOR.—An interesting article in the *Scientific American* (December) by Prof. H. N. Russell, describes recent researches on this star. A few years ago Messrs. Adams and Joy at Mt. Wilson found that it is a spectroscopic binary (as are the bright components of Castor) with a period of 19 hours 32 minutes. Dr. van Gest, of Leyden, finds that partial eclipses of each component by the other occur at intervals of $9^h\ 46^m$. Their distance apart is 1,600,000 miles, and each is 520,000 miles in diameter. The mass of each is 0·52 sun, and the density 2·5 sun, or 3·5 water. It is the greatest density found for a spectroscopic binary. The total light of each is $\frac{1}{60}$ of the sun's, and the surface brightness $\frac{1}{2^1_5}$ of the sun's. The concluded surface temperature is 3500° C., in good accord with the *M* type of spectrum which was found for them. It is of great interest and importance to have these accurate details of a pair of typical dwarf stars.

Research Items.

WEST INDIAN STONE COLLARS.—An interesting suggestion relating to the origin of the 'stone-collars,' which are a problem in West Indian archæology, is made by Mr. A. D. Russell in *Man* for December. The collar stone is an object in shape much like a horse collar, but obviously too small for that purpose, and unsymmetrical in shape, being bent to one side at the narrower end. Various theories as to their origin have been put forward. Mr. T. A. Joyce has suggested that a wooden mechanism is indicated, two unequal ends of the fork of a tree being bent round and fastened together, the part of the tree cut off below the fork being represented by the protuberance called by some archæologists the 'shoulder.' It is here suggested that this wooden mechanism was a tree climber, which is symbolised by the stone collar. This might more accurately be termed a belt or cincture. The palm climber of West Africa and the West Indies, with which the collar is compared, is made in two pieces. Two lengths of supple wood are bent into a long oval hoop, the two ends on the right side being secured by a permanent fastening, those on the left being done up and undone as need requires. The identity of the palm climber in West Africa and the West Indies is scarcely to be explained as introduced by the slave trade, since the archaic stone collar proves its existence in the latter area before slaves were introduced.

MOHAMMEDAN CHILD-KILLING DEMONS.—In *Man* for November, Mr. W. Ivanow points out that Persia has preserved under a Mohammedan cloak many customs and beliefs descended from a remote antiquity. A great deal of this material is to be found in the literature and, especially, in manuscripts. In support of this, extracts are given from a rare medical treatise, written at Delhi in 1376, which reveals some peculiar beliefs relating to the supernatural malevolent beings causing death or harm to young children. The work is called "The Comfort of Man," the author being Abdu'l-Qawi ibn Shihábi'd-din, surnamed Ziya. All evil beings are divided into five classes. The vampires attacking children belong to the fifth class of *diws* and *peris*. Of these there are two divisions, shapeshifters or were-hyænas (*Kaftár*) and Ummu's-sibyan, called in Arabic "the mother of children," probably an ancient conception of the spirit causing the premature death of new-born babes: apparently Lilith, the Lamia, or the Strigil. According to Ziya she is the mother of devils and has seventy-five baby-*diws* at her breast. When a woman gives birth she may, if not watched, substitute a *diw* for the human child. Burnt hair from the back of a black cat will drive her away. The *Kaftár* or hyæna, a rare animal in Persia, seems to imply a witch, but it has not much connexion with lycanthropic ideas. References to it are rare in Persian literature, and it is doubtful if the belief survives among the people to-day, unless it is under another name.

SPERMATOGENESIS IN THE MOUSE AND THE RABBIT.—K. Masui (*Jour. Coll. Agr.*, Imp. Univ. Tokyo, 8, No. 2, 1923, just received) undertook a reinvestigation of the spermatogénesis of the mouse and of the rabbit, chiefly with the purpose of studying the chromosomes. Measurements of the spermatogonial chromosomes show that these are in pairs and that there is a constant relation between their size and their form. Two special chromosomes are probably the sex chromosomes. The observed variation (44 to 54) in the number of chromosomes in the rabbit is attributed to the fragmentation of certain chromosomes caused by the fixation. The diploid number in the mouse is 40. The conjugation of the chromosomes probably takes place by telosynapsis in the mouse and by parasynapsis in the rabbit. From the behaviour of the sex chromosomes it is suggested that dimorphism of the sperm results. The mitochondrial granules do not originate from the nucleus in the early stages of the spermatocyte, but exist in the cytoplasm from the beginning.

PHYLOGENY AND CLASSIFICATION.—In an extended discussion of phylogeny and the natural system, Dr. W. B. Crow (*Jour. of Genetics*, vol. 17, No. 2) reviews the various conceptions of phylogeny and their relation to classification. He covers a wide field of reference with relation to plants and animals, but occasionally betrays an inadequate first-hand acquaintance with the various interpretations placed upon the variations he is discussing. His paper serves, nevertheless, to focus attention afresh upon phylogenetic problems. He points out the inadequacy of causal morphology without an historical background to explain the problems of relationships, and shows, *e.g.*, that there are good reasons for concluding that such a simple colonial form as Pleurococcus has been derived by reduction from filamentous ancestors. He emphasises the principle of Cope, that in tracing the descent of genera, purely specific characters should not be taken into account, and similarly concludes that, in tracing the phylogeny of species, no account should be taken of the genealogy of individuals. This leads to a discussion of Mendelism from a phylogenetic point of view, and the recognition that the genealogy of gametes has its bearing on the phylogeny of characters.

TERTIARY SHELLS FROM JAPAN.—A number of fossil mollusca and brachiopoda from beds in the island of Sado, off the coast of Echigo, Japan, have been described by Prof. Matajiro Yokoyama (*Jour. Fac. Sci.*, Imp. Univ. Tokyo, Sect. 11, Geol., etc., vol. 1). These fossils come from the Sawané formation, and the author concludes that their geological horizon corresponds to the Musashino (Pliocene) of the neighbourhood of Tokyo. Following the few "general remarks" and table of distribution, the paper consists of descriptions of 149 species of mollusca and brachiopoda, including a goodly number believed to be new and figured on the six accompanying plates. There is also a good index.

MARINE SHELLS OF THE W. COAST OF N. AMERICA.—The first volume of what promises to be a most important manual on "The Marine Shells of the West Coast of North America" (*i.e.* Canada and the United States, but not Mexico), dated 1924, has only just reached us. It is published by the Stanford University and in somewhat Gilbertian manner forms No. 1, vol. 1, of the "Geological Sciences" series, and has been compiled by Mrs. Ida S. Oldroyd, the Curator of the Geological Museum. When completed the work will cover in extended form the same ground occupied by the 'Summary' by Dr. Dall, issued in 1921 (*U.S. Nat. Mus. Bulletin*, 112) with the addition of the Brachiopoda. The classification followed, though not so stated, is that of the same veteran conchologist, first proposed in 1895 (*Trans. Wagner Free Instit.*, vol. 3, No. 3). The major divisions above genera are not defined, but each genus is, while with each species is given the original reference and description, supplemented where necessary from other sources, followed by the citation of the type and type locality, with its 'distribution' (or 'range' as alternative term) and 'range in time.'

It is stated that some new species described by Dr. Bartsch are included, but apparently not in the present volume, which deals only with the Pelecypoda and Brachiopoda. To the 247 pages of text there are appended 57 plates of unequal merit that do not proportionately enhance the value of the volume, while the individual members of a genus, instead of being figured together, are peppered indiscriminately among the plates, sometimes widely apart. The task of bringing together this mass of material must have been enormous, and Mrs. Oldroyd will receive the cordial thanks of all fellow-workers, who will impatiently await the issue of the further volumes.

ISOSTASY IN SPAIN.—A recent report on the isostatic reduction of gravity stations in Spain (*Mem. del Inst. Geog. y Cadastral*, Madrid, vol. 15, 1926) is summarised and commented upon by W. Bowie in the *Am. Jour. Sci.* for October 1926. The computations were made by the U.S. Coast and Geodetic Survey. The method of least squares shows that the most probable depth of compensation is 96 km. as in the United States. The average anomalies are +0·011 with regard to sign and 0·032 without regard to sign, the corresponding United States figures being −0·006 and 0·021 respectively. It is noteworthy, in looking for an explanation of the residual anomalies, that the Spanish stations on pre-Cambrian formations give an average anomaly of +0·047, while those on Tertiary formations give −0·033. Anomalies have also been computed for depths of compensation ranging from 56·9 km. to 184·6 km. Very little difference was revealed by the results, except for the greater depths where the larger anomalies became exaggerated and nearly all became positive. The recent tendency towards adopting a smaller depth of compensation than those formerly advocated thus receives support.

ISOLATION OF ELEMENT 61.—Since the appearance of a preliminary note on the independent isolation by Rolla and Fernandes of element 61, mentioned in NATURE, December 4, 1926, p. 820, we have received a fuller account of their investigation in the September issue of the *Gazzetta Chimica Italiana*. The paper contains diagrams of spectra and a chart illustrating the long series of fractional crystallisations to which the didymium earth was submitted. Among the peculiarities displayed by the absorption spectra of the extreme fractions may be mentioned the strong absorption bands in the yellow, attributed up to now to neodymium, which by dilution of the solution are divided up into numerous lines having for the various fractions very diverse relative intensities. The peculiarities of these fractions are identical with those which are attributed to the presence of element 61.

PROPERTIES OF ACETONE.—Some accurate values for the vapour pressures and densities of acetone from about −80° to +60° appear in the *Journal of the American Chemical Society* for November. These are intended to replace the existing data, among which considerable discordance is noted. The determinations were carried out by Felsing and Durban in calibrated apparatus to which the acetone, purified and dried by distillation and by crystallisation as the acetone-sodium iodide addition compound, was transferred by direct vacuum distillation. The measurements were carried out in two types of cryostat, one containing liquid paraffin and kerosene for temperatures above 0°, and the other containing ethyl bromide for the lower temperatures. The solubility of carbon dioxide in acetone was also determined over the range −75° to +20°, and the latent heats of evaporation at different temperatures were calculated from the vapour pressure data by means of the Clausius-Clapeyron equation.

LOW-TEMPERATURE CARBONISATION RETORT.—In pursuance of a policy of the Department of Scientific and Industrial Research adopted in 1924 (NATURE, September 20, 1924, p. 441), the Director of the Fuel Research Board has issued a report (H.M. Stationery Office, 9*d*. net) on a test on a 'Fusion' rotary retort for the carbonisation of fuels at low temperatures. The retort, installed at the works of Electro-Bleach and By-Products, Ltd., Cledford, consists of a horizontal externally heated rotary cylindrical retort, through which the material passes while stirred and kept from lodging on the walls by a special type of 'breaker.' The retort was rated to treat 5 tons per day, but in the test 3·4 tons of Welbeck Cannel was put through. 50 gallons of tar and oil was collected per ton, and it was shown that the recovery might have been increased to 54 gallons. 2740 cub. ft. of gas of calorific value 1070 B.T.U. per cub. ft. (gross) was obtained. No operating difficulties of any great consequence were noted. The test showed that a good yield of liquid products was obtained, but the solid product was in a finely divided form as a result of the action of the breaker and probably suitable for pulverised fuel firing. This may be satisfactory when dealing with a non-caking low-grade fuel, such as was used here. It restricts the scope of the process, which scarcely seems adapted to produce a smokeless domestic fuel.

THE SHOCK-WAVE FOLLOWING DETONATION OF HIGH EXPLOSIVES.—What is the nature of the 'shock-wave' sent out by the detonation of a high explosive? How far and at what speed does it travel? How is it that the flame from a high explosive may apparently penetrate a region occupied by an explosive gas mixture without igniting it? These are some of the problems raised by the use of high explosives in fiery mines, and they are problems which have not yet received authoritative answers. Indeed, it may be said that, until the recent work inaugurated by Prof. R. V. Wheeler, of the Safety in Mines Research Board, the functions of the shock-wave have not been so fully studied in England as they have been abroad, especially in France, where *l'onde du choc* has received both theoretical and practical investigation. The Mines Department has now issued a paper (No. 29) forming Part 2 of the research "On the Pressure-wave sent out by an Explosive," by W. Payman and W. C. F. Shepherd, assistants at the Mines Experimental Station. An apparatus has been constructed whereby the flame issuing from a high explosive has been directly photographed on a moving film, which at the same time registers the passage of the preceding shock-wave by *Schlieren* photography and also the movements of the products of combustion, since these were found to be opaque to the arc-light which gave the *Schlieren* effect with the pressure wave. It was thus possible to measure the speed of the shock-wave sent through the air by the explosion of a No. 6 Detonator, and its gradual slowing down as it travelled away from the experimental tube. The expanding products of combustion closely follow the shock-wave from the mouth of the tube, but soon begin to fall behind it. Behind the products of combustion the visible flame issues from the tube, and never gets in front of the products. This explains why a No. 6 Detonator will not ignite firedamp mixtures, since the inflammable gas would be shielded from the flame by an extinctive blanket of burnt products. The speed of the shock-wave as it starts through the open air was found to be roughly twice the velocity of sound.

Perth Meeting of the Australasian Association for the Advancement of Science.

THE eighteenth meeting of the Australasian Association for the Advancement of Science was held in Perth during the week commencing on Monday, August 23, but was extended in the form of excursions well into September. As this was the first time the Association had consented to visit Western Australia, special efforts were made to induce members from the other Australian States and New Zealand to attend the meeting. The State Government of Western Australia granted £1,200 for printing and publishing, and offered free transit over the State railways to all visiting members; and the Australian Commonwealth Government was induced for the first time to contribute towards the general expenses of the meeting the sum of £750, out of which travelling allowances were paid to members of known scientific standing who came to Perth over the Transcontinental Railway. Furthermore, private hospitality during the meeting was arranged in Perth for all members from other States who would accept it, and on most of the excursions members were carried free.

In response to the invitation more than 200 members from the other Australian States and New Zealand attended the meeting. To transport this number in addition to the ordinary traffic an average distance of more than two thousand miles each way taxed the resources of the Transcontinental Railway, but the task was satisfactorily accomplished. About half the visitors, including most of the principal officers of the Association, were carried in a special train, thus making the overland journey an excursion in itself. The total enrolment for the Perth meeting included about 750 members and more than 200 associates. Among the visiting members were delegates from some fifty scientific, technical, and educational bodies in the other States, and delegates from the Commonwealth Government and the Governments of New Zealand, New South Wales, and South Australia. More than twenty scientific and other bodies in Western Australia also sent delegates to the meeting.

At noon on Monday, August 23, the Mayor of Perth gave a civic reception to the Association in the Perth Town Hall. In the afternoon Mr. G. A. Julius, chairman of the reconstituted Council for Scientific and Industrial Research, addressed the Association on the organisation and aims of that body, and explained the important influence its activities must have on the future development of pure and applied science in Australia. In the evening the incoming president, Prof. Edward H. Rennie, delivered his inaugural address in the Perth Town Hall on "The Chemical Exploitation, Past, Present, and Future, of Australian Plants." The retiring president, Lieut.-General Sir John Monash, presided, and at the close of the address a cordial vote of thanks was proposed by the Governor of Western Australia (Sir William R. Campion) and seconded by the Mayor of Perth. On Thursday, August 26, the University of Western Australia gave a garden party in its new grounds at Crawley. Three meetings of the General Council were held during the week, the most important business done being to adopt a new constitution for the Association and to advance the Subsection of Pharmacy to be a full Section to be designated "Section O." Sectional business extended from Tuesday, August 24, to Friday, August 27, inclusive, meetings being held in the daytime in the Perth Modern School and in the evening in the temporary buildings of the University. At the end of the week most of the visitors left to take part in various long-distance excursions.

An innovation tried in some of the sections at the Perth meeting was to hold evening sessions for papers and discussions on topics of more general interest, including in a few cases the sectional presidential address. This was to enable local business and professional men to take part who could not have attended in the daytime, thus extending the opportunities of the general public to share in the activities of the Association. The innovation was fully justified by results, and will probably be taken as a precedent at future meetings.

In his inaugural presidential address, Prof. Rennie, after an appreciative reference to the late J. H. Maiden, for many years general secretary of the Association, and Mr. F. G. Smith, well known for his work on the eucalyptus oils, gave a brief summary of recent work on the structure of the atom, the discovery of new elements, the possibility of atomic transformation, and the significance of the penetrating radiation discovered by Millikan. The main part of the address dealt, however, as its title implies, with the constituents and economic possibilities of Australian plant products, much of it describing Prof. Rennie's own work of the past forty years. The chief plant constituents and products considered were essential oils (eucalyptus, sandalwood, boronia, etc.), gums and resins, coloring matters, and the poisons which cause so much loss to stock owners and farmers. Prof. Rennie strongly urged the need in all the Australian States for active reafforestation to maintain a supply of raw materials, and for research on new products and on methods of utilising the present great waste from timber mills.

At the conclusion of his address, the president presented the Mueller medal of the Association to Prof. F. Wood Jones, for distinguished work in anthropology.

In Section A (Astronomy, Mathematics, and Physics) Prof. Kerr Grant gave the presidential address on "Atomic Transmutation." He showed that the developments in physics during the past twenty-five years are based chiefly on the theory of relativity, the quantum theory and the theory of the nucleus atom. The various attempts that have been made to bring about transmutation were reviewed and discussed, and the conclusion was drawn that transmutation of the heavier elements by artificial means, although not improbable, has not adequately been proved.

In his presidential address to Section B (Chemistry) on "Some Aspects of the Problem of Molecular Structure," Prof. James Kenner reviewed the chemical and physical data at present available for developing a rational theory of molecular structure. Such a theory must account for the intricate structure of carbon compounds as well as for absorption, catalysis, and molecular association, the last being specially important since substances like the proteins and rubber have been shown to be associations of relatively simple molecules. Prof. Kenner believes that a firm basis for such a theory and the means to develop it are already at hand. This address followed that in Section A, the two addresses in fact being the first items in a joint discussion of the two Sections on "The Atom and Valency."

In Subsection B_2 (Pharmacy) Mr. A. T. S. Sissons gave the presidential address on "The Indebtedness of Pharmacy to Organic Chemistry," summarising the achievements of organic chemistry in purifying and standardising naturally occurring drugs, and in synthesising these together with many others not found in Nature.

In Section C (Geology and Mineralogy) Sir Douglas Mawson, president of the Section, gave an address on "The Igneous Rocks of South Australia—a Brief Survey of Present Knowledge Relating Thereto." Igneous activity in South Australia appears to have been restricted to four periods: the older pre-Cambrian, as seen at Port Lincoln and Carrow; middle pre-Cambrian, shown by uncrushed granites in the Eyre Peninsula; late pre-Cambrian, as in parts of the Mt. Lofty Ranges; and Tertiary, as in the effusions in the Mt. Gambier district and on Kangaroo Island.

Prof. Launcelot Harrison, president of Section D (Zoology) gave an address on "The Composition and Origins of the Australian Fauna, with special reference to the Wegener Hypothesis." The Australian fauna seems to have had three main origins: an Autochthonian, established in the south-west in very early times; a Euriotian, probably derived by way of the Antarctic continent in Mesozoic or Miocene times; and a more recent Papuan element. The address served also to open a joint discussion between Sections A, C, D, E, and M on "Biological, Geological, and Physical Evidences regarding the Relationship of Australia to other Lands, with special reference to the Continental Drift Theory."

In Section E (Geography and History), Prof. Ernest Scott took as the title of his presidential address "The Discoveries of the Western Australian Coast, with especial reference to Dampier and D'Entrecasteaux," in which he gave the results of an examination of documents bearing on the history of the ill-fated D'Entrecasteaux Expedition in the Archives Nationales in Paris.

The presidential address in Section F (Ethnology and Anthropology), by Prof. F. Wood Jones, contained caustic comment on the treatment meted out to the Australian aborigines in the past, and urged that the only way in which the race can be saved from extinction is by establishing native reserves, where the natives can live their own lives under natural conditions and be protected from pauperisation.

In Section G (Social and Statistical Science) the president, Major L. F. Giblin, took as the title of his address "Federation and Finance—an Examination of the Financial Relations of States to a Federal Commonwealth." In this he showed that the present financial arrangements between the Commonwealth and the States, including taxation, are almost exclusively on a *per capita* basis, which is inequitable, as wealth and population do not run parallel.

Sir Charles Rosenthal, president of Section H (Engineering and Architecture), was unable to attend, but forwarded his address on "Nation Building," which was read to the Section. The address dealt with the dependence of the progress of civilisation on engineering and architecture, and amongst other things urged the necessity on strategic and economic grounds for a uniform gauge for the Australian railways.

In Section I (Sanitary Science and Hygiene) the president, Dr. F. S. Hone, gave an address on "Notification and its Relation to the Prevention of Disease," in which he showed the great need for co-ordination and reform of the methods of notification in use in the Australian States. To make notification effective for controlling disease, the number of permanent medical officers of health will have to be increased.

In Section J (Mental Science and Education) Mr. P. Board spoke on "Economic and Social Values in Education." Education creates the soul of the nation, acting as the sum of the effects of all the teachers on all the pupils. An extension of the school age is desirable, but will probably require some form of family endowment.

Mr. C. E. Lane Poole, president of Section K (Agriculture and Forestry), who was unable to attend, forwarded an address on "Forestry and Land Settlement." Forestry is agriculture on a long rotation, and to convert good forests into poor grazing land, as so often happens in Australia, is economically unsound; also the wholesale destruction of forests affects the climate adversely.

Prof. J. Douglas Stewart addressed Section L Veterinary Science) on "The Relationship of Veterinary Science to the Prosperity of the State." Heavy losses of stock are caused annually by parasitic and other diseases. These can be combated successfully only by preventing infestation, but this requires a knowledge of the life history of the parasites, which in many cases we do not possess. Much research is needed, but the veterinary services of the Commonwealth are sadly undermanned.

In Section M (Botany) Prof. A. J. Ewart gave his address on "Past, Present, and Future Development of Botanical Science," dealing with the killing of weeds by poison, which at present is done on purely haphazard and empirical lines, the need for botanical research in Western Australia, and modern views on the ascent of sap in trees.

In the new Section N (Physiology and Experimental Biology) Prof. W. A. Osborne gave the presidential address on "The Study of the Reflex." The response to changes in environment is one of the most obvious manifestations of life, and the higher the organism the wider the range of environmental changes to which it is sensitive. In man the highest form of reflex action is found in the emotions. Prof. Osborne suggested that many body changes that seem without purpose in the individual become clear when the individual is regarded as a member of a society, as they express the interaction between him and his fellows.

Most of the sections had very full programmes. Intersectional discussions were a prominent feature of the meeting, the following discussions being held in addition to those already mentioned: "Catalysis and Enzyme Action" and "Hydrogen-ion Concentration" (Sections B and N), "Teaching of Hygiene in Schools" (I and J), "Soil Classification and Survey" (B, C, K, and M), "Adult Education and the Workers' Educational Association" (E, G, and J), "Poison Plants" (B, K, L, and M), "Water Supplies—Domestic, Agricultural, and Pastoral" (B, C, H, I, K, L, and N), "Treatment of Low-grade Ores" (B and H), "Biological Control of Pests" (D, K, L, and M), and "Timber Preservation" (B, H, K, and M).

Danish Observations of the Planet Jupiter.[1]

THE observations of the planet Jupiter made at the Urania Observatory, Copenhagen, during the period 1919–24 are summarised in the publication before us. By far the greater part of the report, however, deals with the observations secured during the very remarkable apparition of 1919–20—an apparition which saw the revival of the well-known hollow in which the Red Spot normally lies, the south tropical disturbance, and the south component of the south equatorial belt—all of which had disappeared in the earlier part of 1919. In the succeeding apparitions, bad meteorological conditions, and later the

[1] La surface de la planète Jupiter 1919–1924. Par C. Luplau Janssen. (D. Kgl. Danske Vidensk. Selsk. Skrifter, naturvidensk. og mathem. Afd., 8 Række, XI., 1). Pp. 88+7 plates. (København: Andr. Fred. Høst and Son, 1926.) 10 kr.

low position of the planet in the sky, rendered systematic work impossible. We accordingly limit our reference to the discussion of the 1919–20 observations.

The work done may be divided into three parts:

(1) Micrometrical measures for determining the co-ordinates of individual spots.

(2) Micrometrical measures for determining the latitudes of the belts.

(3) Descriptive notes and drawings of the surface features.

M. Luplau Janssen is a firm believer in determining the longitudes as well as the latitudes of Jovian markings with the micrometer, but some eye-estimated transits across the central meridian were also recorded. Many of the older observers of the planet will recollect the discussions which took place several years ago as to the relative merits of the two methods of deriving longitudes. A comparison of M. Luplau Janssen's micrometric results with central meridian transits by other observers shows the accuracy attained to be of much the same order, but it seems to the reviewer that in a given time a considerably larger number of spots can be observed by the transit method, which is a matter of great importance. On the other hand, valuable results can, of course, often be obtained with the micrometer of an object which has already been observed by the transit method, or for some other reason cannot be observed at its central passage. Micrometer measures also have the advantage of furnishing values for the equatorial as well as the polar diameter of the planet, and from his series of observations in 1919–20, M. Luplau Janssen deduces the figures 37″·72 and 35″·54 respectively at mean distance, which gives for the oblateness of the disc the value $\frac{1}{15}$. The figures for the equatorial and polar diameters at present adopted in the physical ephemerides are 37″·87 and 35″·35.

In the discussion of the observations of individual spots, the conclusions drawn suffer from the, relatively speaking, small number of longitude determinations. In fact, the identifications in some cases seem to the reviewer to be entirely erroneous. A striking example is found in the case of some remarkable spots observed in the south tropical zone (the zone between M. Luplau Janssen's bands IV. and V.). On p. 66 of his report five observations are taken together as referring to one and the same object, but if we accept the conclusions arrived at in the twenty-second report of the Jupiter Section of the British Astronomical Association recently published, which are based on a very much larger number of observations, we find that they actually belong to four separate objects, and that what is, perhaps, the most interesting fact revealed during the apparition—namely, the abnormal drift in opposite directions of two pairs of spots—has been entirely missed. Similarly, when all the available material is considered it appears that mistakes in the adopted identifications are accountable for some of the large irregularities of motion attributed to certain other spots by M. Luplau Janssen.

A valuable part of the report is that which contains a summary of the micrometrical measures of the latitudes of the belts and a comparison with results obtained by other observers in previous years. As has been often remarked, the latitudes of the belts show considerable variations, and especially has this been the case in recent years with the north edge of the north equatorial belt (M. Luplau Janssen's band III.). M. Luplau Janssen considers that there is evidence in the measures of some of the belts of changes of a periodic nature which are related to the position of the planet in its orbit. It may be questioned whether the available evidence is sufficiently strong to warrant such a conclusion, but the matter is certainly worth careful investigation, and there can be no doubt that measures of the positions of the belts (as emphasised several years ago by the late Prof. G. W. Hough) should be regarded as an important part of the work on Jupiter. M. Luplau Janssen lays emphasis on the stability in position of the south equatorial belt (his band IV.); yet it is worth noting that it is this belt which in 1919 and again in the present year has faded to such an extent as to become invisible save for its north component. Overlying vapours may perhaps be accountable for the effect observed, but on the other hand, in 1920 the revival was attended by disturbances which seemed to indicate some deep-seated cause in the planet's interior.

At the end of the report are seven plates containing 41 drawings, 37 of which belong to the apparition of 1919–20. These drawings illustrate the remarkably rapid and amazingly complicated changes which were associated with the great revival of the south equatorial belt and the south tropical disturbance during that apparition.

Taken as a whole, the report contains a mass of valuable data which will be very welcome to all students of the planet.

The Problem of Secretion.

THE attention of those who are interested in the problem of secretion is directed to a series of three papers by Dr. Robert H. Bowen, of Columbia University, New York, which have appeared in the current volume of the *Quarterly Journal of Microscopical Science* (vol. 70, parts 1, 2, and 3), and especially to the very capable critique of the topography, structure, and function of the Golgi apparatus in glandular tissue which he has given in a fourth paper (part 3, October 1926). Believing that the older theories of secretion had broken down and that the field was clear for the thorough examination of the Golgi apparatus as a synthetic intermediary in the process of secretion, he has concentrated his attention on this subject and has made only brief references to the secretory possibilities of other components of the cell.

Dr. Bowen concludes that the Golgi apparatus is present from the beginning in all kinds of secretory cells, and, when large numbers of secretory granules are being produced, becomes greatly hypertrophied, establishing a volume in rough relation to that of the secretory products, the other elements of the cell diminishing more and more. The topography and behaviour of the Golgi apparatus are different in different kinds of glands, but can be divided roughly into three general types characteristic of cells which produce serous, mucous, and lipoidal secretions. The secretory granules make their first appearance only within the area delimited by the Golgi apparatus. In a few cases there are indications that the secretory granules arise in close connexion with the Golgi material, and in fact that there is a constant and intimate topographical association between them. Dr. Bowen concludes that the secretory granules are differentiated by the Golgi material, but that no direct transformation of one into the other occurs, such as has been claimed by some authors who have advocated the mitochondrial origin of secretions. Dr. Bowen suggests that the Golgi material is structurally homologous throughout the range of animal cells, and that the so-called idiosomic substance sometimes associated with it is to be looked upon as one phase

of a duplex system in which the relative development of lipoidal and idiosomic substances may undergo considerable variation.

Having established a probability in favour of the essential homology between secretory granules and the acrosome of the animal sperm, Dr. Bowen suggests that the relationship between the Golgi apparatus and the secretory granules is homologous to that existing between the Golgi apparatus and the acrosome, and that our more complete understanding of the latter phenomenon can be used as a basis for interpreting the much more obscure phenomena in the gland cell. He adds that the establishment of the views developed in his paper must depend finally upon further critical evidence from favourable material bearing upon the exact relation which exists between the individual secretory granule and the Golgi complex.

Dr. Bowen holds that no cytological evidence of the origin of secretory products from the nucleus receives any acceptance at the present time. The nucleus can be considered as the source of secretions only in the indirect sense that it may possibly exercise some control over the process as a whole, or may collaborate with other parts of the cell-system in preparing materials for the synthetic operations of the Golgi apparatus.

When a cell is divided into a nucleated and a non-nucleated portion, the latter is able to carry on synthetic activities for a brief period only; meanwhile the nucleated part regenerates and appears none the worse for the operation. Hence it was concluded that the nucleus is the centre of synthetic operations, and particularly of the formation of those intracellular enzymes upon which living activity is now supposed to depend. But it is at least equally possible that the nucleated piece alone continues capable of constructive metabolism because it possesses the complete cell-system, while in the non-nucleated piece the system is disrupted. Dr. Bowen remarks that if the Golgi apparatus could be eliminated, the cell would doubtless be fatally affected. While secretion is an activity in which the cell-system as a whole is probably involved, and over which the nucleus exercises some controlling influence, the actual synthetic centre for the differentiation of secretory granules is the Golgi apparatus. That this source of the visible secretory granules "is likewise the source of the invisible, intra-cellular enzymes . . . cannot at present be doubted, but our scanty knowledge of these things makes any hypothesis whatever almost pure speculation."

Forestry in Illinois and Great Britain.

IT is common knowledge that the drain upon the world's resources of coniferous timber is very heavy, and that in some countries the outlook is regarded with increasing disquietude. In the "Third Report on a Forest Survey of Illinois," by C. J. Telford, the position of the State is explained with great clarity, and the parallel to the state of affairs existing in Great Britain is depicted. The present forests of the United States contain an estimated total of 481,800 million cubic feet of standing timber, the annual cut is 25,000 million cubic feet and the annual growth 6039 million cubic feet. "The virgin forests," the report says, "will carry us another 25 years, after which we shall probably be wholly dependent upon growth from cut-over lands. By utilising the entire 470 million acres of forest lands at prevailing rates of growth these cut-over lands can supply us with an estimated annual yield of 14,000 million cubic feet—a little more than half our present requirements. The conviction that satisfactory substitutes for wood will be found is untenable when the enormous amount of wood required is appreciated. This drain of 25,000 million cubic feet of standing timber a year means that for every hundred pounds of coal, iron, cement, petroleum and copper consumed the forests supply 67 pounds of wood, and the crop lands supply 44 pounds of all forms of crops, including cereals, seeds, clover, hay, forage, cotton, potatoes, sugar, fruit, and nuts. It is obvious that a satisfactory substitution for a commodity representing by weight two-thirds of virtually all the minerals consumed, or one and a half times all crops raised in the United States, is impossible. A timber famine will be more disastrous to Illinois than to any other State. Its manufacturing establishments employ 11·6 per cent. more hands than agriculture, transportation, and mining combined, and thirty per cent. of all persons employed in manufacture are in industries dependent upon wood. In the single item of lumber, Illinois consumes one-thirtieth the total lumber-cut of the world."

The process of forest destruction is far advanced in Illinois. Virgin timber has practically disappeared, and the present drain on the cut-over forests and second growth stands, unchecked, will, it is held, result in an early disappearance of all forests in the State. There was an increase in unforested waste land of 250,000 acres in the ten years from 1910 to 1920, and Illinois now has a total of 1,577,663 acres in this class. The 3,021,650 acres now forested are on lands unsuited to ordinary farming, and if cleared will generally revert to waste land. The state of affairs thus briefly delineated is sufficiently alarming from the industrial outlook alone and renders the more interesting the following comparison with the position of Great Britain.

"There is a striking parallel between Illinois and Great Britain in the total wood consumption and in the total area forested. Each annually consumes approximately the same quantity of wood—560,720,000 cubic feet for Illinois and 600,000,000 cubic feet for Great Britain; each has about the same area forested —3,021,650 for Illinois and about 3,000,000 acres for Great Britain. But Great Britain, despite a population of 437·5 to the square mile as compared with 115·7 in Illinois, and the consequent pressure for land, has deliberately undertaken to replant 1,770,000 acres, and this planting is being done at the rate of 20,000 acres a year. Illinois has never planted 200 acres of publicly owned forests, her farm woodlands are decreasing at the rate of 4500 acres a year, and the unimproved and waste land on farms is increasing at the rate of 25,000 acres a year."

Bird Flight.

IN the *Transactions of the Royal Society of South Australia*, vol. i., 1926, an interesting contribution is made by Prof. F. Wood Jones on the flight of sea-birds. It has long been observed that many sea-birds spend protracted periods, sometimes soaring, sometimes gliding, and at any rate to the novice, apparently without a visible tremor of the wing. Their flight appears to be merely an ability to slide ahead with no other power than their own weight and a presumably instantaneous ability to readjust their planes and alter their cant and poise apparently largely by movements of the head.

As a result of close study and observation extending over many years, Hankin maintains that in the

wake of a ship the air must possess a physical property which he terms 'soarability' by means of which sea-birds are enabled to extract from the air in that region an upward momentum. Presumably this must mean that the air in passing over the ship is set into a state of disturbed eddying of such a general direction of rotation and of such a distribution of intensity vertically that the bird experiences a lift it would not otherwise acquire.

Prof. Wood Jones, on the other hand, regards the soaring and gliding of pelagic birds as due rather to a morphological adaptation of the bird as an adjusted plane than to any chance condition of "soarable" air. Regarded in this way, he maintains, the zoned north and south distribution of the different morphological types of sea-birds and the failure of the albatross, for example, to follow ships into the tropics, well adapted as it is for gliding, must be investigated from the point of view of bird structure correlated to the environment to which it appears to be adapted. In the case of the albatross, there appears to be a perfect mastery of aerial conditions well to the south of the equator, a lessening mastery farther north, and a positive disability, laboured flapping flight, as the journey is made towards the equator. The same facts apparently hold with regard to the northern representatives.

Prof. Wood Jones points out, moreover, that the zonal distribution of species from the equator northwards is very similar to the distribution southwards from the equator, with a similar increasing ratio of weight to wing area, culminating at both poles with the southern penguins at one end and their extraordinary parallels, the northern auks, at the other. The clue to this gradation is to be sought in the increase in atmospheric density from the equator in both directions, so that a bird adapted for flight in the denser atmosphere finds difficulty in maintaining its gliding and soaring in the rarer atmospheres of the tropics. By indicating this new line of approach, Prof. Wood Jones undoubtedly has given a new impetus to the study of bird flight.

University and Educational Intelligence.

BIRMINGHAM.—Mr. H. Munro Fox, fellow of Gonville and Caius College, Cambridge, has been appointed to the Mason chair of zoology to succeed the late Prof. F. W. Gamble. Mr. C. G. C. Chesters has been appointed assistant lecturer in botany.

The Council has recommended to the Court of Governors that the title of emeritus professor be conferred on Thomas Turner, formerly professor of metallurgy.

EDINBURGH.—At the graduation ceremony on December 17, the degree of D.Sc. was conferred on Baini Prashad, Superintendent of the Zoological Survey of India, the Indian Museum, Calcutta, for his thesis on (1) "Recent and Fossil Viviparidæ: a Study in Distribution, Evolution, and Palæogeography," and (2) "The Shell and Mantle of the Viviparidæ"; the degree of Ph.D. on R. K. S. Mitchell for his thesis on "Some β Octyl Esters of Substituted Acetic Acid"; and the degree of M.D. on Eric H. Ponder, with gold medal, for his thesis on "Studies in Hæmatology."

APPLICATIONS are invited by Yale University for two Theresa Seessel Research Fellowships for the promotion of original research in biological studies. The value of each is 1500 dollars. Preference will be given to candidates who have already obtained their doctorate, and have demonstrated by their work fitness to carry on successfully original research of a high order. The holder must reside in New Haven during the college year, October to June. Applications, accompanied by reprints of scientific publications, letters of recommendation, and a statement of the particular problem which the candidate expects to investigate, should be made to the Dean of the Graduate School, New Haven, Conn., before March 1, 1927.

IN the course of the past year inquiries were made by the Institution of Mechanical Engineers of the colleges and schools conducting approved part-time courses as to the ages and occupations of candidates for the Ordinary and Higher National Certificates in mechanical engineering. Information has been supplied from 85 colleges and schools in Great Britain in respect of 1000 candidates for the ordinary certificate and 334 for the higher certificate. The average age of the former candidates was about 19·5 years, and of the latter about 21·5 years. No less than 801 of the 1000 candidates for the ordinary certificate were between the ages of 18 and 21 years. Classifying the candidates in respect of occupation, it was found that apprentices of all classes constitute 71·3 per cent. of the candidates for the ordinary certificate, and 32·4 per cent. of those for the higher certificate, and that the combined proportions of trade apprentices and mechanics following these courses are 42·4 per cent. for the ordinary certificate and 37·7 per cent. for the higher certificate. The proportions of successful candidates were 52·5 per cent. for the ordinary certificate and 67 per cent. for the higher certificate.

THE East Anglian Institute of Agriculture, Chelmsford, announces in its Calendar for 1926–27 that alterations during 1925–26 have enabled it to offer facilities for instruction of a more advanced character than that obtainable at any similar institute in Great Britain. The research work at present in progress includes deterioration diseases of potatoes, seeds mixtures, autumn versus spring sowings, composition of butter-fat in goat's milk, winter spraying, colonisation of salt marshes, bunt in wheat, wheat bulb fly, and Hessian fly. Agricultural economics courses include one on the history of British agriculture. Special courses on the agriculture of New Zealand, of Australia, and of Canada and South Africa, are provided. A list of appointments held by past students does not indicate that any of them have as yet gone abroad. The North of Scotland College of Agriculture has a very different record in this respect, a very large proportion of the posts held by its former students being in other countries. The Calendar of this College for 1926–27 announces, among other courses, a "Planter's Certificate Course" specially provided to meet the requirements of students intending to enter on service upon tea, coffee, rubber, sugar, and other plantations in tropical and subtropical countries. It extends over two complete winter sessions and one intervening summer session. No preliminary qualifying examination is prescribed. Nine students obtained the degree of B.Sc. in agriculture during the past session. The courses in forestry formerly provided by the College have been transferred to the University of Aberdeen. The Edinburgh and East of Scotland College of Agriculture has in the past, like the North of Scotland College, sent many students abroad, but the list published in its new Calendar of appointments gained by students shows a falling off in this respect. This College, like the East Anglian Institute, offers a course on the history of British agriculture based on Lord Ernle's "English Farming, Past and Present."

Calendar of Discovery and Invention.

January 1, 1801.—After the enunciation of Bode's law and the discovery of Uranus, it was thought there must be an undiscovered planet the path of which lay between the orbits of Mars and Jupiter. A group of astronomers, therefore, agreed to make a systematic search, and on January 1, 1801, Giuseppe Piazzi, at Palermo, saw Ceres, the first of the minor planets or asteroids. By 1845 four others had been discovered, but since the application of photography to astronomy many hundreds have been identified. Ceres, however, is the largest, being 485 miles in diameter.

January 1, 1855.—Among the methods used for determining the density of the earth is that introduced by Airy, who, in 1826 and 1828, with Whewell and Sheepshanks, made pendulum experiments at Dolcoath Mine, Cornwall. Later, he repeated these experiments at Harton Colliery, South Shields, at a depth of 1260 feet, and gave an account of these in a lecture at South Shields on January 1, 1855. The result he obtained gave 6·56 as the mean density—a value, however, considerably too high.

January 2, 1818.—The foundation of the Institution of Civil Engineers was due to six engineers, of whom the best known were William Maudslay, Joshua Field, and Henry Robinson Palmer. The first formal meeting was held at the Kendal Coffee House, Fleet Street, on January 2, 1818. On January 23, 1820, it was proposed to ask Thomas Telford to become president. He was formally installed on March 21 of that year, and held the presidency until his death in 1834. The first home of the Institution was at 15 Buckingham Street, Adelphi, and the first volume of *Proceedings* was issued in 1836.

January 3, 1752.—While spectrum analysis was due to Newton, it was the young divinity student Thomas Melvill who first used a prism for the examination of various flames; introducing sal-ammoniac, potash, alum, etc., into burning spirits. He gave an account of his experiments to the Medical Society of Edinburgh on January 3, 1752, while another paper of his was read to the Royal Society in 1753 by Bradley. (See NATURE, November 5, 1914, vol. 94, p. 263.)

January 4, 1896.—On this day Röntgen gave an account of his discovery of X-rays to the Physical Society of Berlin. His discovery was made on November 8, 1895, and was described in a paper entitled "On a New Kind of Rays," which appeared in the *Sitzungsberichte der Würzburger physik.-medic. Gesellschaft*. A translation of this paper was given in NATURE of January 23, 1896, together with an article and an X-ray photograph contributed by Mr. A. A. Campbell Swinton.

January 7, 1610.—No accidental discovery has had more far-reaching results than the discovery of the principle of the telescope. From the report of what Lippershey had done, Galileo made telescopes magnifying three, eight, and thirty times, and on January 7, 1610, at one o'clock in the morning, observed for the first time three of the satellites of Jupiter, and thus ushered in the era which has seen so vast an extension of our knowledge of the sky.

January 7, 1785.—The first to make a balloon ascent solely for scientific purposes, Dr. John Jeffries, on January 7, 1785, with the famous aeronaut Blanchard, crossed the English Channel from Dover to Calais, where a marble column was erected to commemorate the feat. On an ascent from London in 1784, Jeffries carried with him meteorological instruments and obtained samples of air at various heights for Cavendish. E. C. S.

Societies and Academies.

LONDON.

British Mycological Society, November 20.—W. J. **Dowson**: An unusual species of Botrytis attacking Narcissus. The fungus is the cause of 'fire,' marking the leaves with one or more yellow patches. The spores of the fungus are very large, and germinate with as many as thirteen germ tubes after up to one hour in water or in dilute glycerine.—Miss A. Lorrain **Smith**: A new family of lichens. The lichen *Cryptothecia subnidulans* was described by the late Dr. Stirton, and has led to much difficulty in assigning it to a systematic position. Stirton's herbarium has revealed three additional species of the genus and two closely allied ones for which a new genus is proposed; the two genera form a family characterised by the apparently double-walled ascus containing septate or muriform spores and embedded in a lax peridium of interwoven hyphæ. Affinity with the fungi Myriangiales and Gymnoascales is suggested; the nearest lichen allies appear to be Thelocarpaceæ and Mycoporaceæ.—O. V. **Darbishire**: Isidia and soralia of lichens. Isidia in *Peltigera prætextata* develop endogenously from special hyphæ which make their way to the surface, breaking through the cortex or making use of a crack. The mature isidia are very highly developed assimilators. There is a primary cortex on the upper surface with walls of wavy outline. The secondary cortex is similar to the cortex of the thallus. The gonidia are fairly closely packed towards the upper cortex with a very loose arrangement just inside the lower cortex. This cortex is of one layer of cells, with sinuate walls and interrupted here and there by pores. Soredia also have an endogenous origin. A few gonidia are gradually surrounded by the fungus and the differentiating soredium is raised to the surface of the sorial tissue, from which it becomes detached as a reproductive organ.—W. R. I. **Cook**: The genus Ligniera. Cross inoculations have shown that several species which have been described are merely host varieties. Infection takes place by zoospores entering root hairs. Spores serve as a resting stage and for propagation within the plant. Reduction division occurs at the formation both of spores and zoospores. Conjugation has not been seen.—W. A. **Roach**: On the nature of disease resistance in plants, with special reference to the wart disease of potatoes. Wart disease is an example of physiological resistance. Evidence at present suggests that immune and susceptible varieties form two distinct classes and not end members of a continuous series. The reaction towards wart disease is unaffected by grafting on either a foliage system, a root system, or of a complete plant of opposite reaction to the disease. Immunity from, or susceptibility to, wart disease is therefore probably innate to the cell and must be sought in compounds which cannot cross a graft fusion layer unchanged, and so probably cannot leave a cell. These compounds may be proteins.

Geological Society, December 1.—Howel **Williams**: The geology of the Snowdon massif (North Wales). The area described is limited on the north-east by the Pass of Llanberis, on the south-east by the Vale of Gwynant, on the south-west by the Colwyn and Gwyrfai Valleys to near the village of Salem, and on the north-west by the supposed line of junction between the Cambrian and the Ordovician rocks. The general stratigraphical succession is made out. The exact relationship between the Ordovician and the Cambrian systems on the northern flank of Snowdon is uncertain. Ramsay's threefold division of the

Snowdon Volcanic suite remains the most useful basis for its study. The Upper and Lower Rhyolitic series were derived from a potash-rich magma. The approximate age of the Snowdon Volcanic suite is inferred to be between Middle Llandeilian (zone of *Climacograptus peltifer*) and Middle Caradocian (zone of *Dicranograptus clingani*). Many dykes, inclined sheets, and bosses of quartz-porphyry, micro-granophyre, and intrusive rhyolite occur on Snowdon, the largest intrusion being that of Crib Goch, formerly considered to be an outlier of the Upper Rhyolitic Series. Both mineralogically and chemically, the acid intrusive rocks resemble the Snowdon rhyolites. Pre-cleavage sills of augite-dolerite and spilitic dolerite occur at several horizons, and present various biotite- and copper-rich modifications. The major folding is of north-east-and-south-west strike, and occurred almost wholly after the period of basic intrusions. Its dominant expression is the so-called 'Snowdon syncline,' the north-western limb of which lies in a recumbent position in the area immediately south of Rhyd-ddu. The major folding was succeeded first by a cleavage of similar strike, and afterwards by a minor folding and thrusting due to pressures directed south-eastwards, the thrusting being most pronounced along the recumbent limb of the 'Snowdon syncline.' Finally, the area was broken into blocks by faults, most of which belong to the same family of movements as those just enumerated, although some may have moved again during the Tertiary era.—Albert **Heard**: On Lower Old Red Sandstone plants showing structure, from Brecon (South Wales). A new fossil plant locality is recorded from the Senni beds in the neighbourhood of Brecon. A new Lower Old Red Sandstone plant, *Gosslingia breconensis*, is recorded; the plant is rootless and leafless, with stomata and hairs; gregarious, erect, dichotomously-branched, cylindrical stems arise from dichotomously-branched rhizomes with rhizoids; the stems are circinately coiled in the apical regions. The stele consists of a large strand of tracheids which have both spiral and reticulate thickening, surrounded by protoxylem and phloem; the outer cortex of the aerial stem consists of four layers of thick-walled cells. Reniform appendages borne on special branches are interpreted as sporangia. There is also a peculiar organism resembling Pachytheca.

Society of Public Analysts, December 1.—William G. **Savage**: Recent advances in the bacteriological examination of food and water. The four tests used to differentiate the high and low types of coliform organisms in water and their value as indicators of excremental contamination are discussed. As regards milk, the value of examining centrifugalised deposits for the tubercle bacillus is considered, and new tests for distinguishing pathogenic streptococci from those of bovine origin not injurious to man are described.—L. H. **Lampitt**, E. B. **Hughes**, and L. H. **Trace**: On the presence and detection of furfural in vinegar. In the distillation of malt vinegar or wine vinegar, furfural is produced by the acid hydrolysis of the pentosans contained in the vinegar. Added caramel in vinegar will only give the furfural it originally contained as such. A modified aniline acetate test has been devised wherein the rose-coloured furfuraniline is extracted by an immiscible solvent, amyl alcohol. Thus dark-coloured vinegar may be tested for furfural without distillation. The test is quantitative.—E. R. **Dovey**: The rapid determination of opium in stomach contents. A standard solution is made from ordinary prepared opium which has itself been standardised to contain 10 per cent. of morphine and 5 per cent. of meconic acid. A measured quantity of the stomach washings are treated successively with dilute hydrochloric acid, mercuric chloride solution, and ferric chloride solution, and the resulting colour is matched with that given by the standard under the same conditions. The mercuric chloride inhibits the formation of any coloration with thiocyanic acid in the opium.—C. H. **Manley**: A rapid method for the sorting of butters and margarines. The method depends upon the butyric acid content of butter fat. The filtered fat is saponified, the soap solution acidified with sulphuric acid, and the insoluble fatty acids filtered off under specified conditions. The excess of sulphuric acid in the filtrate is neutralised (methyl orange as indicator) and the titration with standard alkali continued to neutrality, with phenol phthalein as indicator. The difference between the result and that obtained in a blank test affords a measure of the soluble fatty acids. The neutral solution may be used for determining the Kirschner value.

CAMBRIDGE.

Philosophical Society, November 22.—H. W. B. **Skinner**: On the polarisation of mercury lines emitted from a discharge tube in a magnetic field.—C. F. **Sharman**: The application of the method of the magnetic spectrum to the study of secondary electronic emission. The relative merits of the method of retarding potentials and of the magnetic spectrum for the investigation of the energy distribution of electronic emissions are discussed. The latter method was used in the case of the secondary emission excited in metal surfaces by a beam of electrons with energies between 100 v. and 1000 v. With a copper target, the distribution curve is very nearly independent of the energy of the primary beam. The results are in general agreement with those obtained by means of retarding potentials; there is, however, a discrepancy in the position of the low energy peak as given by the two methods.—L. H. **Thomas**: The calculation of atomic fields. The effective field V inside an atom is assumed to be that due to the nuclear charge and to electrons distributed uniformly in the phase space of their motion in the field at 2 for each h^3 of phase space corresponding to closed orbits. Thus

$$\nabla^2 V = \frac{64\sqrt{2}}{3}\pi^2 \frac{e^{\frac{1}{2}}m^{\frac{3}{2}}}{h^3}V^{\frac{1}{2}}.$$

The fields so calculated agree well with those that have been constructed to fit X-ray data.—L. **Wertenstein**: A contribution to the theory of diffusion pumps. The mercury vapour stream in a diffusion pump carrying gas from the 'low pressure' side to the 'high pressure' side creates a pressure gradient which explains the working of the pump. The pressure gradient is given by a diffusion formula (Gaede, Hertz) or directly by a dynamical method (corresponding to the calculation of diffusion coefficients by dynamical considerations: Langevin, Chapman). The agreement is excellent for hydrogen, a little worse for air. Hence the final ratio of pressures on 'high' and 'low' pressures side of a diffusion pump must be higher when the diffusion coefficient is smaller, *i.e.*, that so far as final vacuum is concerned, the diffusion pump is more efficient for heavier than for lighter gases. This result seems at first in contradiction with the fact that the diffusion pump pumps out quicker the lighter gases, but it was found that, at the same temperature, carbon dioxide was removed more perfectly than argon, and argon than hydrogen.—W. **Burnside**: On a group of order 25920 and the projective transformations of a cubic surface.—P. A. M. **Dirac**: The Compton effect in wave mechanics.—J. B. S. **Haldane**: A mathematical

theory of natural and artificial selection. Part iv.—G. C. **Steward**: On the addition of the primary aberrations. In applying the characteristic function to particular optical systems three steps are necessary: the properties of the composite system must be examined in general, and then their dependence upon the corresponding properties of the component systems, and finally an examination must be made of the simplest components. The first and third of these have been undertaken elsewhere; a simple method is now given of achieving the second step—the method being applicable especially to the primary aberrations. Relations are obtained between the aberration coefficients of the composite system and the corresponding coefficients of the components.

LEEDS.

Philosophical and Literary Society, November 2.—P. K. **Dutt**: Anilopyrine and antipyrine (Preliminary Note). Anilopyrine alkohydroxides, in the absence of water, decompose spontaneously into 2-alkyl 5-pyrazolones, and a secondary amine. Further, the character of the substituents in position 2 and in the 5-amino group profoundly influences the yields of the two products. The fallacy of Michaelis's arguments in support of his bridge formula for anilopyrine is pointed out; there is no ground for discarding the anil structure of anilopyrine suggested by Stolz.—H. M. **Dawson** and C. R. **Hoskins**: Isohydric solutions and the velocity of chemical change. Measurements of the rate of reaction of acetone with iodine under the catalysing influence of isohydric solutions containing equivalent quantities of acetic acid and sodium acetate are in accord with the view that the reaction velocity corresponds with the sum of effects due respectively to the hydrogen ion, the hydroxyl ion, the acetate ion, and the undissociated acid. The proportion of the total effect attributable to the hydrogen and hydroxyl ions amounts to about 30 per cent. in a 0·005 molar solution, whereas this proportion is only about 0·2 per cent. in the case of a molar solution.—H. M. **Dawson** and L. H. **Angus**: The nature of solutions of the strong acids from the standpoint of the salt effect: the system nitric acid, sodium nitrate. The changes produced in the solubility of iodine in water by the addition of sodium nitrate can be expressed by an exponential formula $S = S_0 e^{-kc}$. When nitric acid solutions (1·3 N and 2·7 N) are substituted for water, there is no change in the nature of the salt effect. The observations support the view that nitric acid is an almost completely ionised electrolyte.—R. Whytlaw **Gray** and H. **Whitaker**: A new method of determining the vapour pressures of aqueous solutions. This consists in suspending a droplet of solution from a fine silica spiral microbalance and measuring its weight when it has come into equilibrium with a solution of known vapour pressure placed in the balance case. Preliminary measurements with droplets of solutions of sulphuric acid surrounded either with sucrose solutions or with partially dehydrated oxalic acid have shown that the method is capable of giving accurate results.—B. A. **Burrell**: Atmospheric pollution in Leeds, 1922–25.—E. **Percival** and H. **Whitehead**: Biology of the mayfly *Ephemera Danica*, Müll. Observations have been made on the conditions under which *E. danica* exists. The nymphs are largely confined to sandy deposits where the particles consist chiefly of the coarse and fine sand fractions. The insects are positively rheotactic, negatively phototactic, and, in the light, burrow rapidly. These responses, along with poor swimming powers, tend to limit the distribution of the animals to the sandy regions of streams. An attempt has been made to relate quantitatively the occurrence of these nymphs with their habitat.—J. H. **Priestley**: The relation of cork formation to the endodermis in the shoot of the dicotyledon. An account is given of the occurrence and distribution of the polyderm in the shoot of *Rubus Idæus*, and of the suberised layers in the stem of *Camellia japonica*. In the light of these facts the distribution of cork in Camellia, superficial below the bud scale scars and pericyclic elsewhere in the axis, and the extent of the formation of wound cork in both stems, becomes intelligible. No interpretation of the influence of suberised endodermal structures upon cork formation in the dicotyledon shoot will be possible except upon the basis of detailed studies of this type.

MELBOURNE.

Royal Society of Victoria, November 4.—O. W. **Tiegs**: Metamorphosis of insects. Different degrees of metamorphosis are exhibited by different groups of insects. In dragon-flies there is probably but little change; in coleoptera there occurs a partial tissue disruption, and a partial tissue rejuvenation; in muscid flies a very profound tissue disruption occurs; but the most profound metamorphosis yet described occurs in the chalcid wasp (Nasonia), where *every* specialised larval cell disintegrates at metamorphosis, and, after removal by phagocytes, or after simply dissolving in the blood, is replaced by imaginal cells. In Nasonia the death of the larval cells is not due to phagocytic action, but is a direct consequence of their enormous growth in size, increase in the size of the larva being the result, not of an increase in the number of larval cells, but of an increase in their volume.—A. J. **Ewart** and Lesley R. **Kerr**: Contributions to the flora of Australia (No. 32). The paper contains a number of additions to the flora of the Northern Territory. *Euphorbia petala* n. sp. is related to *E. ulsiniflora* and *E. Drummondi*; *Indigofera uncinata* n. sp. is a xerophytic adaptation of *I. australis*. *Eucalyptus Gillein* n. sp. from the summit of Mount Gillen is related to *E. Oldfieldii*; *Vellira prostrata* n. sp., while related to *V. perfoliata*, has the bracts practically free at the base instead of connate. The collection of abundant material of Ptychosema in all stages of development has made it clear that this genus, and also Lamprolobim, belong not to the Galegeæ but to the Genistæ.—J. M. **Baldwin**: The technique of the Nanson preferential majority system of election. This system of election, in contrast to other majority systems, fulfils the fundamental condition of majority representation, namely, that a candidate who could beat each of the other candidates separately must be elected. The technique evolved reduces the work of scrutineering to within practical limits. The technique developed has been tested in practice, the time for the tabulation being $Nn(n-1)/1000\ m$ hours (N voters, n candidates, m scrutineers). A method for reducing the number of candidates to ten is suggested which, while not rigidly accurate, is so unlikely to lead to error that the possibility may be neglected.

VIENNA.

Academy of Science, November 4 and 11.—J. **Zellner**, K. **Knie**, E. **Rosenblüh**, M. **Stein**, and J. **Richling**: Contributions to comparative vegetable chemistry (xv.). Chemistry of barks (fifth communication). Acer, Cratægus, Pavia, and Picea have yielded various substances, including ceryl alcohol, palmitic and stearic acids, invert sugar, tannins, etc.—J. **Zellner**, E. **Huppert**, R. **Klapholz**, K. **Knie**, O. **Pollatschek**, A. **Spitzer**, J. **Richling**, and M. **Stein** (xvi.): Chemistry of plants with milky sap. The

juices of seven species of the chicory family were found in qualitative agreement containing caoutchouc, two stearin-like alcohols, lactucerol and other substances.—E. Feyertag and J. Zellner (xvii.): *Rhododendron hirsutum*.—J. Zellner: Chemistry of halophytes. Those on the eastern shore of the Neusiedler See near Vienna are rich in sulphates.—R. Seka and O. Schmidt: Nitro-derivatives of dinaphtanthracene-diquinone and their transformations.

Diary of Societies.

SATURDAY, JANUARY 1.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. V. Hill: Nerves and Muscles: How we Feel and Move: (3) The Heart and some other Muscles.

MONDAY, JANUARY 3.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—F. Rodd: Camels and Caravans (Christmas Lecture for Young People).

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Capt. T. W. E. Higgens: Man and his God: The Origin of Religion in the Gentile World as taught by St. Paul.

INSTITUTION OF AUTOMOBILE ENGINEERS (Western Centre) (at Merchant Venturers' Technical College, Bristol), at 6.45.—Prof. W. Morgan: The Optical Indicator as a Means of Examining Combustion in Internal Combustion Engines.

SOCIETY OF CHEMICAL INDUSTRY (London Section) (at Chemical Society), at 8.—J. H. Coste and Col. Butler: Modern Developments in the Treatment of Sewage.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—B. Anrep: Mosaics.

TUESDAY, JANUARY 4.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. V. Hill: Nerves and Muscles: How we Feel and Move: (4) The Lungs and Blood: How the Muscles get Air and Fuel.

INSTITUTION OF AUTOMOBILE ENGINEERS (at Royal Society of Arts), at 7.—Dr. B. A. Keen: The Place of the Tractor in Soil Cultivation.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—M. Adams Impressions of America and Canada—Photographic and otherwise.

HULL CHEMICAL AND ENGINEERING SOCIETY (at Hull), at 7.45.—G. H. M. Hutchinson: Refrigeration.

INSTITUTION OF AUTOMOBILE ENGINEERS (Coventry Graduates' Meeting) (at Broadgate Café, Coventry), at 7.45.—W. N. Haynes: Recent Developments in Motor Cycle Engine Design.

WEDNESDAY, JANUARY 5.

ROYAL SOCIETY OF ARTS, at 3.—Prof. C. R. Darling: The Story of a Wireless Valve (Dr. Mann Juvenile Lectures) (1).

PHILOSOPHICAL SOCIETY OF ENGLAND (at 138 Piccadilly), at 4.30.—Rev. J. B. Jaggar: The Philosophy of Faith.

GEOLOGICAL SOCIETY, at 5.30.—C. S. Elton: The Nature and Origin of Soil-Polygons in Spitsbergen.—Dr. F. Dixey: The Tertiary and Post-Tertiary Lacustrine Sediments of the Nyasan Rift-Valley.

ROYAL SOCIETY OF MEDICINE (Comparative Medicine and Tropical Diseases and Parasitology Sections), at 5.30.—Discussion on Trypanosomiasis in Man and Animals.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—G. H. Nash and others: Informal discussion on The Acoustic Problems of Microphones and Loud-Speakers.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Caxton Hall), at 7.—R. E. Herring: The Supervision during Erection and Maintenance of a Low Pressure Hot Water Heating Apparatus.

ROYAL MICROSCOPICAL SOCIETY (Biological Section).

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Middlesbrough Branch, Graduate Section) (at Middlesbrough).—C. Boast: Marine Condensing Plant.

THURSDAY, JANUARY 6.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. V. Hill: Nerves and Muscles: How we Feel and Move: (5) Nerves and Muscles Working Together.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—A. R. Cooper: Electrical Equipment of Track on the Underground Railways of London.

INSTITUTION OF THE RUBBER INDUSTRY (Birmingham and District Section) (at Grand Hotel, Birmingham), at 7.—A. W. T. Hyde: Physical Tests and their Significance.

SOCIETY OF CHEMICAL INDUSTRY (Bristol Section, jointly with Fuel Section) (at Bristol University), at 7.30.

SOCIETY OF DYERS AND COLOURISTS (West Riding Section) (at Bradford).—Prof. F. M. Rowe: Soledon Colours (SDC) and their Development on Cotton and Wool.

INSTITUTION OF MECHANICAL ENGINEERS (Manchester Branch) (at Manchester).—R. Potter: Pulverised Fuel.

FRIDAY, JANUARY 7.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 3.30.—J. H. Reynolds: A Little Journey in the Kingdom of Iceland (Christmas Lecture for Young People).

INSTITUTION OF ELECTRICAL ENGINEERS (South Midland Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.—W. Wilson: Electrical Research.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Dr. C. H. Lander: Developments in the Carbonisation of Coal.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Pictorial Group), at 7.

PHOTOMICROGRAPHIC SOCIETY (at 4 Fetter Lane), at 7.—F. Martin Duncan: Notes on the Photography of Plant Tissues.

SOCIETY OF CHEMICAL INDUSTRY (Manchester Section) (at 16 St. Mary's Parsonage, Manchester), at 7.—Short Papers.

GEOLOGISTS' ASSOCIATION (at University College), at 7.30.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—P. J. Haler: Distortion in Heat-treated Case-hardened Carbon Steels.

SATURDAY, JANUARY 8.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. V. Hill: Nerves and Muscles: How we Feel and Move: (6) Speed, Strength, and Endurance.

CONFERENCES.

ANNUAL CONFERENCE OF EDUCATIONAL ASSOCIATIONS (at University College).

Thursday, December 30, at 3.—Sir Henry A. Miers: The Choice of What is Good for Others (Presidential Address).

Friday, December 31, at 11.30 A.M.—Earl of Clarendon: Empire Settlement and Development.—King Alfred School Society, at 3.—J. Wicksteed: The Evolutionary Value of Co-Education.—Royal Drawing Society, at 5.30.—H. E. Peacock and P. Griffith: The Education and Development of Æsthetic Ability in Young People.

Saturday, January 1.—Educational Handwork Association, at 2.—J. H. Everett: The Teaching of Practical Elementary Science.—Leplay House, at 3.—Discussion: The Periodical Observation. Its Use for Observational and Regional Survey Work.—International Language (Ido), at 5.—G. H. Richardson: International Language: The Present Situation and the Prospect.

Monday, January 3.—Eugenics Society, at 11 A.M.—Prof. E. W. MacBride: The Nature and Origin of Racial Differences.—British Psychological Society (Education Section), at 6.—Discussion: S. J. F. Philpot, Miss Barbara Low, and others: The Cinema in Relation to the Mind of the Child.—British Association for Physical Training, at 5.30.—C. S. Thomson: Hygiene and Physical Training.

Tuesday, January 4.—School Nature Study Union, at 3.—Dr. E. J. Salisbury: Salt Marsh Vegetation.

Wednesday, January 5.—Society for Experiment and Research in Education, at 10.30 A.M.—J. H. Whitehouse and others: Creative Education.—Child Study Society, at 5.30.—Miss Lilian Barker: The Girl Delinquent.—British Esperanto Association, at 5.30.—Rev. Prof. T. G. Bailey: Esperanto in the World to-day.

Thursday, January 6.—National League for Health, Maternity, and Child Welfare, at 5.—Miss Gardner, Dr. R. J. M. Horne, and others: Discussion: Open Air Schools.—London Head Teachers' Association, at 5.—W. A. Brockington and Prof. Godfrey Thomson: Technique of Examination.

Friday, January 7.—British Broadcasting Company, at 11 A.M.—J. C. Stobart and others.

GEOGRAPHICAL ASSOCIATION (at London School of Economics, Houghton Street, Aldwych, W.C.2).

Thursday, January 6, at 11.30 A.M.—Major C. Patrick: Mapping from Air Photographs.—At 5.—Miss Eileen Power: Trans-Asiatic Caravan Routes in Ancient and Modern Times.—At 8.—J. Fairgrieve: Geography Teaching in Primary Schools.—Sir Henry G. Lyons: Geography in the Universities.

Friday, January 7, at 10 A.M.—Prof. H. J. Fleure: The Teaching of Geography.—At 11.45.—Sir C. F. Close: Population Problems of the Empire (Presidential Address).—At 2.—Col. Jack: The Work of the Ordnance Survey Department.

Saturday, January 8, at 10 A.M.—Prof. T. P. Nunn: Boy Scout Geography.—At 11.30.—Mrs. Ormsby: Regional Survey in a Large City.

JANUARY 3 AND 4.

MATHEMATICAL ASSOCIATION (Annual Meeting) (at London Day Training College).

Monday, January 3, at 5.30.—Prof. R. W. Genese: An Elementary Exposition of the Methods of Grassmann.

Tuesday, January 4, at 10.30 A.M. to 12.30.—Prof. M. J. M. Hill: The Teaching of Mathematics (Presidential Address).—Prof. A. Lodge: The Importance of including in School Work the Graphic Solution of Quadratic Equations.—G. Goodwill and others: Discussion on The Choice of Units in the Teaching of Mechanics.—A. C. Heath: On the Approximation to Irrational Numbers by Rationals.—At 2.30 to 4.15.—Prof. H. F. Baker: Can the Range of Geometry taught in Schools be Widened?—W. C. Fletcher: Geometrical Congruence.—A. T. Edwards and others: Discussion on The Relation of Art to Mathematics.

EXHIBITION.

JANUARY 4, 5, AND 6.

SEVENTEENTH ANNUAL EXHIBITION OF THE PHYSICAL SOCIETY AND THE OPTICAL SOCIETY (at Imperial College of Science and Technology, South Kensington), from 3 to 6 and from 7 to 10.

January 4, at 8.—Prof. E. N. da C. Andrade: Reproduction, with Contemporary Apparatus, of a Physical Lecture of the Early Eighteenth Century.

January 5, at 8.—Dr. C. V. Drysdale: A Lecture on Progress in Electrical Instrument Design and Construction.

January 6, at 8.—J. L. Baird: A Lecture on Television.

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