NATURE

SATURDAY, OCTOBER 13, 1928.

CONTENTS.

Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.

Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3076, Vol. 122]

South Kensington Museums and the Royal Commission.

IT is seldom that the representations of scientific men have been so fully, amply, and speedily justified as in the recent report of the Royal Commission on National Museums and Galleries (Cmd. 3192, 2*s*. net), to which attention was directed in our issue of Sept. 29, p. 465. The present is an interim report dealing "with certain glaring defects of accommodation," and its concluding sentence expresses "the earnest hope that speedy action will follow our specific recommendations on urgent practical matters." These do not involve any question of principle or of policy, with which the Commission will deal in its final report. The growth of the institutions concerned is recognised as having been "severely checked, and economy has already been pushed beyond the point of prudent administration." These are strong words, but the Commissioners are essentially a business body and they issue a business report, admirably weighing the necessity for immediate saving of money as against the economical needs of education. The maintenance of national prestige is emphasised, and this is peculiarly important in these post-War days of increased intercourse by travel. It is not shopping potentialities, sport, or playhouses that primarily attract visitors to our metropolis, but it is historical associations, seen in buildings and design, and it is the importance of its great national collections. Their function is to be spiritually educational, and that this is of real value to practical business life few thinkers are now prepared to deny, while museums pertaining to science teach truths of far-reaching utility to commerce, to production, and to every phase of national life.

The actual proposals that concern us at the moment are mostly connected with biology, but we are glad to observe the recommendation of a small grant to complete the conference room of the Science Museum. This, together with the general tone of the report, we understand means that the Commissioners favour a more active educational policy on the part of the staffs of museums and galleries in making the value and importance of the national collections better known. Particularly in science is "exchange of ideas by personal discussion" of great importance, as the Prince Consort said on the close of the Great Exhibition of 1851. For extensions to the Natural History Museum the recommendation is a grant of £247,500, of which buildings representing £123,500 should be put in

hand at once. This total would have been increased had not the Treasury, through the Empire Marketing Board, previously assigned £30,000 for a building to relieve the congestion in the Entomological Department.

This grant gives practical recognition of the urgent importance to the agriculture of the Empire in the systematised study and identification of the vast mass of insects and other pests of crops and domestic animals. The amount recommended to be expended immediately is £50,000, while the total cost of the whole building is £95,000. Assuming modern methods of construction, this means the addition of an available floor space of about 25,000 square feet, while we venture to think that a properly thought out scheme for fifty or a hundred years would require twice this, namely, the construction of the whole block, and would be cheaper in the end. The further scheme is to replace the unsightly, inconvenient, and unsafe buildings to the north of the Museum by a block the full length of the Museum, of which a quarter would be built at once at a cost of £34,000 for the exhibition and study of whales, an extension of the new spirit building, at a cost of £49,000, replacing the older buildings. Lastly, a reconstruction of the Geological Department at a cost of £20,500, this involving the basement and existing workrooms, will do much to relieve the present congestion, and certainly should precede the building of the east wing, although this is required. Left over as of less immediate importance is the rest of the northern block (£124,000), but we trust that its building will follow.

Correlated with the above scheme is the removal of the Geological Survey and its Museum from Jermyn Street to Exhibition Road, a new home on the north part of the Natural History Museum site with access to both the Science and the Natural History Museums. It is essential that this Museum should maintain its own entity, for it illustrates British stratigraphy and economic aspects of geology, and as such is both the working collection of the Survey and the reference collection of many local collectors from every part of Great Britain. At the same time, its relationship with the Natural History Museum is clear, and the directors of both may be trusted to see that there is harmonious scientific working between their independent institutions. The proposal is financially a 'straddle,' for the value of the Jermyn Street site is estimated to provide the cost of a new building.

We see no proposals as to the oft-debated question whether botanical collections should be maintained both at the Natural History Museum and at Kew. There are such difficulties in amalgamating the two herbaria—and both must be preserved—that there is no likelihood of any saving of public money. Kew is a priceless possession for the plants that are alive; and it has many small museums, mostly economic. At the same time, there is need for an attractive, systematically arranged exhibition of plants, and it should not be beyond the resources of the Natural History Museum to provide this, instead of relegating the Department to attics.

On the whole question of the proper utilisation of museums, the Commissioners show their predilections in reference to the suggested new Museum of Practical Geology: "the proposed arrangement, which provides for less, though better designed display on the exhibition floors and at the same time for greatly improved facilities for storage and study, is in accordance with the best modern ideas of Museum organisation." It is useless to attempt to exhibit every kind of animal and plant. Where it is done, the ordinary visitor is wearied, while the specialist cannot see under a glass case the characters he seeks. Molluscan shells are the boxes containing animals, and corals are the stools of anemones. Birds and other land vertebrates are doubly interesting if exhibited in their natural surroundings, and merely sample skeletons need be shown. All kinds of animals and seaweeds go to make up a water environment. Only in a few cases can a museum show lines of evolution or the results of heredity. For the rest it is more attractive to display exhibits "in a life enhancing way, instead of in the depressing, confusing, fatiguing, and life-diminishing way in which they are now mainly to be seen" (Evidence, p. 303). Show cases can be altered as interest and discovery demands, but this means that a museum must have a staff of artistic technicians, and in this respect the National Museum is deplorably weak. A museum has to teach, and a definite part of the show space must be devoted to this end. Only a limited number of the masterpieces of creation can be shown; overcrowding is psychologically fatal. The public taste can be cultivated, and, if the public is not attracted, let it be clearly recognised that the exhibits or the methods employed are at fault. Why should not periodic displays illustrative of the recent advances and discoveries in biology rival similar exhibitions in the neighbouring Science Museum?

Research is essential, but for this the worker has to penetrate to rooms where he can have suitable

light and can handle specimens. He is the person who, by his gifts and published research, has largely made the collections what they are. A museum with such collections, properly named, is the only place where the post-graduate student in systematics can at the present time adequately train himself for research. Large numbers of specimens are requisite, for without them mistakes of fundamental importance will occur. Frequently, the scientific problems that arise can only be solved in the field, and in the future adequate provision will have to be provided, so that members of the staff may study their groups in their natural environments and at the same time collect so as to enrich the National Museum.

The responsibility of science is to see that new museums or additions to old museums are designed towards definite ends. It is certain that systematic collections of all the animals and plants of the world must be deposited and permanently preserved at certain centres, preferably national. These collections will have to contain a series or at least several specimens of each species, but to-day it is not beyond the capabilities of science to estimate the requirements even of the National Museum as to space for this purpose. New buildings should be sectional and easily extensible, their rooms so far as possible interchangeable. Well and preferably north lighted research accommodation is essential, and all buildings must be fireproof.

The exhibition galleries of a museum should present a noble and characteristic frontage and be artistically designed, but it is probable that its hive of research workers would be more comfortable and efficient in factory buildings than in noble halls. The permanent staff of the Natural History Museum is totally inadequate for its necessary scientific work, and science must take care that the money required for brains is not squandered in bricks and mortar. Some of the evidence leads us to believe that it is possible that some rearrangement of the present buildings into those suitable for exhibition as apart from study and research would prove that the exhibition space is at present adequate. Let us then build for the real needs of science, and this would appear to be the views of the Commissioners, for they have mainly suggested ideas for what will ultimately be simple interior buildings, not decorative structures. We would welcome a fuller plan than that presented in their Report.

The Royal Commissioners have begun their task well, and we look forward to the publication of their full report in a year or two, by which time we trust that what they have recommended as urgent will have been put in hand. They still have many knotty questions to solve, chief of which is perhaps the relationship of the Natural History Museum to museums in many British countries. Clearly its function is to represent the Empire, but the progress of research in each Dominion and Colony requires a systematically arranged collection of its own animals and plants as well as an attractive exhibit to stimulate public interest. Scientific development demands that the ties between all such museums should be drawn close by the freest possible interchange of material. The problem is one that to some degree concerns all galleries and museums, and we trust that the Commissioners will suggest a policy. Clearly, the more the educative and scientific machinery of the Empire can be organised as one whole, the more stable will that Empire become.

Science in Medieval Cipher.

The Cipher of Roger Bacon. By Prof. William Romaine Newbold. Edited with Foreword and Notes by Prof. Roland Grubb Kent. Pp. xxxii + 224 + 38 plates. (Philadelphia: University of Philadelphia Press; London: Oxford University Press, 1928.) 17*s.* net.

IN 1912, Mr. W. M. Voynich discovered in Italy a manuscript entirely written in cipher—a small quarto of 116 leaves, of which eight are missing and some are folded. It measures on the average about nine inches by six. Its history has many gaps, but Mr. Voynich is, we believe, right in his conjecture that it was sold by Dee to the Emperor Rudolph at the close of the sixteenth century, attributing it to Roger Bacon, and that it was probably "the book containing nothing but hieroglyphics" of which Dee's son spoke to Sir Thos. Browne. The usual methods of dating a MS. fail us: the writing cannot be placed, the vellum is coarse for the thirteenth century, but not impossible, the ink is good. Only the drawings remain, and owing to their complete absence of style the difficulty of dating is but increased; it is strange that the draughtsman should have so completely escaped all medieval or Renaissance influences. The cipher has been attacked by several experts in the ordinary methods, and has not yet been read.

It is known that Bacon was interested in ciphers, and made some use of them. A simple one is attached to one of his early works, the "Tractatus

Trium Verborum," the enigma to which attention was directed in our pages on Feb. 11 last being possibly not his work. It has not escaped the attention of Prof. Newbold, who almost correctly transcribes it—"vcrdhsm mcnezdhsm Rlicrh azdsn ad fratrem Hlgznnc de ozrht Alk"—and remarks that "the words would suggest to any one that *Hlgznunc* is a proper name and that *ozrht* is some attribute or subdivision of alchemy." As a matter of fact, the cipher reads "tercium mendacium Rogeri bacun ad fratrem Johanne[m] de Paris, alkemista." It is a well-known cipher, used in classical times. The words are labelled "Nonsense Words" in the facsimile on Plate IX. (where Nos. 2 and 3 are transposed). So much for a genuine thirteenth-century cipher!

If Prof. Newbold was, however, unable to detect *Paris* in *ozrht*, he was able to find a cipher in places where it had not hitherto been suspected. Sometime before 1254 Bacon wrote an "Epistola de accidentibus senectutis" addressed to Innocent IV. (1243–54). Reading this text, Prof. Newbold "found it difficult to believe that Bacon could have written such confused and clumsy Latin," but on applying the alphabetical process he had devised to it, he discovered (p. 178) that it concealed a letter to Clement IV. (1265–68) containing the date "Sexto mensis Septembris" 1266, a cure for the stone, and a method of producing metallic copper by dry distillation of tartar, common salt, and vitriol. Unusual prescience!

Another early work of Bacon, the "De Mirabili Potestate Artis et Naturae," was subjected to the same process. Chap. x., certainly enigmatical, turns out to be (p. 139) the story of a quarrel in 1273 at Oxford between the "milites" who were studying there, and the "ecclesiasticos." In the course of the story the "milites faciunt salutationem militarem sicut dederunt Cancellario militariter consulenti," and the ancient custom of drinking neat wine and beer on the first of April is alluded to: in short, a farrago of anachronisms of thought, fact, and language.

The connexion of these remarkable results with the Voynich manuscript is that on the last page of the manuscript is found a sentence in Latin broken up by some unintelligible syllables—"michiton oladabas + multos + te + tccr cere + portas." Taking the sentence as "michi dabas multas portas," and assuming that its 22 letters were a key to the cipher, an alphabet of 22 letters omitting *k* was obtained. The word 'portas' suggested the 'gates' of the Kabbalah, the combination of the letters of the alphabet, two at a time. This gives 484 symbols. To each of these one or more up to eight letters are assigned. In reading a text, double all but the first and last letters of each word; for example, Incipit = In, nc, ci, ip, pi, it. In = c, t, e, m, n; nc = a, c, e, r; ci = u; ip = e, i, m, n; pi = a, c, r; it = c, i, u. Epistola ep = c, i, r, u; pi = a, c, r; is = i; st = p, i, n, s; to = c, p; ol = c, u; la = m, p; and so on. Setting down these new values in a row, the first letters may be Te; change u into o we get *Teo*, and by selecting values and reversing the order of the next four symbols we get "Teoriae." With this as a clue, a cross-word puzzle mind, a wide range of possible values to choose from, and no restriction whatever as to the order in which the letters of the solution are to be arranged, a fairly intelligible reading of the result is not beyond the powers of a scholar of Prof. Newbold's attainments.

In the cipher manuscript itself there are two separate fields of inquiry—the writing and the drawing. The only aid to dating the writing comes from some half-dozen or so words on the last page—very slender material indeed on which to form an opinion. One has the impression that they may conceivably date from the thirteenth or fourteenth century, and be perhaps in a north Italian hand. The cipher should be readable to experts, there being 33 pages of it with 1500 or more characters each. Prof. Newbold's theory is quite inadmissible. It is, to take a concrete example, that a letter, a long *s* measuring 4·1 mm. in height, is made up of 12 distinct significant elements, many of them Greek shorthand characters (Pl. XVIIIa). The average height of the short letters is 1·6 mm., and these also are decomposed into significant elements. The results obtained from these are in cipher and have to be de-coded in the same manner as those already described. Now, though Greek shorthand had once been known in Byzantine countries, there is not the slightest evidence for its existence in the thirteenth century there, and *a fortiori* in western Europe. In this particular case, we have to remember that medieval ink was not a stain but a pigment, that it was applied by a quill, and that it dried to a solid; that it was applied to a hard surface not particularly smooth, and thus was liable to crack and flake off. The letter *s* in question, when the photograph is examined with a good lens in a strong light, seems to show in its descending stem the marks of the quill points, with the ink between them. (The reproductions in the book are useless for the purpose, being half-tone blocks; they should have been collotypes.) Even a photograph is untrustworthy, as we have the grain of the plate and the grain of the paper for disturbing

elements when a magnification of 5 to 10 diameters is employed.

The drawings present great difficulty. The only drawing that can be approximately dated (on fo. 74 v.) is not reproduced or mentioned in this book. It represents a cross-bow man wearing a fifteenth-century hat, and is evidently a later insertion since the drawing covers part of an inscription. There are 125 pages of drawings of plants, but apparently not one of them has been identified with certainty, and they bear no relation to the drawings in well-known medieval herbals. The diagrams of an astronomical character have been given explanations more bizarre than the drawings themselves, and those which are thought by Prof. Newbold to be biological are explained by him as representing human ovaries, spermatozoa, cell-division, etc. What they do represent must be left until the cipher is read. Prof. Newbold's account of Bacon's theory of generation is entirely inaccurate—he has lost sight of the meaning of 'matter' and 'form,' and he is wrong in making a distinction (p. 51) between Bacon's theory and Aristotle's, which is shortly stated in the "Physics," ii. c. 3 (194, b, 13), "homo generat hominem et sol" in the words that Bacon knew.

To sum up, the Voynich MS. is an interesting and puzzling piece of pre-Renaissance work, which has baffled the efforts of cipher-readers from Kircher to our own days. Prof. Newbold's suggested solution, with its complicated series of contractions and expansions, is intrinsically unlikely in medieval times and far too dependent on the knowledge and imagination of the decipherer to merit any confidence. It is a first principle that when a writer uses a cipher to conceal a discovery, in all the historical cases known, the concealed text is clear, the surface text involved; here, on the contrary, the surface text is clearer and more grammatical than the one thought to be concealed. The author's honesty and his learning are unquestionable, and some of his results are interesting problems for psychologists. In conclusion, a hearty tribute must be paid to the skill and devotion which have been lavished on the production of this volume by Prof. Kent, who has, as an editor should, entered fully into the mind of Newbold, and has extended and brought together many fragmentary studies on portions of the manuscript. It is to be hoped that Mr. Voynich may find it possible to bring his manuscript to England and make it accessible to specialist students.

ROBERT STEELE.

A Minor Mystery of the Pacific.

Rossel Island: an Ethnological Study. By W. E. Armstrong. Pp. xxviii + 274 + 24 plates. (Cambridge: At the University Press, 1928.) 18*s*. net.

MR. ARMSTRONG is to be congratulated on the solution of one of the minor mysteries of the Pacific, for though Rossel Island lies only some twenty miles north-east of Sudest (Tagula), the intervening reefs make its approach so difficult, that having nothing of value to offer to the trader, its inhabitants were but little known to the white man, while the mental habit of its people, so different from that of the Massim generally, cut them off from those trading voyages which throughout the Louisiade archipelago connect island to island, from the Trobriands and Murua in the north to Tagula in the south-east.

It is true that from time to time Rossel Island has loomed out of its mists and rain squalls as the site of the eating of more than 300 wrecked Chinese coolies in three months, in 1858–59, and to the memory of this great killing, with minor ceremonial acts of cannibalism extending down to the present time, are due most of the occasional visits that have been paid to Rossel by government parties. Our knowledge has thus hitherto been limited to a few official reports, which naturally have dealt mainly with the instant purpose of each visit, though enough of the language was recorded to indicate that this differed profoundly from those spoken elsewhere in the archipelago. There has, indeed, always been a special quality of isolation about Rossel, and even raiders from the more western islands seem to have given it a wide berth. Now, thanks to Mr. Armstrong, we know that though its inhabitants differ in no essential physical character from the other southern Massim, their culture differs profoundly from that of the latter, while both vocabulary and grammar reveal the underlying non-Melanesian quality of the language.

The Islanders are totemic, with descent in the female line, and they resemble the Massim generally in their system of linked totems—bird, plant, fish, snake—though here the plant totem is the most important, while the totem snake becomes a god, and is often regarded as an individual rather than a species; moreover, those snakes that are considered as totems are avoided and feared equally by all clans, irrespective of their totems. The remaining three of the (primary) linked totems scarcely seem to be avoided or respected, though it is probable that a person would not kill or eat the bird totem of his father's clan. Thus, even so well

organised an institution as the 'linked totemism' of south-east Papua has been shaped to play a part in the entirely unexpected structure of Rossel Island religion, which Mr. Armstrong describes as a hierarchy of gods with a supreme deity, known as Wonajö, residing on Mount Rossel. Wonajö created the island but not the race of men, who descend from Mbasi, a god invited to Rossel by Wonajö in order that he might become their progenitor, and it is to Mbasi, not Wonajö, that the origin of many elements of culture is ascribed, for example, the dog, the pig, and taro.

Before Rossel, or the other islands of the Louisiades, existed there was only open sea and reef. The reef which now surrounds Rossel enclosed a large lagoon, the floor of which was Temewe—from one point of view the land of the dead—where there existed an immortal race, whose chief was Wonajö. After untold generations, Wonajö made the land within the reef, and himself repaired to a new home on Mt. Rossel, Ngwö, his abiding place at the present day; though the mysterious island of Loa, at the eastern end of the reef (where many of the ordinary words of the Rossel languages may not be used, and which is rigidly taboo to women), is also regarded as the home of Wonajö to a less degree only than Ngwö.

After creating the land, Wonajö made the clouds and the stars, but not the sun and the moon, and the clouds that almost perpetually cover Rossel are the ashes of the first fire, which he threw up into the sky to conceal the island from the older island of Sudest.

Wonajö and his people are considered to have existed in human form in Temewe, but on Rossel he takes the form of a snake by day, to reassume his human form at night. Most of the gods have this double character, alternating in form between the human and snake, though certain of their company take the shape of other animals, and many are normally stones. In their snake form the gods are dangerous to man, and are supposed to become of enormous size, and to swallow any human being who has the temerity to approach the sacred places in which they exist.

Such sacred places are many of the shrines and areas called *yaba*. Each is concerned with some object or principle, and often contains a stone which represents the substance or quality with which the *yaba* deals, for example, the original bundle of sago hidden by Wonajö is now a stone in the sago *yaba*. Moreover, "since every god is associated with a *yaba*, and many of the gods are, in a certain sense, the totems of clans, we should expect a division of religious function amongst the clans and an association of clans with particular *yaba*. This, in a general way, is certainly the case, but I was unable to prove that a given *yaba* is always either possessed by or controlled by the appropriate clan, though this may be the case. It was, however, fairly clear that the gods are of equal importance to all the clans, and a given god is neither particularly favourable to nor favoured by the clan totemically associated with his *yaba*."

Mr. Armstrong gives a long list of *yaba*, which, if in the highest degree dangerous if neglected or rashly trespassed upon, are also the shrines at which correct treatment or ceremonial ensures the well-being—each more or less rigidly in its own special sphere—of the people. "The universe is like a machine, with a few exposed parts, which, so long as they are kept clean, ensure the smooth working of the whole. That is the chief religious duty of man; but the machine requires oiling at times, and we find that this is a more positive duty of the priests of certain of the more important of the *yaba* that give a beneficent reaction."

The extraordinarily complex monetary system of the island takes nearly thirty pages to explain. Its complications permit of no more than the mention of its existence in a review such as this.

The volume begins with an admirable introduction by Dr. Haddon, wherein are assembled and considered the available data concerning the physical characters of the Massim, and there are appendices by Mr. Armstrong, giving (1) a full history of and bibliography of the island, (2) an account of the physical measurements of its inhabitants, and (3) an essay on the general theory of the classificatory system of relationship.

To sum up: this work, though not to be regarded as the final monograph on Rossel, constitutes an important and long-desired addition to our knowledge of Melanesia. C. G. S.

A Critic of Modern Biology.

Modern Biology: a Review of the Principal Phenomena of Animal Life in relation to Modern Concepts and Theories. By J. T. Cunningham. Pp. xii + 244. (London: Kegan Paul and Co., Ltd., 1928.) 10*s*. 6*d*. net.

THAT the modern fashions of biochemistry and genetical study have resulted in most valuable contributions to that rather incoherent mass of knowledge which we call biology will be denied by no one; that these methods have severe limitations is not perhaps so clearly realised. Mr. Cunningham,

whose marked independence of mind is known and valued, has in this book applied a keen logical intelligence to the theories and concepts arising out of these new disciplines, and has brought out some of their obvious limitations. His aim has been to test the validity of these modern views by applying them to the fundamental questions of biology in order to see whether they supply satisfactory answers.

While Mr. Cunningham accepts a good part of the gene hypothesis as solidly based on fact, he is by no means inclined to swallow the mutation-selectionist view which is offered by the Morgan school as a sufficient explanation of adaptation and evolution. He considers that the sort of facts established by the study of Mendelian inheritance are of a different order and of minor significance as compared with those that constitute the major problems of adaptation, recapitulation, functional development, and the like. For these a different kind of explanation is required, and is in the main still to seek.

Mr. Cunningham is equally critical of the claims of biochemistry. He roundly asserts that "biochemists have no true conception of the problem of life at all, because they have approached the subject from the chemical point of view and have not studied living organisms from any other point of view. It is very probable, if not absolutely certain, that life is a phenomenon which is altogether different from the chemico-physical processes which take place both inside and outside the organism. Biochemistry and physiology in the ordinary medical sense treat the organism as an engine in action at a given moment without regard to the past or future of the organism" (p. 9). Biology is not, and can never become, merely comparative biochemistry.

These are the main critical themes of the book, and they are developed with much knowledge, fairness, and acuteness of judgment. For this alone the book deserves careful study, especially by those whose enthusiasm for 'some new thing' leads them to uncritical acceptance of the latest doctrines.

However, there is also a constructive side to Mr. Cunningham's book. He develops in an interesting way the modern Lamarckian theory which he has already outlined in 1908 and in his "Hormones and Heredity" (1921). In this connexion he gives a most useful critical account of modern work on the transmission of acquired characters. Though himself convinced that without such transmission evolution is inexplicable, Mr. Cunningham does not allow this belief to mitigate the severity of his analysis of the evidence recently adduced in favour of this transmission, notably by Tornier and Kammerer. Particularly interesting is his account of McDougall's experiments on the inheritance of acquired habits in rats.

In the concluding chapter, Mr. Cunningham sketches, but unfortunately does not elaborate, his own philosophical position. It is one with which the present reviewer, at any rate, has much sympathy. In Mr. Cunningham's view life is coterminous with some degree of mind or consciousness. "The principle of continuity applies here as elsewhere in evolution, and so far as I can see, there is no possibility of separating life and consciousness. The difference between the 'mind' of an earthworm or an amoeba and of a man may be very great, that of an earth-worm is merely a potentiality rather than an actuality, but the difference must logically be regarded as a difference of degree, not a difference of kind. In this sense even plants may be considered to have the rudiment or potentiality of consciousness and mind" (p. 225).

It is true that for the purposes of science we may regard the organism purely objectively, and abstract from its psychical aspect, but in so doing we are artificially limiting the scope of biology and pursuing the phantom of a complete physico-chemical explanation of the living thing. Mr. Cunningham, while rejecting any dualism of body and mind, is a vitalist in the sense that he regards the living organism as being, if a mechanism at all, then a mechanism "essentially different from any inorganic, non-living mechanism." The truth seems to be that 'mechanism' is a more abstract concept than 'organism,' and while it may be very useful in biological research, as events have shown, it is inadequate when we come to tackle the major problems of development and evolution.

E. S. R.

Fundamental Principles of Radio Communication.

Principles of Radio Communication. By Prof. John H. Morecroft, assisted by A. Pinto and Prof. W. A. Curry. Second edition, thoroughly revised. Pp. xiv + 1001. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 37*s.* 6*d.* net.

THE science and practice of radio communication have developed so rapidly during the past ten or fifteen years, and now cover such a wide field, that it has become impossible to confine an adequate technical description of the subject within

the covers of a single volume. Whatever alteration may take place on the practical engineering side, however, it is unlikely that the fundamental principles of the generation, transmission, and reception of electromagnetic waves will be materially changed; and it is with such principles that the somewhat formidable volume compiled by Prof. Morecroft is concerned. It is the second edition of a book with which many radio engineers are already familiar; and although, as mentioned in the preface, two chapters from the first edition have been deleted and a third has been considerably reduced in length, the amount of new material dealt with is such as to bring the present volume up to just above one thousand pages. The newcomer to the wireless art will probably be appalled by the size of the volume, but there is no doubt that the serious student and the technical engineer will find the book a mine of information and an extremely useful text-book.

The first chapter of the book deals with "Fundamental Ideas and Laws," and leads the reader quickly but firmly from the electron up to the properties of alternating currents, with their associated circuits either alone or coupled together. Many illustrations are given of alternating current and transient phenomena with the aid of oscillograms taken at frequencies of the order of sixty cycles per second. Chap. ii. is devoted to a detailed consideration of those most important electrical quantities, resistance, inductance, and capacity. The utility of this chapter is considerably enhanced by the inclusion of many formulæ and tables for the calculation of these quantities in practical wireless circuits. It is interesting to note here that in connexion with mutual induction and screening, the author is clearly under no misunderstanding as to the relationship existing between electric and magnetic fields. After the above introduction the student is taken in the third chapter into a study of the oscillatory circuit, which is fundamental to either transmission or reception in radio.

For some reason which is not quite clear, a description of the various types of antennæ by means of which the oscillatory currents are converted into electromagnetic waves is delayed for several chapters. The fourth chapter assumes the generation of such waves and describes briefly the main phenomena met with in the propagation of waves over the earth's surface. This chapter is all too short for the subject and most of the important English work carried out since 1921 is omitted; but we must neither forget the title of the book nor its present size. The propagation of electromagnetic waves is nowadays more suitable for treatment in a separate monograph.

After devoting about seventy-five pages to spark transmitters, the thermionic vacuum tube receives very full consideration, first as a general treatment of the theory and operation of valves of various types, and then later in connexion with a description of the circuit arrangements and performance of different kinds of valve amplifiers at both audio and radio frequencies. Here oscillograms are again reproduced as illustrating such points as grid rectification and the effect of grid bias on distortion. The various modes of producing undamped oscillations for continuous-wave telegraphy are dealt with in Chap. vii., while the following chapter describes the means employed for modulating such oscillations and applying them to radio-telephony and broadcasting. As already mentioned, a later section of the book is devoted to a description of the various types of antennæ used in practice, with the means of calculating the radiation from them. The transient oscillations set up in an antenna when a pulse is applied thereto are illustrated with further oscillograms, and a brief consideration is given to loop antennæ and their application to direction-finding.

Altogether the author has carried out his somewhat arduous task in a very satisfactory manner, and has provided a most useful book of reference which should be available to every serious technical worker in the field of radio communication. In perusing the book, very few misprints have been noticed, and the work is both written and produced in a most satisfactory manner.

R. L. SMITH-ROSE.

Our Bookshelf.

The Principles of Electric Power Transmission by Alternating Currents. By H. Waddicor. Pp. xix + 399. (London: Chapman and Hall, Ltd., 1928.) 21*s.* net.

THIS book is intended for engineering students and for electrical engineers who are engaged in transmission and design. All the matters discussed are directly useful to engineers. Since Faraday and Henry discovered magnetic induction, the theory of the transformer has strongly attracted mathematical scientific men. In our opinion there has been very little true theoretical progress since Maxwell gave the theory of the air core transformer in 1865. Fleming has expanded this theory and given it in a form which can be easily understood. When, however, attempts are made to take hysteresis and eddy currents into account, we have to fall back on approximate formulæ, and in most cases we are ignorant of their limitations.

Although it is difficult to deduce formulæ for the iron core transformer from formulæ for the air core transformer, the converse operation is always possible, and if the results do not come out correctly, then there must be something wrong with the formulæ being tested. In this book the limitations of the theories are rarely stated. This makes progress rapid, but must sooner or later cause difficulties to engineers using the formulæ. For example, the statement that if we add to the resistance of the primary n^2R_2, where R_2 is the resistance of the secondary and n is the ratio of the secondary to the primary current, we get the true effective resistance of the transformer on the primary side, is true for the air core transformer. But students have a difficulty in believing that the ratio n is a constant, seeing that it is zero on open circuit.

Great stress is very properly laid on making the sum of the cost of the operating losses and the overhead charges in dollars per annum a minimum, but some of the mathematical equations given, as, for example, on p. 95, we have quite failed to understand. Although we think that the methods of obtaining the formulæ used in practice given in the book could be very considerably improved, it contains much valuable information for engineers.

Bestimmung, Vererbung und Verteilung des Geschlechtes bei den höheren Pflanzen. Von C. Correns. (Handbuch der Vererbungswissenschaft, herausgegeben von E. Baur und M. Hartmann, Lieferung 3 (II. c), Band 2.) Pp. iv + 138. (Berlin: Gebrüder Borntraeger, 1928.) 19·20 gold marks.

THE genetics of sex in plants is probably more complicated than in animals. It is even doubtful how far sex phenomena are comparable in the two kingdoms. Certainly they have diversified along different lines with the greater individual unity and specialisation in the higher animals as contrasted with the less clearly defined individuality of the higher plants, which have often the power of vegetative multiplication in addition to, or even almost replacing, sexual reproduction. It is only a few years since sex chromosomes were discovered in seed-bearing plants, and the unsolved problems of 'sex' in the Cryptogams and in hermaphrodite, monœcious, and polygamous Phanerogams are manifold.

A summary of the present position of our knowledge of sex in plants by a pioneer and recognised authority on this subject is of considerable importance. Prof. Correns does not deal with plants lower than Bryophytes. Utilising Blakeslee's terminology of homo- and heterothallic types for the diploid phase, he is able to divide his subject under four main headings. Attention has lately been concentrated on more or less completely dicœcious flowering plants, and though even amongst them complications appear in different genera and species, a useful attempt has been made in this work to reduce all the examples known in sufficient detail to two generalised schemes. The work is illustrated by 77 text-figures (including diagrams) and has references to literature occupying 9 pages. An ample list of contents is provided but there is no index.

The Modern Calorimeter. By Dr. Walter P. White. (American Chemical Society Monograph Series, No. 42.) Pp. 194. (New York: The Chemical Catalog Co., Inc., 1928.) 4 dollars.

ALTHOUGH it is written essentially for the specialist in calorimetry, this book is arranged in such a way as to be equally valuable to the general scientific reader. Dr. White has made important contributions to recent developments of calorimetry, and while his book does not completely cover the whole field, it gives a good account of the numerous practical details necessary in obtaining reliable estimates of accuracy. The author remarks that "calorimetric processes depend on temperature distributions and heat flows; things invisible, hard to measure or control with exactness," and he has therefore endeavoured to show the value of systematic calculations involving accurate estimates of the precision and reliability of the various methods and apparatus employed.

The book deals with fundamental processes and measurements, particular methods and particular apparatus, and calorimeter design and the planning of installations. The author refers to it as "an experiment," and it must be voted a successful one.

(1) *The Life of the Spider.* By J. Henri Fabre. Translated by Alexander Teixeira de Mattos. With a Preface by Maurice Maeterlinck. (People's Library.) Pp. xxxi + 288. (London: Hodder and Stoughton, Ltd., n.d.) 2*s.* 6*d.* net.

(2) *The Spoilers.* By J. Henri Fabre. Translated by J. E. Michell. Pp. 287. (London: Hodder and Stoughton, Ltd., n.d.) 7*s.* 6*d.* net.

THE first mentioned of these two volumes consists of translations of articles from Fabre's "Souvenirs entomologiques," dealing with the life of spiders, and with the exception of Chapter ii., none has previously appeared in English. The second volume, "The Spoilers," is written in the form of dialogue between a benevolent informer and his pupils: various kinds of injurious and other insects are discussed in a conversational manner, moths and beetles coming in for the largest share. The translations of both books are well done, and they should interest the growing body of readers to whom popular writings on insect life make an appeal.

Le grandi industrie chimiche. Gli acidi inorganici: solforico, nitrico, cloridrico; fabbricazione, macchinarie, impianti. Per Dott. Antonio Aiti e Prof. Henry Molinari. Pp. xv + 472. (Milano: Ulrico Hoepli, 1928.) 48 lire.

AITI and Molinari's work gives an account of the actual position of the mineral acid industry which usefully supplements the existing treatises, since it deals with many processes which are not adequately described in the standard works on the subject. It is a valuable addition to the literature of chemical technology.

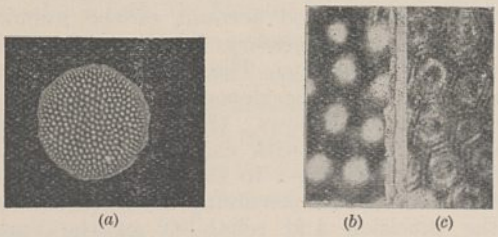
Letters to the Editor.

[*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.*]

Markings on Diatoms and Resolving Power of Microscopes.

AT various times there has been discussion as to the actual nature of the markings on the valves of diatoms—whether pits, projections, or perforations.

Any image formed by a microscope of objects the dimensions of which are not large compared to the

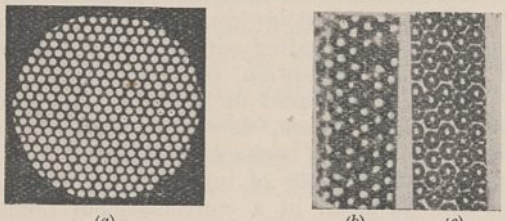


(*a*) (*b*) (*c*)

FIG. 1.—(*a*) Diatom (from New Zealand), diameter 0·004 inch, magnification 150; photograph taken with $\frac{1}{12}$ immersion objective; (*b*) part of *a* enlarged, magnification 900; (*c*) similar enlargement of a negative taken under the same conditions as *a*, but with the objective $\frac{1}{2500}$ in. closer to the diatom.

wave-length of light, should be considered rather as phenomena the meaning of which has to be interpreted than mere magnified copies of the objects in the field. This is true even when the objects are quite thin and flat, but when the thickness is variable, the appearance of the image changes very rapidly as the focal plane is made to approach or recede from the uneven surface.

This is well illustrated in Fig. 1, *a*, *b*, and *c*; *a* is a photograph of a New Zealand diatom, magnification 150, taken with a $\frac{1}{12}$ immersion objective. The diameter of the disc is 0·004 in. and the dots are separated by $\frac{1}{8000}$ in.; *b* is an enlargement of part of *a* (magnification 900); *c* a similar enlargement from a



(*a*) (*b*) (*c*)

FIG. 2.—(*a*) Photograph of a piece of perforated zinc; (*b*) photograph from an enlarged copy of *a* on a thick bichromate film of gelatine, the focal plane of the enlarging lens being about $\frac{1}{4}$ in. from the summit of the gelatine bosses; (*c*) similar enlargement of gelatine print, the focal plane of the enlarging lens being coincident with the floor of the depression between the bosses.

negative taken in the same condition as *a*, but with the focal plane $\frac{1}{2500}$ in. closer to the slide. In Fig. 1, *b*, the dots appear as bright circular patches, while in Fig. 1, *c*, the dots are dark and are separated by well-marked hexagonal boundaries.

These appearances can be explained if the surface of the valve is supported or covered with convex bosses separated by troughs with somewhat rounded cross sections. The bosses act as condensers, and when the focal plane of the objective approaches that of the bosses, the latter show bright images of the source of light.

Of course, no very good image can be produced by a lens the diameter of which is only two or three wave-lengths, but the bosses do produce some concentration of the rays passing through them, and the size of the bright patch focused by the microscope varies with the distance between the focal plane of the objective and the approximate focus of the bosses.

In Fig. 1, *c*, the focal plane of the microscope coincides with the floor of the valleys separating the bosses, and what is photographed is the virtual image formed by the concave trough with some of the dependent diffraction bands.

For the sake of comparison, a surface similar to that assumed for the diatom valve, but on a large scale, was prepared by photographing a piece of perforated zinc (Fig. 2, *a*) and printing this on a thick film of bichromated gelatine. The bichromate was removed by soaking in cold water, and the plate was then placed for some time in a fairly strong solution of glycerine, and allowed to drain. In this way the unaltered swollen gelatine remained as convex bosses, which, though rather flat on top, yielded results very similar to that obtained from the diatom. Photographs corresponding to *b* and *c* of Fig. 1 are given in *b* and *c* of Fig. 2. The marking on such diatoms as *P. Angulatum* or *A. pellucida* differ probably from the coarser form only in scale.

I remember seeing at one of the Royal Society's soirées a photograph of *A. pellucida* taken by ultra-violet light with quartz lenses, which might very well have been supposed to represent a piece of perforated zinc. In 1879, Messrs. Powell and Lealand showed me *A. pellucida* under a $\frac{1}{25}$ immersion lens, and here the valve appeared covered with parallel lines so well defined that it seemed that several more lines might have been inserted between them. A small alteration of adjustment, however, changed the direction of the apparent lines, and in one condition the two series were both visible, their intersection suggesting dots.

The late Lord Rayleigh was, I believe, the first to point out that the resolving power of a lens (which may be defined as the least distance which must separate two objects if their images are also to appear separated) depends on the difference of the optical length of the rays from the objects to their respective images. If this difference does not exceed a quarter of a wave-length at least, there will be no real separation; and for complete separation a difference of not less than a half wave-length is requisite. This statement applies to all optical instruments, but the appearances in the field depend in a great measure on the illumination; whether, for example, the objects are self-luminous like stars, or obtain the light by which they are seen from a common source, in which case there is a phasic relation between the waves in each ray.

Microscopists seem to have an exaggerated idea of the resolving power of their lenses. With an object consisting of alternate opaque and transparent lines on a plane film very thin compared with the wave-length,[1] no objective (no matter what its numerous apertures might be, or what form of illumination was employed) could separate the lines if their spacing was much less than a whole wave-length. In *A. pellucida* the spacing is about half a wave-length, and the fact that their resolution is readily effected in ordinary light shows that the surface of the valve is uneven. A difference of elevation of a two-hundred-thousandth of an inch between the hills and valleys would allow ridges or dots to be distinguished, while if the surface were plane they would be quite unrecognisable.

A. MALLOCK.

9 Baring Crescent, Exeter.

[1] The only test plates in which, so far as I know, these conditions are approached, are those which I ruled on films of methyl violet. The film in question varies from a tenth to a thirtieth of a wave-length in thickness.

A Method of Preparing Sections of Fossil Plants contained in Coal Balls or in other Types of Petrifaction.

THE method described in this letter was devised in collaboration with Dr. R. G. Koopmans of Utrecht. A flat surface must first of all be cut or ground on the coal ball or other petrified mass parallel to the planes in which the sections are required: this surface is ground smooth, but a fine polish is not necessary. The surface is then immersed for a definite length of time in an etching solution of hydrochloric acid, the optimum concentration being found by trial. The acid dissolves away a film of the carbonate of which the mass is largely composed, and the plant substance contained in the film is left behind, standing in relief above the surface. The surface is washed carefully and dried. A solution or fluid, which on drying or hardening forms a tough film, is then poured over the surface and allowed to dry or harden. Several solutions have been used for this purpose; the best as regards consistency is the trade preparation 'Durofix,' but other solutions containing cellulose compounds may be used. When quite hard this film of cellulose-compound may be peeled off, as it has considerable tensile strength. The plant substance which was left in relief by the etching process is embedded in the film and is detached with it from the surface of the petrifaction. The film is then washed, first in the acid and then in water, dried, cleared, and finally mounted in Canada balsam between a slide and coverslip. The surface of the petrified mass is gently rubbed down on fine carborundum paper and is then ready for the removal of another section.

These sections consisting of the plant substance embedded in a film of cellulose compound are scarcely distinguishable from good petrological slices cut from the petrified mass direct, and are usually much superior. The thickness of the plant section depends on the length of exposure to the acid bath, and may be of a very small order if so desired. The sections are of uniform thickness and are almost unbreakable. From the botanical point of view, the main advantage of the new method is that almost continuous serial sections may be prepared, since the old method of cutting petrological slices allowed at the most three sections to five millimetres of material. The sizes of the films are limited only by the size of the petrified mass from which they are made. When a petrifaction contains several different objects, it may be convenient to cut up the films with scissors and mount the parts separately. The cost of making a film is negligible compared with the cost of preparing a petrological slice, which involves in its production a considerable amount of hand labour. With silicified material hydrofluoric acid must be used instead of hydrochloric.

No attempt has yet been made to apply the method to plants preserved in pyrites, but here again a suitable acid must be chosen to dissolve the pyrite.

JOHN WALTON.

Department of Botany,
University of Birmingham.

Condition of Radium Salts after Storage in Sealed Glass Tubes.

IT has recently been found necessary in the Government Laboratory to open and subdivide two tubes containing radium salts which were sealed by us in 1921, and it is thought that the experience gained in opening them may be of interest to others working with radium preparations of high grade.

The tubes contained 171·8 and 54·9 milligrams of radium element as 92 per cent chloride and 50 per cent bromide respectively. These salts had been dried at 240° C. for two hours before they were sealed into thin glass tubes, each furnished with a small piece of fine platinum wire fused into it.

To open the tubes a method believed to have been devised by the late Mr. Harrison Glew was used. Each was placed in a clean lead tube such as is used to contain tooth-paste, and the lead folded down on the glass. By applying pressure with a screw jaw spanner the radium tube was then cracked, whereupon the lead tube was slit with scissors and the radium salt washed out.

We had been led by other workers to expect that there would be a considerable gas pressure in the tubes, arising from the decomposition of water, but no sign of this was observed, as, for example, by distension of the tube. The glass of the tubes, although strongly coloured, showed no apparent disintegration or deterioration from the action of the rays. It may be concluded, therefore, that considerable quantities of high grade radium salts, sealed in glass tubes, can safely be kept unopened for periods of at least seven years, provided the drying has been thorough.

The effect of the action of the radium on the labels and packing may be mentioned. Thus on evaporating the filtered radium solutions a gummy organic impurity was observed, apparently produced under the action of the rays from the paper labels on the tubes and from cotton-wool packing. The cotton had completely disintegrated, some traces only adhering to the tubes. It has been observed in this laboratory that when cellulose is exposed to β and γ rays in presence of air, it is chemically altered, the proportion of material soluble in 3 per cent caustic soda solution notably increasing. It would thus seem advisable to avoid attaching any label or other foreign material directly to the glass of tubes containing radium, and to store the tubes out of contact with organic matter.

Two further points may be mentioned as regards recovery. To purify the contaminated radium, it was ignited at a faint red heat in silica dishes. After this treatment the dishes were found to be distinctly radioactive, and upon treatment with hydrofluoric acid four dishes yielded 0·3 milligram of radium which had not been removed by means of hydrochloric or hydrobromic acid.

Finally, it may be mentioned that more than 98·5 per cent of the radium salt, after it had been kept in a sealed glass tube for seven years, was still in a state soluble in dilute acid.

A. G. FRANCIS.
A. T. PARSONS.

Government Laboratory,
Clement's Inn Passage,
Strand, W.C.2,
Sept. 24.

The Crystal Structure of Solid Methane.

IN view of the recent controversy concerning the structure of the methane molecule, it is proposed to state briefly the results of an X-ray 'powder' investigation of solid methane at a temperature intermediate between that of liquid air and liquid hydrogen.

Only one modification, a cubic one, was found, and the observed spacings indicated a structure based upon a face-centred lattice, the unit cell having an edge 6·35 A. and containing 4 molecules of methane. (This gives, for solid methane, a density of 0·413 gm./c.c., while that of liquid methane at its boiling-point, − 164° C., has been given as 0·415 gm./c.c.)

There are no abnormal spacings except those characteristic of a face-centred lattice, hence the

possible space-groups are: T^2, T^3_h, T^2_d, O^3, O^5_h. Of these, if it is assumed that all the carbon atoms are crystallographically identical, and that all the hydrogen atoms are identical in this sense, only T^2 and T^2_d give 4 equivalent positions for the carbons and 16 equivalent positions for the hydrogens, but it is extremely doubtful whether this restriction can be applied, on account of the uncertainty concerning the symmetry of the hydrogen atoms in the well-known ammonium chloride structure. However, if this restriction is permissible, the symmetry of the carbon atom in solid methane is evidently either T or T_d.

Assuming as a first approximation that the carbon atoms are alone responsible for the scattering, a very satisfactory agreement between the observed and calculated intensities of reflection from the various planes (taking into account in the latter the Ponte reflecting power factor for the carbon atom in addition to the usual factors) is obtained. The question of intensities will be fully discussed later in a more complete account of the work.

Weissenberg has recently concluded from theoretical considerations that among substances of the type Ca_4 there is no reason why electrically symmetrical molecules (representing a tetrahedral structure) should not occur just as frequently as molecules with dipoles (pyramidal structure), hence the tetrahedral structure for solid methane demanded by the results of this research is evidently not in disagreement with the most recent theoretical conclusions on the subject.

J. C. McLennan.
W. G. Plummer.

Physics Building,
University of Toronto, Sept. 20.

The Period of Human Gestation.

There is perhaps no problem of greater human interest than that of the factors which govern the duration of pregnancy and the onset of parturition, and any new information bearing upon the mechanism involved is of profound interest, not only to the gynæcologist and obstetrician, but also to biologists in general, and to the layman in particular.

No apology is necessary, therefore, for bringing to the attention of a wider scientific circle the important contribution by Prof. W. A. Jolly, of the University of Cape Town, in the *Journal of Obstetrics of the British Empire*, vol. 35, No. 2, "On the Period of Human Gestation." Collaborating with his colleagues, and presumably by observations on European women, Prof. Jolly has brought forward a considerable body of evidence to demonstrate at least one cause of the fluctuations in duration of the gestatory period in human beings. Recognising the fundamental physiological comparison between the menstrual and gestatory phenomena, he has shown:

(1) That the period of human gestation is intimately related to the length of the mother's menstrual cycle in any particular case.

(2) That the physiological period of gestation extends customarily over eleven cycles, counting from the middle day of the last menstrual flow, and not ten cycles as is currently assumed.

(3) That this law holds good in pregnancies in which the maternal cycle is short. When the cycle is of 24 days and regular, the pregnancy, counting from the last menstrual flow, lasts for 264 days (that is, 11 cycles). In 26-day-cycle cases, the pregnancy lasts for 286 days.

(4) That in long-cycle cases—27 days and upwards—the law is commonly modified by a complication resulting from the age of the fœtus, and birth is likely to take place when the tenth missed period following conception falls due, or shortly thereafter.

The extension of Prof. Jolly's observations and deductions for human beings of different races by obstetricians, and the application of the underlying physiological principle to comparative embryology by zoologists, presents a wide field for future scientific investigation.

Raymond A. Dart.

Medical School,
University of the Witwatersrand,
Johannesburg, Sept. 8.

The Daily Terrestrial Magnetic Variations; and the Sun's Magnetic Field.

R. Gunn has recently suggested (*Physical Review*, July 1928) that the daily variation of the earth's magnetic field is due to the diamagnetism of the outermost layer of the atmosphere, where the ions and electrons can freely spiral many times round the lines of the earth's magnetic field between collisions; their circular motion renders them equivalent to small magnets directed opposite to the field. The magnetic effect is, however, far outweighed by that of a drift acquired by the charges under the joint action of the magnetic field, gravity, and the vertical electrostatic field which prevents the light electrons from spreading upwards much farther than the heavier ions.

The drift is westward for the electrons and eastward for positive ions; it therefore constitutes an eastward current. The magnetic field of the drift currents, which are stronger over the sunlit than over the dark hemisphere, is similar to that due to the diamagnetism of the same outer layer, but greatly exceeds it in intensity; both are very similar to the observed field of the daily magnetic variations. It does not seem possible as yet to decide whether the latter are caused mainly by the drift-currents in the outer layer, or by dynamo action in the conducting layer below. The outer layer, though highly ionised, is almost non-conducting, as P. O. Pedersen has pointed out ("The Propagation of Radio Waves," Copenhagen, 1927); this is because a force F, acting on a charge in a magnetic field H, produces no mean motion in its own direction, but only a transverse drift, normal to F and H.

The drift-currents seem capable also of explaining the rapid outward decrease of intensity in the sun's magnetic field, and may play a part in the magnetic field of sunspots. The initiation of the general solar field and the sunspot fields has to be explained by separate hypotheses. Details of these and other cognate results will shortly be given elsewhere.

S. Chapman.

Imperial College of Science,
South Kensington, S.W.7,
Sept. 21.

The Presence of *Phlebotomus chinensis* in Syria.

Recently the Kala-Azar Commission of the Royal Society implicated *Phlebotomus chinensis* as a carrier of kala-azar in Northern China. The distribution of this sandfly is therefore a matter of the very greatest importance. Hitherto it has been found only in Northern China and in the Himalayas.

Among sandflies collected by us in Aleppo in Syria, about one per cent were found to be *Phlebotomus chinensis*. It is therefore to be expected that *P. chinensis* has a wide and continuous range of distribution from Northern China to Asia Minor and Syria. Kala-azar is present in Turkestan and Transcaucasia and has recently been reported from Syria.

P. chinensis has until recently been considered a variety of *P. major* (syn. *P. perniciosus*), which it resembles externally. This classification was due to the fact that the external male genitalia (which are very similar in *P. major* and *P. chinensis*) were considered to be of specific value, a view which, in the light of recent researches, is no longer tenable, and to the fact that until quite recently no characters were known which could be used for the identification of females.

The Kala-Azar Commission of the Royal Society (*Proc. Roy. Soc.*, B, vol. 102; 1928) made *P. major* var. *chinensis* a subspecies on the character of the spermathecæ. We consider *P. chinensis* to be an independent species, for the spermathecæ and the pharynx in the female and the pharynx in the male show constant and very marked differences from those of *P. major*.

The diagnosis of sandflies in the Mediterranean region has hitherto been based only on the character of the male genitalia, a character which cannot distinguish *P. major* from *P. chinensis*. Further research based on the characters of the spermathecæ and the pharynx is therefore necessary to determine whether *P. chinensis* is present in the kala-azar areas round the Mediterranean from which *P. major* has been recorded.

If, as we think probable, *P. chinensis* will be discovered in these areas, new light might be thrown on the epidemiology of kala-azar in the Mediterranean region.

S. ADLER.
O. THEODOR.

Microbiological Institute,
Hebrew University,
Jerusalem, Sept. 17.

The Dissociation of Pure Mercury.

BY applying Sommerfeld's expression (*Zeit. für Physik*, **47**, p. 1; 1928) for the conductivity σ of a metal

$$\sigma = \frac{8\pi}{3}\frac{e^2 l}{h}\cdot\left(\frac{3n}{8\pi}\right)^{\frac{2}{3}}$$

to the conductivities of dilute amalgams, it is possible to calculate n for pure mercury without a knowledge of l: e is the charge and l the M.F.P. of an electron, n the number of electrons per c.c.

Let there be c atoms of the metal X per atom of mercury. If both X and mercury are divalent, and both completely ionised, $\sigma = \sigma_0(1+c)^{\frac{2}{3}} = \sigma_0(1+\frac{2}{3}c - \frac{1}{9}c^2 \ldots.)$, this equation is of the form obtained experimentally for cadmium amalgam, but the coefficients disagree. Williams gives for cadmium at 14° C. (*Phil. Mag.*, **50**, p. 599; 1925) $\sigma = \sigma_0(1 + 4{\cdot}37c - 6{\cdot}27c^2)$.

The two expressions can be reconciled by assuming that only a fraction q of the mercury is ionised. Then $2/3q = 4{\cdot}37$, $q = 0{\cdot}15$, a value confirmed by that obtained from the second coefficient; $1/9q^2 = 6{\cdot}27$, $q = 0{\cdot}13$.

Compound formation, and incomplete ionisation of dissolved metal aggravate the discrepancy, so that the value given for q is a maximum. Specific effects do not, however, greatly influence the conductivities of those dilute amalgams for which σ increases with c, as is seen from the values of the coefficient of c: cadmium, 4·37; zinc, 4·78; magnesium, 6·18. The value for zinc is calculated from Larsen's results (*Ann. Physik*, **4**, I. p. 126; 1900).

A density correction may be introduced. If M is the molecular weight of X, d the density of the amalgam, d_0 that of pure mercury,

$$\frac{n}{n_0} = \frac{1 + c/q}{1 + \dfrac{Mc}{200{\cdot}6}}\,\frac{d}{d_0}.$$

Hence observed values of σ must be corrected by multiplication by

$$\left[\left(1 + \frac{Mc}{200{\cdot}6}\right)\frac{d_0}{d}\right]^{\frac{2}{3}}.$$

Using Richards and Forbes's values for d (Carnegie, Inst. Pub., 56) at 20° C.—the slope of the d/c curve is probably but slightly affected by small temperature changes—we obtain for cadmium amalgams $q = 0{\cdot}13$; for zinc amalgams $q = 0{\cdot}12$.

R. S. BRADLEY.

The University, Leeds.

Unit of Acceleration.

REFERRING to Mr. Keeping's letter on p. 478 of NATURE of Sept. 29, I agree that learners of the elements would be helped by a handier specification for acceleration; but a name for unit velocity would suffice. Speed is a primary apprehension, and it is rather odd that no unit name has been chosen for it; except 'knot.' Suppose for a moment that the velocity unit were called a 'vel'; then acceleration would be in vels per second, and momentum in gram-vels or pound-vels. These are not hopelessly bad: context would show whether feet or centimetres were intended; in any serious non-teaching specification abbreviations are seldom permissible.

Too many fanciful and slang names are undesirable: they were essential in electrical engineering because the real nature of the phenomena were and are unknown, so ohms and volts and amperes have proved invaluable. We are now beginning to think that the real nature of mechanical quantities is unknown too, but anyway we are accustomed to them, which is what we mean by understanding; so their units should not be named on the same plan as electrical units, by appropriation of great names. Watt and Joule, and perhaps Gauss, were fortunate in having monosyllabic names, but 'Gal' would be disrespectful. 'Erg' and 'dyne' have proved fairly serviceable, and any further mechanical unit should be named on that plan if it is to be international. 'Vel' happens to be suggestive and intelligible in several languages.

OLIVER LODGE.

Sept. 30.

Geological Jargonese.

IN some of the elementary books used in learning languages, a short glossary of difficult words is set at the head of each exercise. Will you not follow this practice in your technical articles and reviews? A recent obviously brilliant notice of a geological work of surpassing interest—on partition of the continents—is practically Chinese to us unfortunates who learnt our little geology in days when Lyell and Geikie were current and could be read with ease, pleasure and profit. Only recently, a visitor to my house, who had picked up from my table a number of the *Proceedings of the Geologists' Association*, remarked to me that he had found the articles entirely beyond him, although he once could master its pages. 'Prawns in Aspic' comes home to most of us. Not a few can understand 'Preserved in Formaldehyde' written upon a museum label. What a mountainous form 'preserved in sima' may be, the Gods may know; no ordinary reader of NATURE can put meaning into the phrase and not a few others like it. Other subjects than geology are often made equally impossible for the average reader of your wonderful journal. I would beg you to help us, if not in the way suggested, by choosing reviewers who will write an English that carries an obvious meaning.

ONE WHO ATTEMPTS TO READ
"NATURE" THROUGH.

The Live Stock Industry and its Development.[1]

By Dr. J. S. GORDON, C.B.E.

STATE AID TO THE LIVE STOCK INDUSTRY.

UNTIL quite recently, all efforts to improve the live stock of the British Empire were left entirely to private individuals—the breeders of pedigree stock—and this small band of enthusiastic workers have left behind them a notable monument to their skill and unremitting labours in the formation of breeds and in the improvement which they effected in the type and quality of pure bred stock.

It was only at a comparatively recent date that the British Government considered the agricultural industry to be of sufficient importance to justify the State in making some financial provision for its improvement and development.

The first parliamentary grant for the special purpose of live stock improvement was voted in 1885. This grant was given to Ireland to be administered under the auspices of the Royal Dublin Society, which adopted the method of subsidising pedigree sires, and thus Ireland was the pioneer country in the British Empire to undertake live stock improvement with the help of a State grant.

Since 1914, parliamentary grants for the improvement of live stock have been made to the Ministry of Agriculture and Fisheries and to the Board of Agriculture for Scotland, and each of these Departments put into operation schemes somewhat similar to those in Ireland.

The live stock schemes originally devised by the Royal Dublin Society were continued and developed by the Irish Department of Agriculture, which was established in 1900, and on the formation in 1922 of separate parliaments for Northern Ireland and for the Irish Free State, still further extensions of the schemes were made by the Agricultural Departments of these two Governments.

The latest published figures for each part of the United Kingdom and for the Irish Free State show the total number of breeding stock, the total number of bulls, and the number of these sires subsidised to be as follows :

	No. of Breeding Stock (Cows and in-calf Heifers).	Bulls.	Subsidised Bulls.
England and Wales	2,790,703	88,405	1287
Scotland . . .	460,317	17,578	937
Irish Free State .	1,332,591	23,275	2205
Northern Ireland .	270,283	4,662	623

From the following table it will be seen that the proportion of subsidised to non-subsidised bulls and the number of breeding stock per subsidised bull vary very considerably in the several parts of the British Isles.

Turning for a moment to the Dominions—

In Canada the improvement of live stock is developed chiefly by two methods :

1. The Live Stock Branch of the Department of Agriculture of the Dominion Government purchases and loans out pure bred bulls to specially organised associations in newly settled districts and in backward sections in the older Provinces. This system was commenced in 1913, and 4692 bulls had been placed out on loan up to 1926, an average of 361 bulls per annum. By this means the value of

	Subsidised.	Non-subsidised.	No. of Cows per Subsidised Bull.
England and Wales	1 to	69	2168
Scotland . . .	1 to	19	491
Irish Free State .	1 to	11	604
Northern Ireland .	1 to	7	434

pedigree sires has been demonstrated and farmers have been induced to purchase pure bred sires for their own use.

2. By grading beef cattle, sheep, and lambs according to age, quality, and weight when they are put on the market, and by demonstrations and propaganda, attention is directed to superior beef and mutton. In this way a growing demand from the consumer for more tender and juicy joints has been created. This plan has directly assisted breeders to improve their stock, as considerably higher prices can now be obtained for prime beef, mutton, or lamb than for coarse joints. The Canadian Government is paying special attention to this side of marketing with remarkably successful results. The home consumption of meat and eggs per head has gone up considerably since this system of grading was commenced. Thus, in 1916 the consumption of eggs per head was sixteen dozen; in 1927 it had increased to twenty-eight dozen and all exports had ceased.

Australia (Queensland) in 1925 adopted a scheme by means of which the Department of Agriculture made available to the approved purchaser of a pedigree bull a subsidy of 50 per cent of the cost price, provided the subsidy did not exceed £50.

In South Africa a scheme for the distribution of pedigree bulls to farmers in the Transvaal through breed societies came into operation in 1924. These animals are sold to selected applicants at reduced prices. Several of the agricultural schools throughout this Dominion have stud farms, and young sires raised on these farms are sold and placed out under the Department's bull distribution scheme.

Although the value of the State-aided live stock breeding schemes in Ireland was clearly shown in the great improvement in the stock of the country both in quality and in the increased prices obtained, the results achieved were not anything like what they would have been if the widespread use of animals totally unsuitable for breeding purposes had been prohibited. The scrub bull not only inflicted serious damage on the owners of cows, but also lowered the reputation and value of Irish live stock and to a large extent neutralised the good effect of the live stock schemes.

[1] From the presidential address to Section M (Agriculture), delivered at the British Association at Glasgow on Sept. 6.

These were the chief reasons which induced the Governments of Northern Ireland in 1922 and of the Irish Free State in 1925 to introduce legislation providing that bulls below a certain standard of merit should not be used for breeding purposes and that all suitable bulls should be licensed. By subsidising pedigree sires we have the means of improving and grading up our stock, and by permitting the use of none but licensed sires we get rid of the inferior animals and prevent them from doing harm. This ensures that the improvement is continuous and that much quicker results are produced.

In England and Wales there is only one premium bull to every sixty-nine non-premium bulls, and there are 2168 cows to each premium sire, whereas in Northern Ireland, where more than half the number of bulls are pedigree animals, there is one premium bull to every seven non-premium bulls and 434 cows to each premium sire. Yet after forty years' experience of the premium scheme, we have found it absolutely necessary to bring in a licensing system to supplement the former owing to the progress of improvement being so comparatively slow.

Great Britain has the reputation of having the finest pedigree stock in the world, and yet probably nowhere else in the British Empire is improvement in the cross-bred cattle more urgently needed. It is a strange anomaly that our pure-bred stock are exported to all parts of the Empire and to foreign countries for the improvement of the native stock, while at home our own cross-bred stock are in comparison so inferior to the pure-bred stock.

In Canada, United States, Australia, and South Africa the elimination of the scrub bull has received attention, and these countries in recent years have instituted with considerable success campaigns against the use of inferior sires. Western Australia introduced legislation, which came into operation in 1924, to enable its agricultural department to get rid of scrub bulls.

Is Further State Aid Required?

Would it be advisable for the State to devote larger funds than are granted at present to the improvement of live stock? My opinion is that, as the money which has already been applied to this purpose has proved so reproductive, and as the live stock breeding industry is so important to the whole community, it is questionable if funds expended in any other way could produce anything like the same returns.

In January 1923, Mr. T. P. Gill, who for more than twenty years was Permanent Secretary of the Department of Agriculture, Dublin, stated before the Commission on Agriculture appointed by the Irish Free State, that—

"By the infusion of pure bred blood and better methods of keeping, feeding, and management, producing an animal which matures more quickly, fattens more cheaply, and yields more beef and milk, the intrinsic value, independent of price fluctuations of Irish cattle, has been increased since the department started in 1900 by about £5 per head. This is based on the estimates of the British Salemasters who handle this import as well as of the most experienced Irish cattle traders. On the number of cattle exported last year, counting the exports only, this would mean an increased annual income of approximately £5,000,000 for an expenditure of £20,000, or a return of 250-fold."

If we calculate that the increased value was only £3 per head, it means £3,000,000 per annum, or a return of 150-fold.

Some will think, perhaps, that I have laid too much stress on the importance of the pedigree sire in the improvement of stock, but the improvement which has taken place in the stock of the Argentine Republic gives us food for thought. In 1848 the first shorthorn bull was imported into that country. At that time only native breeds existed, animals which from our standard were of very inferior quality and extremely slow-growing. The Rural Society founded in 1875 was the chief agency in bringing about improvement in the live stock of the Argentine chiefly through the importation of pedigree sires and through the shows of live stock held by the Society.

In 1895 native cattle constituted 50 per cent of the total in the province of Buenos Aires. In 1914 this had declined to 3·5 per cent. The cross-breds and half-breds increased during this period of twenty years from 49·2 per cent to 93·9 per cent, and the pure-bred or pedigree cattle from 0·6 per cent to 2·5 per cent.

Similar progress in the case of sheep has been recorded. In 1895 native breeds constituted 16·5 per cent of the total; in 1914 they had fallen to 2·3 per cent. The cross-breds increased during this period from 83 per cent to 95·6 per cent, and the pure-breds from 0·5 per cent to 2·1 per cent. In the other provinces an equally noticeable improvement has been effected.

Between 1895 and 1922, 41,519 pedigree bulls were exported from the British Isles to the Argentine.

To-day the best quality Argentine chilled beef ranks next to the best home-produced, and in Smithfield Market it commands prices higher than some of our own home-produced and considerably higher prices than any other imported beef.

The following figures from the *Statist* show the prices of home and Argentine beef for the year before the War, for 1926 and for 1927:

Class of Beef.	Prices per Stone of 8 lb.		
	Jan. 30, 1914.	Dec. 2, 1926.	Dec. 3, 1927.
Argentine chilled hindquarters	3*s.* 8*d.* to 3*s.* 10*d.*	3*s.* 10*d.* to 4*s.* 4*d.*	4*s.* 8*d.* to 5*s.*
Scottish sides.	4*s.* 6*d.* to 5*s.*	6*s.* 6*d.* to 7*s.* 4*d.*	6*s.* 4*d.* to 7*s.*
English sides.	4*s.* 2*d.* to 5*s.* 1*d.*	4*s.* 8*d.* to 5*s.* 6*d.*	4*s.* to 4*s.* 10*d.*

English sides, it will be observed, have actually fallen in price since 1914, whilst Argentine chilled beef has risen. The substantial difference in favour of English beef over Argentine chilled beef which existed in 1914 has disappeared. The two principal

factors in this revolutionary change are the use of pedigree sires and marketing methods. Surely no stronger argument could be put forward for the urgent necessity for the improvement of the cross-bred cattle of the British Isles.

NEED FOR EXTENDED RESEARCH.

Although I consider that the pedigree sire is the best foundation for the improvement of live stock, it is by no means the only way by which improvement can be brought about. The changes and improvements already mentioned are largely the results of the ability and judgment of the breeder himself, but latterly he has been assisted considerably by the agricultural scientist, chiefly along four distinct lines of research and experiment: (1) animal nutrition, (2) animal diseases, (3) animal breeding, (4) marketing.

Animal Nutrition.—Animal nutrition is of the greatest importance from three points of view—

(*a*) Most stock owners will agree that the greatest mortality in live stock is due either directly or indirectly to imperfect nutrition and not to disease—probably seven out of every ten deaths occurring on farms in the British Isles (excluding those caused by accidents) are due to imperfect nutrition.

(*b*) Owing to early maturity and forcing young animals forward to an age when they are ready to be killed, a much more thorough knowledge of foods and the science of feeding is necessary than under the old system. In the case of cows with high milk yields and of poultry where high egg records are being produced, such knowledge is specially required.

(*c*) The practical farmer as a rule has little or no knowledge of how to form well-balanced rations; indeed he has a very slight knowledge of the composition of foods and of their physiological action. How could it be otherwise when we consider that it is only of recent date that attention has been given by agricultural scientists to the necessity for balanced rations in feeding different kinds of stock and how little even they know about the digestibility of foods, the proper balance of a ration, and the action of minerals in relation to health and disease resistance.

In 1890 the British Government gave local authorities (county councils) in Great Britain grants to be used either for reducing rates or for agricultural and technical instruction purposes. Many of the county councils from the beginning utilised those funds entirely in developing agricultural and technical instruction schemes, and in later years all the county councils expended these grants in this way. From 1890 until a few years ago practically all the funds made available to local authorities for the development of agriculture were applied to agricultural education, experimental and research work chiefly in connexion with soils, manures, and crops, comparatively small amounts being devoted to research and experimental work on live stock problems.

While I realise the great advantage to be gained by the application of science to soil, fertiliser, and crop problems, the chief factor in the British Isles is live stock, and it has been to a great extent neglected. It is the chief source of our farmers' income—the hub of the wheel—and, so long as the production of live stock is an economic success and crops are utilised chiefly by converting them into live stock products, more attention should be given to research on live stock problems than to the experimental side of soils, manures, and crops.

This position is, however, being rectified, and we have now research stations engaged in animal nutrition work at Aberdeen, Cambridge, Belfast, and Dublin, but the funds available are quite inadequate if this work is to be developed on broad lines and is to be of practical assistance to the stock breeder in his efforts to overcome many of his difficulties and losses.

Animal Diseases.—I am sure that no one will question the need for extended research into the diseases of our farm animals or the necessity for protecting our live stock industry against epidemics which annually threaten it so seriously. In connexion with the latter I may refer to the outbreaks of foot-and-mouth disease in Great Britain, which have been almost continuous since 1919, and have been the cause of the loss of so many stock through slaughter. During the last nine years, 1919–1928, no fewer than 162,214 cattle, 114,679 sheep, 71,536 pigs, and 256 goats have been slaughtered, and the compensation paid to farmers amounted to £5,314,000. This does not by any means cover the full value of pedigree stock, as only commercial prices are paid in compensation, nor does it include the administrative expenses incurred in stamping out each outbreak of this disease. Moreover, when whole herds of pedigree stock are slaughtered, it means in many instances the destruction of the life work of breeders—work which can never be replaced—and for this loss no sum could ever compensate the breeders or the State.

Here is a field of research which would justify the State in devoting large sums in order to employ the most skilled scientists obtainable to ascertain a means of prevention. When we consider the enormous cost to the nation and the constant danger of losing our best pedigree herds, as well as the possibility of losing our trade in pedigree stock with other countries, the justification for further and immediate research in this direction is apparent.

Considerable loss to our agriculturists is caused by many other animal diseases regarding the prevention of which very little is known. The most important are tuberculosis, abortion, infertility or sterility. The first named not only causes loss through the death of animals but also is a constant source of danger to human beings through the consumption of milk from tubercular cows. The latter two diseases are widespread in many areas and affect seriously the production of stock. These are only a few of the many animal diseases into which research is required and for which adequate funds are urgently needed.

Animal Breeding.—One of the greatest problems

which breeders have to face in the management of their studs, herds, and flocks, is the selection of sires. Both amateur breeders and old experienced breeders have the same difficulty, namely, how to select a prepotent sire. The only way in which breeders can determine this at present is by the offspring. This means a delay of two years in the case of beef cattle and from three to four years in the case of dairy cattle. If, at the end of that time, the sire proves unsuitable, the owner may have from two to four crops of calves inferior to their parents and, therefore, of no use in improving the herd, and such animals have to be sold at an unremunerative price. The owner suffers a considerable loss in time as well as money, and runs the risk of ruining his herd if he retains animals of this blood.

Owners of small flocks or herds cannot afford to keep more than one high-priced sire, and therefore are handicapped much more than those who own large herds or flocks. The latter can afford to keep a number of sires on trial, mating each with only a few females until each sire is proved, instead of risking all the herd with one unproved sire, as has to be done in most cases by small breeders. In Scotland most of the herds of pedigree cattle are in the possession of tenant farmers, many of whom have only small farms. In Northern Ireland there are 682 pedigree herds, and the majority of the owners have farms less than fifty acres. These breeders could not afford to keep more than one sire or to pay a very high price for a pedigree sire. Money may enable the breeder to procure a high-class sire of a fashionable pedigree, but this is no guarantee that the sire will prove to be a good stud animal. Experience and judgment also assist the breeder in his selection, but even the most experienced breeders and keenest judges often purchase animals which turn out quite unsuitable as sires.

Another problem is how to induce breeders of commercial stock and even breeders of pure-bred dairy stock to keep bulls until such time as the value of their progeny can be determined, and then to retain, so long as they will produce stock, those sires which are proved to be suitable. This question is of the greatest importance in dairy herds, where frequently the bull is dead when his daughters are proved to be good yielders of milk and butter-fat. Well-bred bulls should be retained until the daughters have demonstrated their sire's true value, and, by the exclusive use of such pure-bred bulls, a real advance would be made in the breeding of dairy stock.

Many pedigree herds and flocks have made names or high reputations simply as the result of having one prepotent sire, and when that sire died these herds for years afterwards lost their reputation for high-class stock. If the animal geneticists could show how to diagnose a prepotent sire or how to breed animals with this hereditary trait and make breeding more of a certainty and less of a gamble, it would encourage and give a stimulus to the breeding of high-class animals, which would reach much further than any form of State subsidy given directly to breeders of pedigree stock, and would be worth millions in money to stock breeders throughout the world.

CONCLUSION.

To sum up, I should like to emphasise the supreme importance of the live stock side of our agricultural industry, the immense scope for development which exists, and the exceedingly rapid strides which can be made in its development by the application of our present knowledge along properly organised lines. We can do for stock in the relatively short period of ten to fifteen years what has been accomplished for crops from 1840 to the present time. Unless we bestir ourselves and organise our efforts we shall find our home markets for stock and stock products in the hands of our competitors, who already, by purchasing the best of our pedigree sires, are placing on our markets products which are superior to the great bulk of our home-produced supplies.

The pressing necessity at the moment is for improvement in our commercial cattle—the great disparity between them and our pedigree stock is little short of tragic. The means towards this end are: (1) The increased use of pedigree sires, and in this direction the State can with great advantage to itself provide a powerful stimulus by the rapid extension of the premium scheme; (2) the elimination of the scrub bull, which, to my mind, with human nature as it is, will only be accomplished in an effective manner by legislative means.

It must not be forgotten, however, that as progress is made in grading up our stock by breeding methods, it is imperative that there should be corresponding developments in our knowledge of nutrition, disease resistance and elimination, and in animal genetics. Research in these branches of agricultural science has in the past been starved. The funds devoted to such work are quite inadequate when viewed in the light of the importance of the live stock industry, which in England and Wales alone is worth, approximately, £154,000,000 per annum.

In connexion with this work may I stress the necessity for such research to apply itself more directly than at present is the case to the solution of practical problems. I realise clearly the need for fundamental research, or, as it is now called, long-range research, but agricultural scientists should be, as the designation implies, essentially applied workers. In setting themselves some of the problems which I have sketched, they will meet with sufficient really fundamental problems to keep them employed for many years to come.

Finally, I would reiterate the necessity for a comprehensive reorganisation of our methods of marketing stock and stock products. If it can be accomplished on a voluntary basis so much the better, but I am convinced that compulsory legislation will eventually be necessary. Much valuable time will be saved by facing this position at once. There is a bright future for the live stock industry, but only if we are prepared to attack the problems which it presents in a live and organised manner.

The Synthesis of Cane Sugar.

THE END OF A CHAPTER.

By Dr. E. F. ARMSTRONG, F.R.S.

THE synthesis of cane sugar in the laboratory has brought to triumphant completion a long chapter of endeavour on the part of the chemist. It has always been regarded as the crowning success to be won in the long series of victories achieved by the chemist in synthesising natural organic products, which began with Wöhler's first synthesis of urea a hundred years ago. It is of considerable interest, therefore, to indicate some of the stages of progress and the lessons which have been learned from them. A technical and, even more, a commercial synthesis of this product of the sugar cane and of the beet remains to be effected, but the possibility of doing this in competition with the plant is very remote.

The origin of the sugar cane is obscure, but it is known that it has been cultivated in eastern tropical Asia from great antiquity and that it spread westwards and eastwards, reaching the new world early in the sixteenth century, and the West Indies in 1641. Markgraf in 1747 was the first to find sugar in the beet, thereby pointing the way to the foundation of the beet sugar industry in Europe, which did not actually commence, however, until 1801.

Naturally, cane sugar early engaged the attention of the chemist, and the first experiments to determine its empirical formula date from Lavoisier, though it was only definitely established by Liebig in 1831. Whilst the question of the constitutional formula of the sugars, and of cane sugar in particular, has persistently occupied the activities of many chemists, the chief progress made will always be associated with the name of the master, Emil Fischer, whose achievement in unravelling the complex stereochemical relationships of the isomeric hexose sugars and in effecting their synthesis stands second to none other in the domain of organic chemistry.

Sucrose was shown to be a compound of the two simple hexose sugars, glucose and fructose, combined together in such a manner that the product was highly susceptible to hydrolysis by the weakest acids, but very stable towards action by alkalis. As the investigation continued it became clear, partly owing to the work of Tollens, that glucose and fructose, when in combination with other substances, existed preferentially, if not entirely, not as aldehyde and ketone respectively, but behaved as if they had the structure of compounds containing a carbon-oxygen ring. For a long time this ring was considered to consist of four carbons and oxygen, though it is true that the assumption was based mainly on the analogy with the acid lactones and was without any definite chemical evidence. The hypothesis gave a ready explanation of the existence of two isomeric series of glucose derivatives and of isomeric glucosides.

The constitutional formula of cane sugar was formulated by Fischer and by Tollens on the basis of a four carbon-oxygen ring structure for its components, and many attempts were made to effect its synthesis by combining them or their derivatives in synthesising natural products. In no case were these efforts—and they were numerous in the years 1890 to 1910—rewarded by success. A claim by Marchlewski in 1891 has never been accepted by sugar chemists, and even the possession of crystalline acetochloro derivatives of the sugars failed to give the much-sought-after cane sugar.

The work of the St. Andrews school, started by Purdie, particularly of Irvine, in studying the methylated derivatives of the carbohydrates opened up a new field of investigation, out of which it was found that glucose reacted in other forms than the accepted stable ring, and afterwards that the supposed ring structure of glucose itself had to be challenged. The work during the next decade, after some disillusions, has evidenced further complexity in this already complicated field. Suffice it to say that it has been proved for each of the sugars that it can react in more than one ring form according to circumstances, whilst the particular ring form present in reference compounds has been studied. In this connexion the work of Haworth deserves the highest possible recognition.

There was thus established an up-to-date formula for sucrose—differing very little, it is true, from that of Fischer and Tollens—which enabled once more hopes to be held out of effecting the so long sought synthesis. Hopes, but no certainty, for, as workers in the field of the sugars know well, the experimental difficulties are extreme, because, whilst the glucose element in sucrose is, in the stable so-called α-modification, easy to make and to purify in the form of its compounds, the fructose element is, in the γ-modification, which is unstable, difficult of isolation, even in its derivatives, and likely to change. The many efforts of a thoroughly systematic and scientific character to effect the synthesis of sucrose from the requisite derivatives of α-glucose and γ-fructose have met with no better success at the hands of Irvine and his school, of Haworth and his co-workers, than attended those of Fischer and Armstrong, Ryan and others, all of whom had the potential components of the elusive sucrose at their disposal. Complex mixtures, apparent isomerides of sucrose itself, always resulted.

More success has now attended the efforts of our Swiss colleagues, Pictet and Vogel, who, working on much the same lines as their predecessors, sought to condense the tetra-acetate of α-glucose with the tetra-acetate of γ-fructose in the presence of phosphoric anhydride. A complex mixture resulted, from which a well-marked crystalline constituent was separated on solution in boiling alcohol and subsequent cooling. This product has proved to be identical with sucrose octacetate in melting-point and optical rotatory power.

On hydrolysis, cautiously effected by means of sodium methylate, sucrose itself was obtained in measurable crystals. Naturally, in a matter of such importance, the identification of the synthetic sugar has to be very complete. Pictet and Vogel's product had the correct optical rotatory power both before and after inversion; the melting-points of the modifications, crystallised from ethyl alcohol and from methyl alcohol, were also the same as those of the natural product: sweetness and other properties were in accordance with expectation. There seems no room for any other course than a whole-hearted acceptance of the synthesis and the congratulation of Pictet and Vogel on their truly great achievement.

Much is to be learned from this chapter of chemical science—not the least being the value and necessity of manipulative skill of the highest order, involving an apprenticeship and a practical training of a rigour which is sometimes in danger of being overlooked to-day. Again, there can be no better example of the need of maintaining an open critical mind towards accepted conclusions and the advantage of reopening a question, in spite of apparent finality, when new view-points arise.

Writers of detective fiction have taught us that the end of a chapter is by no means the least exciting portion, and this is obviously true of the sucrose chapter. If its structure has now been established and confirmed by synthesis, more than ever is it necessary for the organic chemist to look inside the molecule so as to explain, for example, its behaviour on acid hydrolysis and the readiness with which the hexose molecule can assume different forms. The original formula of glucose, as an aldehyde, postulated a very active substance; perhaps we shall learn how and why this may react in many different modifications according to circumstances, thus providing a clue to reactions in the plant and in the animal.

The physicists proceed apace with a knowledge of the structure of the atom; in the domain of contact catalysis, much has been done to gain an explanation of the nature of absorption at the surface of a catalyst, and an understanding is being sought of how a catalyst works,—whether, for example, an impact of energy proceeds from one point in an organic molecule, at which it is received, along a carbon chain to another point at which the actual chemical change occurs.

It may well be that the study of the subtle changes in internal structure in the sugar group, where a unique series of highly specific catalysts is available, will be highly fruitful, and it is with this hope that we confidently await the beginning of the new chapter. The one we close is full of fame—a long list of honoured men of science of all nations, of which but a few have been mentioned, have each in their turn contributed to a problem which has all too long baffled solution. There can be no more appropriate celebration of the centenary of the first organic synthesis.

The Artificial Silk Industry.

AMONG the new industries of the present century, there are few which have developed so rapidly as the artificial silk industry. In a "Survey of Textile Industries"[1] recently issued, much interesting information is given about this now important industry. It is pointed out that scientific research and experiment have played an essential part in its development. Production on a commercial scale dates back to 1896, when a few hundred tons were produced in France by the nitro-cellulose or 'Chardonnet' process, though since then the viscose, acetate, and cuprammonium processes have been perfected. Of these, the viscose is now the most general, and is estimated to account for at least 80 per cent of world production. Each of the methods differs to some extent in regard to the raw materials used, and also in the chemical treatment employed. Their respective products vary from each other in regard to strength, fineness, lustre, permeability to moisture, etc. In all, however, the essential feature of their manufacture consists of a succession of chemical processes applied to cellulose, derived generally from wood or cotton. In the viscose method, for example, sulphite wood pulp, obtained from pine or spruce logs, forms the raw material. The cellulose is first converted into a viscous pulp, which is then squeezed through small nozzles and emerges in the form of continuous filaments, which after further chemical treatment can be converted into yarn by a 'doubling process.' More recently, it has been found possible to produce short lengths known as 'staple-fibre,' which can be spun like cotton or wool.

In the Committee's report it is shown that, from a commercial point of view, artificial silk has certain important advantages over cotton, wool, or natural silk. Its price is not affected by fluctuations in supply due to unfavourable weather or the ravages of insect pests. Its raw material (timber) is abundant, and output can be expanded (with the proviso that steps may have to be taken eventually to safeguard future timber supplies) to almost any extent by the erection of the necessary factories. Its price is mainly dependent on the cost of manufacturing processes, and these are more amenable to human control than are the direct products of Nature. Nor is its production necessarily confined to nations possessing a particular type of climate or other natural resources. The industry has, in fact, been developed mainly in industrial countries which, besides being favourably situated for obtaining raw material, possess a well-developed chemical industry and a supply of trained chemists and other skilled employees.

As is well known, there has been a remarkable expansion of the industry since the War. At first, the new fibre suffered from certain defects, such as inflammability and liability to damage by

[1] Committee on Industry and Trade. Survey of Textile Industries—Cotton, Wool, Artificial Silk; being Part 3 of a Survey of Industries. Pp. vi+328. (London: H.M. Stationery Office, 1928.) 3s. 6d. net.

moisture, but since the War these defects have been overcome and the product has been made more attractive. Changes in fashion and the increasing demand for elegance in wearing apparel have greatly extended the market. At the same time, the price of natural fibres, such as wool and cotton, had soared to unprecedented heights, while the price of artificial silk was falling substantially and seemed less likely to fluctuate. Economic conditions were thus favourable to a rapid expansion in its production.

Artificial silk differs from other textile fibres in being a continuous smooth filament without scales or protruding hairs. Though not so strong as cotton or so elastic as wool, it has the advantages of softness and peculiar dyeing properties. It can be used alone or in combination with other textile materials for the production of a large variety of manufactured articles. By utilising artificial silk, the older textile industries have been enabled to produce new kinds of fabrics as well as novel designs and original forms of ornamentation.

Though the industry originated in France, leadership had passed to Germany and Great Britain by 1913. In 1922 the United States took the first place in regard to the volume of production, while more recently a notable feature has been the rapid rise of Italy to second place.

In Britain, Germany, the United States, and Italy there has been a marked tendency towards increasing the scale of production, as it has been found that the large firm can introduce important economies of production. A movement towards international syndication has also become noticeable, and this would appear to have been due in the main to a desire to improve marketing facilities. There has been a rapid growth of important and intricate international agreements among producing firms, and in this movement British interests have taken a leading part. In 1927 the three largest firms in Britain, Germany, and Italy entered into agreements with each other, and it is said that this combination controls more than 70 per cent of the world's production of artificial silk.

Obituary.

SIR HORACE DARWIN, K.B.E., F.R.S.

SIR HORACE DARWIN, whose death on Sept. 22 is widely regretted, was born in 1851, the fifth son of Charles Darwin and the third of the group of brothers to become a fellow of the Royal Society. He was educated at Trinity College, Cambridge, taking his degree as a Senior Optime in 1874. Immediately afterwards he entered the works of Messrs. Easton and Anderson and went through the ordinary apprenticeship course in the shops. While there he designed and built his first instrument, a klinostat, for demonstrating responses of a plant to the stimulus of gravitation. At the end of his apprenticeship he returned to Cambridge, and shortly afterwards joined Dew Smith, who was engaged in designing and making instruments for physiological investigations.

Michael Foster had recently come to Cambridge, at first as Trinity prælector in physiology, later as professor, and found that for nearly all the apparatus he required, only German instruments were available. Darwin and Dew Smith became partners and started the organisation which at a later date grew into the Cambridge Scientific Instrument Company. During this period, along with his brother George, he designed a bifilar seismograph which was set up in a basement room at the Cavendish Laboratory. The rocking microtome, developed from an idea of W. H. Caldwell, was one of the instruments designed during the partnership which has proved of very great value to biologists.

At first the apparatus dealt with was mainly that needed in a biological laboratory, but before long the range was extended. Callendar's work on the platinum thermometer (1883–95) directed attention to the electrical method of measuring temperature; the need for resistance boxes designed for thermometry was further emphasised by Griffith's experiments on the mechanical equivalent of heat (1893), and electrical instruments of various kinds were taken in hand. After ten years the partnership came to an end. Dew Smith retired, and in 1895 the Cambridge Scientific Instrument Company was constituted. Darwin was chairman and the chief shareholder.

It was soon recognised that we had at Cambridge a firm of instrument makers the work of which would bear comparison with any in the world, while the head of the firm was a man with a genius for design and a knowledge of mechanics which enabled him to express his design in the simplest form consistent with the purpose for which the instrument was intended. In 1903 the value of his work was recognised by his election as a fellow of the Royal Society.

In 1909, at the suggestion of Lord Haldane, Mr. Asquith appointed the Advisory Committee for Aeronautics "for the superintendence of the investigations at the National Physical Laboratory and for general advice on the scientific problems arising in connexion with the work of the Admiralty and War Office in Aerial Construction and Navigation." Darwin became a member, and threw himself into the work with his usual energy and devotion. It was clear that measurements both on the full scale and in the wind tunnels at the laboratory were needed; for these instruments were required, and the Committee turned to him for suggestions and advice. Methods for measuring the stresses in the structure of an airship and the strength of the fabric interested him; the vagaries of the compass soon attracted the attention of the Committee, and with some of these he dealt in notes submitted to his colleagues. At a later date he watched with keen appreciation the work of Keith Lucas on the compass, and realised the importance of a 'turn indicator,' a device to assist the pilot in maintaining a straight course. His

own instrument for this purpose proved of value in a critical time.

During the War Darwin was an active member of various committees, and in 1917 became chairman of the Air Inventions Committee. His height finder, for determining the height and position of an object in the air, developed as it was by A. V. Hill and his associates, was perhaps the most important of the devices for which he was personally responsible, but his advice and help were sought continually by many workers.

Darwin's own views as to instrument design are expressed in his Wilbur Wright Lecture delivered in 1913, or more fully in the article which he contributed with his colleague, Mr. C. C. Mason, to the "Dictionary of Applied Physics" (vol. 3, Instruments, the Design of Scientific). Maxwell in 1876 and Kelvin on many occasions had laid stress on the importance of geometric design; he quotes with approval Maxwell's statement ("Handbook to Loan Collection of Instruments," 1876): "When an instrument is intended to stand in a definite position on a fixed base, it must have six bearings so arranged that if one of the bearings were removed the direction in which the corresponding point of the instrument would be left free to move by the other bearings must be as nearly as possible normal to the tangent plane at the bearing." He then shows by examples the advantages of adopting a geometric design, though he is careful to point out that there are cases when it is best to disregard the principle entirely. As to the qualifications of the designer: he is to be "a mechanical engineer with much scientific knowledge, well acquainted with the methods of manufacture available, and in order to avoid unnecessary cost the instrument should not require great skill to make."

Those who knew him and his work will agree that Darwin filled the bill far more completely than any of his contemporaries. His father's letter congratulating him on having passed his previous examination, quoted in the *Times*, applies in full measure to him. Discussing what makes man a discoverer of undiscovered things, Charles Darwin wrote: "The art consists in habitually searching for the cause and meaning of everything which occurs. This implies sharp observance and requires as much knowledge as possible of the subject investigated."

It was Darwin's habit to study from all sides the purpose for which he was asked to design an instrument, to acquaint himself by careful observation with the details of the experiment or measurement to be carried out, and then when thoroughly saturated with the problem, to evolve, sometimes with extraordinary rapidity, a piece of apparatus suited for the work. His interest extended to all the instruments made by his Company, though in a varying degree. Among those which find a place in the booklet describing special instruments for which he was more directly responsible, are a cathetometer made twenty-five years since for the National Physical Laboratory—a similar instrument is now being constructed for Japan—a spectroheliograph designed for the Solar Physics Observatory at Kodaikanal, a camera for taking star photographs—the result of a suggestion made by Prof. Turner—and various forms of comparator, specially those built for the Indian Geodetic Survey, in which were embodied a number of suggestions due to Sir David Gill. Some of his aeronautical instruments have already been mentioned. Experiments to determine the value of g always attracted him; the half-second pendulums made at Cambridge are well known, and the last piece of apparatus he was able to design himself was a vacuum box for Sir Gerald Lenox-Conyngham, in which to swing the pendulums for a projected survey. The drawings for this are in pencil on squared paper and are dated August 1925.

The changes which have taken place during the last fifty years in British instruments are far-reaching, and throughout the industry Darwin's influence was felt; he was a leader in the advance, the guide who pointed out the direction in which improvement was to be found, the friend who never grudged the help he was able to give.

This is not the place to write in detail of Darwin's other activities. He was a member of the Cambridge Town Council for some years, Mayor in 1896–97, and in 1919 he was appointed one of the Royal Commission to inquire into the Universities of Oxford and Cambridge. He married in 1880 the Hon. Emma Farrer, and leaves two daughters; his only son was killed in the War. R. T. G.

THE oldest seismologist in Italy, or indeed in the world, Prof. Giulio Grablovitz, died on Sept. 19. He was born at Trieste in 1846. Though without academic training, his fitness for geophysical studies was recognised by his appointment in 1885 as director of the geodynamic observatory of Casamicciola, founded as the result of the disastrous Ischian earthquakes of 1881 and 1883. At this observatory he remained for more than forty years, until its suppression in 1926, furnishing it entirely with instruments of his own design, his horizontal pendulums, and his well-known geodynamic levels. He was also a member of the government commission which planned the geodynamic branch of the central meteorological office, and was one of the founders of the Italian Seismological Society. C. D.

WE regret to announce the following deaths:

Prof. Panagie Cawadias, a distinguished archæologist of Athens, who was an honorary member of the Section of the History of Medicine of the Royal Society of Medicine, on July 21, aged eighty years.

Dr. S. F. Clarke, professor emeritus of natural history at Williams College, known for work on the hydroids of the American coast and on the embryology of the alligator, on Aug. 1, aged seventy-seven years.

Dr. P. E. Goddard, curator in anthropology in the American Museum of Natural History, who was known for his studies on the linguistics of the Apache Indians, on July 12, aged fifty-eight years.

Dr. C. L. Wilbur, Chief Statistician of the Division of Vital Statistics of the U.S. Bureau of Census from 1906 until 1914, on Aug. 9, aged sixty-three years.

News and Views.

THE Bishop of Birmingham's paper at the Church Congress on "The Uniformity of Nature and the Freedom of Man" was an utterance of great interest to students of science. Dr. Barnes did not claim to provide any final solution of the problems which surround this subject; but, what is perhaps an equivalent service, he indicated where the real problems lie. He said that we are confronted with two which are "unsolved and at present insoluble." In the first place, we cannot understand how mental processes can affect physical events; and, in the second place, "assuming that mind has an influence in the physical world, we cannot explain why the laws of that world appear to form a closed system." Dr. Barnes did not consider the first difficulty solved by the assumption that "there is associated with mind some 'vital force,'" since it has not yet been possible to point to any definite process in which such vital force discloses its activity. Nor, as a solution of the second difficulty, would he accept the idea that the will may exercise a sort of directive power without interfering with the principle of the conservation of energy, since all such contentions fail to satisfy the mathematical physicist.

DR. BARNES reminded his hearers that the twentieth century, like the seventeenth, has opened with a remarkable series of scientific discoveries. In the seventeenth century the result of these discoveries was the rise of new philosophic systems, notably that of Descartes, which "in a popular and debased form held its own until the nineteenth century." It is an obvious reflection that whereas in our own century the corresponding new scientific discoveries (notably those in the sphere of physical science) have taken place, we still await the genius who will embody them in a new philosophic system. The nineteenth-century naturalism is for practical purposes a form of Cartesianism, and no longer tenable. Will the new philosophy, when it comes, provide an adequate solution of the body-mind problem? Though he nowhere definitely says so, we conceive this to be the hope of Dr. Barnes. For the present he will not contribute to confusion of thought by adding to the number of expedients whereby many have sought to escape from the existing *impasse*. As he puts it: "I do not pretend to be able to explain the relation of mind and body, and I confess that none of the many theories which have been put forward are free from objection. But it seems to me that the physical and psychical worlds are in truth only different aspects of a single unity." And if these last words do offer a solution, it is one that is perhaps foreshadowed by the new physical theories. As Einstein has made us aware that space and time are artificial constructions by which the human mind breaks up a single unity, so it may be that the body-mind dualism is an artificial construction. Dr. Barnes, with his customary candour, admits that "it is difficult to realise in what way the physical side of the unity can belong to a mechanistic system, complete in itself, while the psychical side is not so limited." Yet is it certain that the physical side is as completely mechanistic as it seems? Prof. Eddington has said, apropos of the new quantum mechanics, that "whatever view we may take of free-will on philosophical grounds, we cannot appeal to physics against it."

WE are inclined to wish that Dr. Barnes could have found space to deal with the psycho-physical problem from the side of physiology as well as from the side of physics (though the latter of course is his own proper province). To many it appears that the researches of neurologists like Sir Charles Sherrington and Dr. Henry Head have shed much light on the function of consciousness, and the nature of spontaneity. The thinking public, however, will register another addition to the debt of gratitude which it already owes to a bishop whose candour is as notable as his learning.

IN December last, a few hours after one of the Christmas lectures to juveniles had been given at the Royal Institution, there was a series of alarming explosions in an electric main outside the building. Windows of the Institution were broken and the basement was filled with poisonous gas; and it is easy to understand that had the explosions occurred while a lecture was being given deplorable consequences and loss of life might have followed. Though the cause of the accident was outside the Institution, yet the managers were forced by it to give serious attention to conditions of safety and possibilities of escape from the building in case of fire or panic. A report was therefore obtained from the architect, and the result is the definite conclusion that the lecture theatre is not fire-proof, that there are not sufficient direct exits to the street, and that the gallery may almost be a death-trap. The fact that there has been no accident or loss of life in the theatre during the existence of the Institution does not absolve the managers from responsibility for the future now that they have the possibilities of danger so clearly shown by the architect. It was on this account that a special meeting of members was summoned for Monday last, for the particular purpose of empowering the managers to prepare plans for any essential alterations to the structure in order to bring it within modern building regulations as to safety without destroying the historic character of any part of the Institution. The meeting approved of the managers' action and empowered them to proceed with the preparation of the necessary plans for submission to a further meeting of members in November.

IT is estimated that a sum of something like £75,000 would be required to remove all objections that can be raised against the safety of the lecture theatre while preserving its present character, to provide easy and sufficient exits, to construct certain new rooms and corridors, and generally to enable the building to satisfy existing regulations for public buildings in which audiences assemble or work is carried on. Should the members of the Institution decide, as eventually they must have to do, that the theatre and certain other parts of the building should

be reconstructed, there ought not to be much difficulty in securing the amount required for the purpose. The Royal Institution has a world-wide reputation, not only for brilliant research, but also for its work for the extension of interest in progressive knowledge by means of the Friday evening discourses and other stimulating lectures. In its laboratories the great electrical industries were created by Davy and Faraday, and it is scarcely too much to say that most British leaders of science in the past century or so have been associated with the Institution in one way or another. If it is reported, therefore, that for safety's sake alone a large part of the Institution must be reconstructed, then it is the duty of the members and the managers to see that this work is put in hand, and it is hoped that they will be relieved at an early date of any anxiety as to the provision of the necessary sum to carry out the work in full sympathy with the wonderful historic past of the Institution and with the desire to ensure its continuance in perfect safety.

AT the northern end of St. Martin's Street, Leicester Square, in neighbourly proximity to the offices of this journal, a building of architectural distinction and pride of frontage has been in course of erection for many months past. Destined as it was to be the habitation of a new public library for the City of Westminster, it offered ample compensation for one formerly in St. Martin's Lane, long since transferred elsewhere in order to meet local exigencies. On Monday last the Dean of Westminster performed the opening ceremony on behalf of the Mayor of Westminster and the chairman and members of the Public Libraries Committee. A large company was present. Special interest attaches to the occasion, for on the site of the new library stood the historic dwelling-house of Sir Isaac Newton, occupied by him from 1710 down to 1725, when ill-health necessitated removal to Kensington, where he died two years later. In course of time, and during the residence of Dr. Charles Burney, the house became known as Newton House, and was the rendezvous of a musical, literary, and artistic coterie, which included Garrick, Sir Joshua Reynolds, and Dr. Johnson. Adjoining on the site, and also demolished, was the Orange Street Congregational Chapel, erected originally in 1685 for Huguenot refugees. An inscription on the façade of the new building gives Newton's period of living at his house as 1710–1727. Presumably the latter date should have been cut 1725, for Brewster tells us that the philosopher left St. Martin's Street early in that year for Kensington, and certainly he did not return. The Dean of Westminster, speaking on books and knowledge, referred to the great gift conferred on the population of that part of the municipality by the provision of the library. The historical associations garlanded around the spot should themselves serve as a mental stimulant.

THE Pereira Medal, awarded annually by the Pharmaceutical Society of Great Britain, was presented on Oct. 3 to Mr. Hubert A. Turner, who was the first candidate in England to pass the new Ph.C. examination held early this year. Jonathan Pereira was a physician who, in 1843, became the first professor of materia medica in the Society's School of Pharmacy. He was a brilliant lecturer and research worker and well known as an authority on his subject. After his death in 1853 a fund was raised by subscription with which a prize was established in the form of a medal called the Pereira Medal. This was to be awarded annually by the Council of the Pharmaceutical Society to the candidate who should succeed at a competitive examination in the subject of materia medica. All candidates must have qualified as pharmaceutical chemists since the last examination for the Medal took place. The Medal has been awarded each year since 1861, and is regarded as the 'blue ribbon' of pharmacy.

AT the opening of the new session at the Pharmaceutical Society of Great Britain on Oct. 3, Mr. R. R. Bennett delivered the inaugural address, taking as his subject "Pharmacy as a Career." He pointed out that education is not simply the acquirement of items of knowledge but the training and development of the student's faculties: study should be systematic and regular, when a subject can be mastered in what may seem an incredibly short time. It is of great advantage to make notes or an abstract of what is read, since the mere fact of writing impresses the data on the memory and leads to their arrangement in proper sequence. Reading should be methodical and critical: a little, well digested, is better than too much, which may destroy originality and independent thought. The amount of work should be measured by the degree of concentration applied and not by the actual time spent on it, and all work is much easier and more quickly mastered if the student is interested in his subject. For success in pharmacy, as in other professions, interest in the subject chosen for a career and hard work are the essential foundations; and it is achieved by competence, capability, and individuality. The law imposes a certain minimum efficiency as represented by the qualifying examination; but no pharmacist should be content with this. He should keep abreast of recent pharmaceutical research and literature as well as the trends of modern medicine. At the same time he should keep in touch with his professional brethren in order to maintain broad views. It should be the concern of every student to make himself as efficient as possible, so as to enhance the reputation of his profession, and to refrain from any action which might act deleteriously upon it. If possible the student should undertake some post-graduate research in pharmacognosy, chemistry, or pharmacology, facilities for which are provided in the Society's laboratories, and all students should make the fullest use of the opportunities they can enjoy at the Society's School of Pharmacy.

THE Electrical Association for Women, of which Mrs. Wilfred Ashley is president, is undertaking a useful campaign to bring to the notice of architects, electrical authorities, and builders, the importance of suitably wiring new houses for electric light and power. A preliminary survey of the new houses that are being built shows that building authorities are not making

adequate provision for electric supply, and that the electric 'outlets' installed are often in unsuitable positions. It is not advisable, for example, to have an outlet in the centre of a wall space which would otherwise be possible for furniture. In a leaflet the Association gives the plan of the standard house recommended by the Ministry of Health, and suggests suitable positions for the outlets in the various rooms. A large amount of labour-saving can be effected when an adequate electric service is available. In the living rooms outlets should be provided for a vacuum cleaner as well as for the fire, fan, and kettle. There should also be outlets in the bathroom for water heater, towel rail, and fire. The outlets in the kitchen should be waist-high and sunk in the wall. The Association is doing good work by pointing out some of the methods of lessening the drudgery of household work.

IN *Electrical Communication* for July, Mr. Rollo Appleyard gives an interesting sketch of the life and work of Georg Simon Ohm. Beyond the fact that he was the discoverer of Ohm's law, it is safe to say that he is practically unknown. He belonged to a German burgher family well known as locksmiths. In 1805, at the age of sixteen years, he entered the University of Erlangen. Lack of means caused his university career to be interrupted, but he graduated in philosophy in 1811. In 1813, Erlangen was the storm centre of the struggle against Napoleon, no less than 33,000 troops being billeted on the 8000 inhabitants. In 1817, through the influence of King Friedrich Wilhelm III., he was appointed a lecturer on mathematics and physics at Cologne. As a teacher he was inspiring and his zeal never flagged, but it was arduous work to get his discoveries recognised in the German universities. At this period Hegel's philosophy was at its zenith of popularity. As Hartmann said, it is more attractive to prove the laws of Nature by 'sovereign' speculation than to perform the tedious and irksome tasks of observing and testing experimentally. The triumph of Ohm did not come until 1841, when the Council of the Royal Society of London awarded him the Copley medal for his researches into the laws of electric currents. The results of these researches were published in his book, "Die galvanische Kette," and in *Poggendorffs Annalen*. The Royal Society stated that Ohm had established for the first time the laws of the electric circuit. Physicists in England found Ohm's law of the greatest value in their experimental work. Had the law been known earlier the industry of experimenters would probably have led to rapid developments in electrical applications. In 1833 Ohm obtained a professorship at the Polytechnic School at Nuremberg, and in 1849 he was appointed professor of physics at Munich. He died in 1854. Outside the College gates he was little known, but the good seed he sowed has grown and flourished luxuriantly.

THE Leicester Literary and Philosophical Society performs a good work in arranging a winter series of discourses by eminent lecturers, "to enable members to keep in touch with modern thought and discovery in as many spheres as possible, and to afford them an opportunity of forming a personal impression of famous men." The *Transactions* of the Society for 1927–28 contain short contributions on "Chinese Life and Thought," on the petrology of the Swanimote Rock, and on the flora of Rutland. The more intimate work of the Society is carried on by a severe splitting up of its activities into ten sections, each dealing with a particular branch of knowledge, after the manner of the British Association. While subdivision of this kind is necessary on account of the enormous membership of the latter body, it seems doubtful if much is to be gained by so great specialisation in a local society. In view of the tendency of scientific workers to pursue self-contained specialties, there is much to be said for retaining in local societies the broad policy of common meetings, where each interest gathers information from every other interest and keeps in touch with activities all along the front of scientific progress.

THE wide scope of the exploration work undertaken or assisted by the National Geographic Society of Washington was indicated in a paper which Col. E. Lester Jones read to the recent International Geographical Congress at Cambridge. The Society is best known for its *National Geographic Magazine*, a monthly publication which specialises in superb photographic illustrations that are generally of geographical interest. In addition, there are given every month a number of excellently produced colour plates which add much to its value. This magazine has an extraordinarily wide circulation, and has been of great value in schools and in popular education generally. The Society has no endowments or government subsidy, but from the income derived from its journal has been able to devote large sums to geographical exploration as well as to award from time to time the Hubbard gold medal. Among recent efforts of the Society have been help given to the late Admiral R. E. Peary, to Com. R. E. Byrd, including a sum towards his present Antarctic expedition, to many expeditions to Alaska and to the West Indies, especially in regard to the study of volcanology and seismology. Some of these researches have been published in special volumes. It is a matter for congratulation that the profits derived from the sale of a popular magazine, in itself of educational value, are put to such useful purposes.

A BUST of Michael Faraday will be unveiled at the Central Public Library, Walworth Road, S.E., by Lieut.-Colonel Kenelm Edgcumbe, president of the Institution of Electrical Engineers, on Wednesday, Oct. 17, at 4 P.M.

AT the invitation of the Egyptian Government, Sir Jagadis Bose paid an official visit to Egypt on Sept. 12–19. He lectured and gave demonstrations of his recent investigations, which are regarded as having an important bearing on the sciences of agriculture and medicine. The Egyptian Government proposes to send some of the post-graduate students

of the University to the Bose Institute, Calcutta, for special training.

MR. LESLIE HOUNSFIELD delivered his presidential address on "The Integrity of the Technical Man" before the Institution of Automobile Engineers on Oct. 2. The Graduates Prize of the Institution for the session 1927-28 has been awarded jointly to Mr. F. Gaye of the Derby Branch, for his paper on "Notes on Automobile Gears," and to Mr. C. I. Kelly of the London Branch, for his paper on "Petrol Engine Lubricants and Lubrication."

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A superintendent of the Zoological Gardens, Clifton, Bristol—Appointments Committee, Zoological Gardens, Clifton, Bristol (Oct. 14). An inspector of materials in the Aeronautical Inspection Directorate of the Air Ministry—The Secretary, Air Ministry (S.1), Adastral House, Kingsway, W.C.2 (Oct. 22). A physician for mental diseases and lecturer on psychological medicine at St. Thomas's Hospital—The Secretary, St. Thomas's Hospital, London, S.E.1 (Oct. 25). A resident assistant pathologist in the pathological department of the Royal Free Hospital and London (R.F.H.) School of Medicine for Women—The Secretary, Royal Free Hospital, London, W.C.1, or the Warden and Secretary, London (R.F.H.) School of Medicine for Women, London, W.C.1 (Oct. 26). A senior lecturer in physics in the Durham Division of the University of Durham—The Head of the Department of Science, University of Durham, South Road, Durham (Oct. 27). A junior lecturer in electrical engineering in the University of the Witwatersrand, Johannesburg—The Secretary to the High Commissioner for South Africa, Trafalgar Square, W.C.2 (Nov. 1). A principal of the University College of South Wales and Monmouthshire—The Registrar, University College of South Wales and Monmouthshire, Cardiff (Jan. 1). A woman lecturer in geography at St. Peter's Training College, Peterborough—The Principal, St. Peter's Training College, Peterborough. A physicist with electrical experience, under the directorate of Radiological Research of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. An assistant lecturer in mathematics, and demonstrator in physics or mechanics, at Faraday House Electrical Engineering College.—Dr. A. Russell, Faraday House, Southampton Row, W.C.1.

Our Astronomical Column.

SEPTEMBER FIREBALLS.—As is usual at this period of the year, fireballs have been abundant. On Sept. 14, $8^h\ 45^m$, G.M.T., a large meteor appeared in the north-west sky as seen from Kinsale, on the south coast of Ireland. It emitted a bluish-white light and lit up the sky as it fell rapidly from the direction of Perseus.

On Sept. 15, at about midnight, a splendid fireball was observed from Co. Cork. It moved slowly from north-west to south-west, and displayed gorgeous colours. It was directed from a radiant on the north-west horizon at $239° + 20°$ and pursued a long flight.

On Sept. 21, $11^h\ 10^m$, G.M.T., a fireball brighter than Venus fell from $39\frac{1}{2}° + 25°$ to $42° + 6°$ in 4 seconds as seen from Shore Ends, Essex.

On Sept. 30, $7^h\ 40^m$, a magnificent meteor was viewed from many places in the north of England. It traversed a long path, south-west to north-east, from over the River Solway to far out into the North Sea, and was directed from a radiant at $251° - 20°$ or $237° - 2°$ in Scorpio or Serpens. The height of the nearly horizontal flight was about 57 miles.

EINSTEIN AND RELATIVITY.—R. D. Carmichael contributes a paper to *Scientia* for September, in which he dwells on the æsthetic side of Einstein's theory of relativity. He points out that this theory was in the main deduced from the central idea of expressing the laws of Nature in such a form with respect to the four-dimensional continuum that there should be no change in the form on passing from one system of reference to another. To do this was an effort of pure thought, and the form of the laws resulting from this effort of thought led to the postulation of the three well-known astronomical tests of the new theory, namely, shift of perihelion, bending of light by gravitation, and shift of spectral lines in a gravitational field. The conclusion is drawn that "there is a deeply-founded solidarity between the laws of human thought and the laws of external nature."

A 'dialogue' on the same subject has been published by A. M. Robertson of San Francisco. It charges Einstein with faking his result for the deflection of light at the sun's limb, 1·75″, from an article published by Soldner about a century earlier. Soldner adopted the corpuscular theory of light and the Newtonian law of gravitation. Through some slips he got a result twice the size that this law really gives, and agreeing with Einstein's shift. But the calculation is such a simple one, and has been verified so often, that there is no question of Soldner being in error; the charge against Einstein is therefore invalid.

MINOR PLANETS.—The present year promises to be a record one for the discovery of minor planets. The number in the first two-thirds of the year is well over a hundred.

The planet 1071, now named Brita, gives a good illustration of the amount of labour that is involved in searching thousands of observations before it can be decided whether an object is really new. 1071 was discovered in 1924, but was not numbered then, the observations being insufficient: last December Herr Reinmuth, in searching for 553 Kundry, found another planet, which was provisionally lettered 1927 *YB*. Mr. B. Asplind calculated a circular orbit for *YB*, which made him suspect its identity with planet 1071. Further research supported the identity. He afterwards found that the object had been detected in 1910, when it was given the letters *JZ*, and some years later it was also detected at Simeis, Crimea, and designated Simeis 99. Mr. Asplind also calculated its place in 1914, and Reinmuth, on re-examining plates of that year, has found images agreeing with the calculations, so that the planet's orbit is now well determined (*Astr. Nach.*, 5584).

Tokyo Astron. Bull. for July 30 last states that the remarkable orbit announced last year for planet 1927 *BD* is erroneous. That orbit was of a cometary character, and extended to the orbit of Uranus. A mistake has been found in one of the observations used. The true orbit is nearly circular, with a period of 6 years 2 months, and an inclination of $17\frac{1}{2}°$.

Research Items.

NATIVE CULTURE OF THE SOUTH-WEST.—Under this title, Mr. A. L. Kroeber has written a valuable analysis of the problems of the anthropology of the south-western United States which consequentially analyses the methods of American archæology and ethnology and more particularly the method of 'cultural areas.' It has been published by the University of California as No. 9 of Vol. 23 of the *Publications in American Archæology and Ethnology*. More especially, of course, the author is concerned with the origins of south-western culture and the direction from which cultural influences penetrated the area. The question is made difficult by lack of information relating to adjacent areas, especially northern and southern Mexico. Incidentally, reference is made to the possibilities of chronological correlation from Mr. Douglass's work on tree-growth which has carried a year identification system for the American south-west back to A.D. 1300, beyond which there is a floating block of several centuries of identifiable year growths. To this block belong rafters from Pueblo ruins, such as Aztec and Bonito, of the third or great Pueblo period, while the Spanish conquest falls into the fourth period. It should therefore be possible to obtain a record back to A.D. 1000, from which period rafters could be obtained to reflect on Mexican conditions of the general Toltec period, and possibly confirm legendary Aztec chronologies. In regard to extra-continental influences in the south-west, little reached the area from South America, though it shares certain elements, such as maize culture, the turkey and rain rituals of South American origin with the central area. Asiatic traits are practically absent, except a hesitating occurrence at the farthest extent of distribution of the sinew-backed bow. Trans-Pacific influences are scarcely to be expected, but in Southern California is the cosmogony of Luiseño and Gabrielino, thoroughly Polynesian in character, and the Gabrielino and Chumash shell fish-hooks, which are strictly Micronesian in form.

POPULATION IN NYASALAND.—Dr. F. Dixey, Government Geologist of Nyasaland, has published in the *Geographical Review*, vol. 18, No. 2, a study of the distribution of population in Nyasaland. According to African standards the population is large, numbering in the 1926 census 1,290,885, a figure which gives an average of 34·6 per square mile as compared with Tanganyika 11·26, Northern Rhodesia 3·2, Southern Rhodesia 5·1, and Portuguese East Africa 7·0. Distribution, however, is uneven, and varies from 201 per square mile down to less than 10 per square mile in an area comprising 21,255 square miles. The most densely populated areas are in the Lower Shiré valley, about Port Herald and the Chiradzu district and adjacent parts of Blantyre. The most sparsely populated area is the northern Nyasaland Plateau, a section which suffers great losses by migration to Rhodesia and South Africa. The population problem is closely bound up with the question of water supply. A number of areas are otherwise suitable for settlement provided water could be supplied. It is especially needed, not so much for agricultural purposes as for domestic use. This is indicated by the alignment of habitations along a network of streams in country uniformly equal in soil. For the moment the problem is in danger of being overlooked, owing to the unusually favourable conditions of the last three years. The population tends to concentrate along the lake shore and along the larger streams and rivers. The average number of inhabitants in a village ranges from a minimum of 57 in Blantyre to a maximum of 259 in South Nyasa. There are 18 villages with a population of more than 1000. Kota Kota township is formed of a number of villages with an aggregate population of 5438; but the largest individual village, near Fort Johnston, numbers 2562. In the fertile areas lying in strips along the river valley or lake shore, it is not easy to find an unoccupied site.

THE AMERICAN INDIAN AS A WILD FOWLER.—G. D. Sprot, a Scottish naturalist now resident in British Columbia, contributes an interesting article on the wild-fowling methods of the Indians of Vancouver Island to the *Canadian Field-Naturalist* for September last. His attention was directed to the subject by the discovery of two 70-feet poles, which had been known to stand on the shore since 1862, and must have been the standards of flight nets in use almost a hundred years ago, though no authentic account exists of the use of such nets on Vancouver Island. Inquiry showed that other varieties of netting were employed. On dark still nights dip nets were used from canoes, a torch being lighted and at once extinguished in the neighbourhood of flocks of geese. This performance repeated several times bewildered the birds, so that they did not attempt to fly away and could be quickly scooped out of the water by the net. Drop nets were also employed from canoes, as well as various kinds of arrows and spears, but the most unusual method of capture was the use by young Indians of a natural 'bird lime.' A large wood slug (*Limax*) having been located, was gently stroked until it had exuded a quantity of slime. This was spread in the approved fashion upon prominent twigs on bushes near hovering groups of the rufous humming-bird, and so tenacious was its grip that one coating was sufficient to hold a number of the birds, which the Indian youths treated rather barbarously as playthings.

THE BEAVER IN DENMARK.—The beaver has long been extinct in Denmark, but evidence is accumulating to show that it existed for a long space of time in prehistoric days. A summary of the records has been made by Magnus Degerbøl in a recent short paper (*Saertryk. Vidensk. Medd. Dansk. naturk. Foren.*, Bd. 86, 1928). Trees gnawed by beavers found in different peat bogs indicate their presence in the last interglacial period, and similar circumstantial evidence shows that they were one of the early immigrants after the glacial period, occurring during the first succeeding temperature optimum ("Allerødrid"). They were present in the post-glacial forest period, and in the Azilian stone age the occurrence of many bones at human settlements shows that they were hunted by man. Thereafter the traces of beavers begin to become fewer. Bones have been found in the kitchen middens of neolithic age in Northern Sjaelland and Lolland, but they are much less numerous than in the earlier deposits, while from the most recent neolithic layers only a single find has been recorded. The author now adds a unique record from a settlement at Hasmark Sønderby which belongs to the Bronze Age, and this is the final record of the presence of the beaver in Denmark.

JAPANESE LAND MOLLUSCA.—The second instalment of Dr. Pilsbry's "Review of Japanese Land Mollusks" (*Proc. Acad. Nat. Sci. Philad.*, vol. 80) deals with that part of the genus *Euhadra*, the only large and conspicuous land shells of the Japanese Empire, grouping about *E. herklotsi*. The group as a whole would appear to have been generally diffused over the Main Island, Shikoku, and Kiushiu with its satellite islands, at some former period of emergence which united them, but without land connexion with

Yesso or Korea. One special pattern of coloration, described as the 'nimbosa pattern,' is restricted to the south-western two-thirds of the Main Island and Shikoku, whilst the sinistral species are confined to the northern half of the Main Island. As yet practically nothing has been recorded of the ecological relations of any of the Euhadras. Systematic descriptions of the species in question are given, and one new species, *E. latispira*, and several new subspecies are defined. The seven plates in illustration are remarkably fine and leave nothing to be desired. There are also figures and sketch maps in the text.

ARTHROPODAN LEGS.—H. E. EWING (*Smithsonian Misc. Coll.*, vol. 80, No. 11, 1928) has investigated the legs and leg-bearing segments of certain groups of Arthropoda. His more important conclusions are as follow: The generalised type of arachnidan leg appears to possess one more segment than the maximum of eight allowed by Hansen for the Crustacea. The generalised pauropod leg is composed of eight rings representing six or possibly seven true segments—coxa, first and second trochanters, femur, tibia, tarsus, and pretarsus—and with this the generalised thysanuran leg is homologous except that it possesses a subcoxa, usually platelike in form. The typical collembolan leg has a subcoxal segment and the tarsus is either lacking or is represented by a short rudiment at the base of the claws. The primitive insectan type of tarsus was three-clawed, as in the Pauropoda, Symphyla, and certain Thysanura; the two- or one-clawed condition found in some Thysanura or in the Collembola is not primitive, but is derived from the three-clawed type. Evidence is discussed bearing on the presence of an additional segment—the cervical—in the insect thorax, which should be considered homologous with the legless postcephalic segment of pauropods and certain symphylids. The primitive thoracic tergal plates were simple structures without condyles or apodemes and did not completely cover the dorsal surface of their respective segments. The primitive thoracic sterna of an insect were probably transversely divided into two sternal plates the posterior of which articulated laterally with the inner condyles of the coxæ.

LEAF SCORCH.—In the *Journal of Pomology and Horticultural Science*, vol. 7, Nos. 1 and 2, July 1928, Mr. T. Wallace completes his examination into this frequent cause of loss to the orchard grower. He concludes that all the available evidence points to leaf scorch arising from defective nutrition, whilst in many cases it develops as the result of unsatisfactory conditions of water supply within the plant. The soil conditions associated with leaf scorch in the field also suggest unsatisfactory conditions of water supply. It has been shown that certain soil conditions are conducive to the trouble; in some of these soil areas proper manurial treatment may enable orchards to be developed profitably, on others the grower would be better advised not to attempt to grow fruit trees. Another paper by Mr. N. H. Grubb in the same journal, upon the effect of potash fertilisers upon apple trees, again shows the value such potash manuring may have, under certain conditions, in preventing the development of leaf scorch.

CAMBRIAN FOSSILS FROM CALIFORNIA.—Twenty years ago Cambrian fossils were discovered in beds resting on an eroded granite surface at Bristol Mountain, near Cadiz, California. There appear to be two layers of fossiliferous shales in the series, of which the upper has been determined as belonging to the Middle Cambrian, but whether the under one should be referred to that or to the Lower Cambrian remains to be decided. Charles E. Resser discusses (*Smithson. Miscell. Coll.*, vol. 81, No. 2) these fossils, which, with the exception of a single Brachiopod (*Paterina*), belong to Trilobita of the genera *Mesonacis* (including three new species), *Pœdumias*, and *Dolichometopus*. Three very clear plates illustrate the paper.

UNDERGROUND WATER SUPPLIES OF SOUTH AFRICA.—For nine years Dr. A. du Toit has been associated with the Union of South Africa Irrigation Department, and in the course of his investigations into underground water supplies he has analysed the data and results of more than ten thousand boreholes. The wealth of information so collected has now been conveniently condensed in a paper of the utmost practical and theoretical interest presented to the South African Society of Engineers (*Trans. Mins. of Proceedings*, 1928). Dr. du Toit discusses the mechanism of infiltration; fluctuations of the water-table; selection of sites; yields and resources; and various engineering questions; and finally he summarises the water-bearing qualities of all the chief formations from the Old Granite to the Tertiary beds. The following statement indicates the vast importance of ground waters to the South African communities: "The occupancy of the vast spaces of South Africa and their closer settlement have been made possible principally through the agency of the boring machine. I firmly believe that more has been achieved towards the general development of the country from the comparatively few thousands of pounds spent annually upon State boring than from all the millions expended upon large diversion and storage schemes."

THE TANGO (JAPAN) EARTHQUAKE OF MAR. 7, 1927.—This earthquake, with its toll of 2900 lives, the most destructive in Japan since the great shock of 1923, still engages the attention of Japanese students. According to Messrs. Watanabe and Sato (*Japan Imp. Geol. Surv. Rep.*, No. 100; 1928), its disturbed area contains nearly 60,000 square miles. Up to the end of March, the number of after-shocks recorded was 899. As already mentioned in NATURE (vol. 122, p. 36), this earthquake was due to successive displacements along two pre-existing faults, nearly at right angles. The present authors notice, however, that the faults are not continuous. The more important fault, the transverse Go-mura fault, has a general trend about north-north-west and south-south-west. It consists of a series of eight faults arranged *en échelon*, and, with few exceptions, the rock on the east side is relatively depressed by as much as 1 metre and shifted through 2 or 3 metres to the north. For several miles to the west of this fault the Japan sea coast has been permanently uplifted by amounts ranging up to 1 metre. The authors suppose that the fault is a reversed one dipping to the west, and they suggest that the earthquake was caused by the uplift of the land on the west side, and that the vibrations, when they reached the perpendicular Yotsugi fault, gave rise to a sympathetic earthquake there. Prof. B. Koto, to whom we owe the well-known investigation of the Mino-Owari fault-displacements of 1891, has also made a detailed study of the two faults illustrated by more than fifty photographs (*Tokyo Jour. Fac. Sci.*, vol. 2, pp. 265-329; 1928). He also notices the double origin of the earthquake, and, on this account, he calls it an 'intersecting twin earthquake.'

TANGENTIAL GRATING SPECTROGRAPH.—The firm of Adam Hilger, Ltd., has furnished us with particulars of new products supplied by them, and we notice descriptions of two instruments of particular interest to scientific workers. In the past three years a new

method of studying soft X-rays and the extreme ultra-violet region of the spectrum has been developed by Dr. Jean Thibaud. His spectrograph employs the principle of the tangential grating. When the rays to be analysed are incident almost tangentially upon the grating, the dispersion is increased, the effect being as if the lines of the grating were much nearer together. In this way very pure diffraction spectra of X-rays may be obtained with short exposure. As the rays in question are very easily absorbed, the whole apparatus must be enclosed in a chamber which can be evacuated. The instrument can, however, be set up and taken to pieces in a few minutes, as all the joints are metallic cones or planes made vacuum-tight with rubber grease. By calibrating the grating with a well-known line in the visible spectrum, standard measurement of the wave-length of X-rays is possible. This gives an independent method for determining the dimensions of the space lattice of crystals, which leads to new and precise estimations of Avogadro's number and the fundamental electronic charge.

REFLECTION ECHELON GRATING.—In 1898, Michelson, in describing the echelon spectroscope, suggested the idea of a reflection echelon grating, but realised the difficulty of construction. In a communication to the Optical Convention of 1926, W. E. Williams discussed the theory of the reflecting echelon, and concluded that the progress made in optical technique had made an echelon of this type a practical possibility. Employing his suggestion of a number of fused silica plates of equal metrical thickness placed in optical contact, the firm of Adam Hilger, Ltd., has been successful in making reflection echelons having full theoretical resolving power. Three sizes are available, having 25, 33, and 40 plates, the resolving power (for wave-length 4000 A.) being 875,000, 1,150,000, and 1,400,000 respectively. The echelon is fitted in a levelling mount which provides for visual or photographic use of the grating. The reflection grating presents a number of advantages over the transmission grating, the first and foremost being that it can be used over a far wider spectral range. It may be remarked that some of the advantages of a reflection echelon were considered by Lo Surdo in 1921.

ELECTRICAL THERAPEUTIC APPARATUS.—We have received from Messrs. Watson & Sons (Electro-Medical), Ltd., a brochure on electro-medical apparatus which contains an illustrated account of the standard items of equipment for all branches of physio-therapy. The 'Polytron' valve universal machine calls for special mention. This machine has been designed to meet the demand for a noiseless earth-free unit which will supply the different varieties of current used for therapeutic work, and also power for cautery and light. Alternating current is required. The special features of the machine are that it has no moving parts, it is noiseless and is 'earth-free'; this latter ensures absolute protection to patients from dangerous electric shocks. Considerable space is given to diathermy apparatus, and in some of the more recent designs an open air-cooled tungsten spark gap is fitted in place of the ordinary enclosed gas spark gap.

PHOTOELASTIC DETERMINATION OF STRESSES.—The issue of the *Physikalische Zeitschrift* for Aug. 1 contains an account by Dr. M. Wächtler, of the more recent researches on the determination of the stresses in materials by the photoelastic method. The method has been adopted almost universally where the materials were of such shapes that calculations of the stresses could only be rough approximations. But it has its limitations, and the author is careful to state them. The double refraction produced by stress is not in all cases proportional to the stress, and the deviation from proportionality increases as the breaking point of the material is approached. Celluloid shows both time and fatigue effects from which glass is free. Examples of the method are given in a number of cases in which the stresses are simple and can be calculated, and the agreement between the results of the two methods is found to be satisfactory. References to 102 memoirs on the subject are given.

THE QUANTUM STATES OF ELECTRONS IN MOLECULES.—The first of a new series of papers by Prof. R. S. Mulliken, on the electronic properties of molecules, has been published in the August issue of the *Physical Review*. The ideas and methods he has employed are essentially those of Hund, but these have been supplemented by other hypotheses, the whole reduced to a set of working rules for analysing spectroscopic and other relevant data, and the rules then applied to the diatomic molecules formed by the light elements between lithium and fluorine, the main properties of sixteen such systems being finally collected in a single comprehensive table. It is possible, as Prof. Mulliken himself points out, that some of his results may be very approximate, but he has at least found it possible to correlate a great amount of experimental and theoretical material, and it is probable that conclusions generally similar to those at which he has arrived will ultimately come to be adopted. Prof. Mulliken's opinion on two controversial subjects will be noted with interest; he accepts the view that a molecule C_2 is the emitter of the Swan bands, and he takes the low value of 13·5 volts for the least ionisation potential of molecular oxygen.

TELEVISION AND RADIOVISION.—At the present time, when television and radiovision are developing so rapidly, it is of interest to have a record of the progress that has been made by inventors in various directions. We therefore welcome the pamphlet that has been written on "la télévision électrique" by Dr. A. Dauvillier, who was one of the earliest pioneers in France to propose a system of vision far exceeding the range of the human eye. He divides the systems into two classes. In the first class an attempt is made to transmit all the rays forming the picture simultaneously, and in the second, the rays are sent in succession, advantage being taken of the persistence of images on the retina. The second class is subdivided into others depending on whether the transmission and reception are mechanical or 'statical.' Ayrton and Perry made some suggestions so far back as 1877 in connexion with the first system, but Fournier d'Albe's acoustic method of television (1924) was the first practical method. In connexion with the second system, many inventors—Leblanc, Nipkow, Belin, Ekstrom, Mihaly, Baird, Jenkins, and Alexanderson—have done valuable work. Baird transmitted outline images by television in 1925, and in 1926 he transmitted the human face. He is also the only person who has transmitted an image when the object is in total darkness. He has sent images across the Atlantic and to a ship at sea. He has transmitted colour television and shown stereoscopic television. A number of systems use mechanical methods for emission and statical methods for reception. B. Rosing uses a rotating prismatic mirror as an analyser and modulates by a photoelectric current the intensity of the cathode beam. In his 'telephote,' Dauvillier has developed the Rosing method into a practical instrument which has the merit of simplicity. The receiving apparatus consists of a cathode oscillograph. In NATURE for June 18, 1908, Mr. Campbell Swinton suggests a purely statical method which has many theoretical advantages.

Homogeneous Catalysis.

IN previous discussions held by the Faraday Society, the influence of surfaces and of light on the velocity of chemical actions has been reviewed, and it was with the object of obtaining a summary of the present position in respect to homogeneous reactions that a further discussion was held at Cambridge on Sept. 28 and 29.

The application of the term catalytic to any reaction occurring in homogeneous phases has been considered by some to be unsuitable, but provided that the original definition of Berzelius is not considered to be too broad for practical purposes, there is really little objection to this title. Our knowledge of the mechanism of many gas reactions has been made more complete chiefly by the work of Bodenstein and Hinshelwood; even the famous case of nitrogen pentoxide, which has defied the attacks of many investigators, has just been solved by Bodenstein, the pioneer in gas reaction technique. Yet, as the recent work of Kistiakowsky on the decomposition of hydrogen iodide reveals, it cannot be said that all is known as to the mechanism of these apparently simple reactions, what molecular target area or what activation by collision really is. No less than seven of the communications, including those of Drs. Bäckström, Christiansen, Dhar, Hinshelwood, Mardles, and Polanyi, were to a great extent devoted to what is undoubtedly one of the centres of interest at the present time, namely, the mechanism of chain reactions, and Messrs. Egerton, Garner, and Moureu took part in the discussion. These are of peculiar interest, in that they include a number of cases of reactions which proceed at great but measurable speed in a sort of no man's land between ordinary chemical reactions and explosions.

In general, a chain reaction, as indicated by its name, consists of a reaction of such a type that when one molecule of the reactants suffers reaction, it causes others to react. The number of molecules induced to react, that is, the chain length, may vary with the reaction from two or three molecules to several millions. Some investigators insist that there are in reality two problems to be solved, how a chain starts and how a chain is propagated. Others emphasise the importance of the propagation and believe that ordinary kinetic collision suffices to set a chain in action.

There are at least three different views as to the nature of the chain mechanism in these reactions; it is indeed possible that there are reactions conforming to each type. Historically, the oldest view is that of Nernst, in which an atom mechanism is postulated. This process can be visualised most readily by the following equations applicable to the combination of hydrogen and chlorine:

$$(1)\ Cl + H_2 \longrightarrow HCl + H$$
$$(2)\ H + Cl_2 \longrightarrow HCl + Cl.$$

Provided a chain has once started, it will on this view terminate when the atoms which form the chain links are fixed by some atom accepter.

A second mechanism is that first advanced by Christiansen, in which it is suggested that the product of combination, containing as it does at the moment of formation both the original energy of activation and that resulting from combination, can excite a fresh molecule of one of the reactants. This suggestion has been applied by Bäckström, especially to the oxidation of benzaldehyde, and by Hinshelwood to the oxygen-hydrogen combination. It may be represented by the following equations:

$$(1)\ A + O'_2 \longrightarrow AO'_2$$
$$(2)\ AO'_2 + O_2 \longrightarrow AO_2 + O'_2.$$

It is worthy of note that inhibitors in these reactions which have been examined so exhaustively by Moureu and his co-workers frequently undergo oxidation themselves, suggesting that the breaking of the chain is effected by a reaction involving either the species AO'_2 or O'_2; likewise that these reactions occur not only in the gas phase, but also in solutions where numerous collisions with solvent molecules must take place between each chain link, if collision, and not radiation be the mechanism of propagation.

Finally, there exists the hypothesis of Semenoff, in which it is postulated that reaction centres are formed; these diffuse through the reacting system and act as initiators of chemical reaction until destroyed by chemical reaction or adsorption on the surface of the vessel. Some investigators believe that ions, which are possibly always formed in small quantities, especially in these reactions, are to be identified with the reaction centres of Semenoff. Many of those reactions increase rapidly in speed after a period of induction, and it is a necessary consequence that the chains must branch or that the concentration of reaction centres must increase during the reaction. A chemical formulation of this action may be made by postulating a dissociation of one of the reactants; for example:

$$A + O \longrightarrow AO'$$
$$AO' + O_2 \longrightarrow AO + 2O.$$

In this case each single molecule of active product AO′ produces two oxygen atoms, giving rise to two fresh reactive molecules.

It was a pity that the limitations of time did not permit of a more adequate discussion of these reactions so that a serious attempt might have been made to reconcile the somewhat divergent opinions expressed.

The second part of the meeting was devoted to discussion of the mechanism of homogeneous catalysis in solution, and with the exception of an interesting paper by Prof. Boeseken in which he developed his well-known views on the application of the theory of molecular 'dislocation' to homogeneous reactions and cited an interesting application in the effect of catalysts on the polymerisation of acetaldehyde, the session was almost entirely confined to the question of the mechanism of reactions accelerated by hydrogen ions. In the discussion on this subject it was clear that the interest of the various investigators was directed to two different aspects of the problem. Some were clearly interested rather in the mechanism of the reaction, that is, the nature of the reacting complex and how it reacts, whilst others were more interested in the formal relationship between concentrations and reaction velocity. Both of these aspects are of course, to a certain extent, interdependent.

The investigations of Kendall on complex formation in ester–water, ester–acid, and acid–water systems may be said to be representative of the first group of investigations; we may include the views of Lapworth, Goldschmidt, and of F. O. Rice on the nature of the complexes formed by the hydrogen ion in aqueous and alcoholic media. The mechanism of the changes taking place in the action of mutarotation, where a sugar hydrogen ion complex is involved, has been elaborated by Brönsted and by Lowry. Emphasis is laid upon the amphoteric character of esters and sugars by Euler, but as observed by Brönsted, it is difficult to decide which are reactants and which products in a reversible system which can be denoted by the equation

$$G^- + H_2O \rightleftarrows HG + OH^-$$

where HG represents the sugar undergoing change.

The second group of investigations includes those in which attempts have been made to deduce the mechanism of these reactions from investigations on the formal relationship between concentrations and reaction velocity. The abnormal effects of strong acids as well as the effects of the addition of non-electrolytes have long been known and different interpretations of the accelerating effects have been advanced from time to time. In this discussion the summaries presented by Drs. Brönsted and Dawson respectively may be said to have been representative of the difference in point of view.

According to Dawson, the catalytic effect of an acid in aqueous solution may well be ascribed to the sum total of a number of several effects, those due to the acid and its components and of the medium. We may represent the velocity of such a reaction by an equation of the following type :

$$v = R_1H^+ + R_2\bar{A} + R_3OH^- + R_4HA + R_5H_2O.$$

In this equation R_1 . . . R_5 represent the specific activities of the various catalytic reactants. In order to justify such an equation it is necessary to evaluate with accuracy the actual concentrations of the reactants ; this is, in the case of electrolytes, no easy matter.

The view advanced by Brönsted and by Bjerrum is based upon the hypothesis of the existence of a quasi-complex or very unstable combination between reactants and catalyst and in mass equilibrium with them, the rate of change of this complex being so slow that the mass equilibrium is always established. This hypothesis leads to a very simple formulation of the reaction velocity :

$$v = k\mathrm{A} \,.\, \mathrm{B} \,.\, \frac{f_A f_B}{f_{AB}},$$

where f_A, f_B, f_{AB} are the activity coefficients of the reactants and complex. Whilst the theoretical evaluation of the relationship between the values of the activity coefficients and the concentrations in the case of electrolytes has not yet been completely solved, in spite of the progress achieved by Milner, Debye, and Hückel, yet their experimental determination by a number of methods does not present serious difficulties.

Brönsted and his co-workers have presented a number of investigations in which this formulation of the reaction velocity has been shown to be justified, and in the case of weak acid and salt mixtures the differentiation between primary and secondary kinetic salt effects is clearly exemplified, although the contribution by Harned and Akerlof demonstrated the complexity of the changes introduced when strong salt solutions are employed. The termination of the second day's discussion likewise proved too abrupt for either of the protagonists to make many converts to their views.

ERIC K. RIDEAL.

New Buildings at the University of Leeds.

AN important stage in the ambitious but urgently necessary development scheme of the University of Leeds was reached on Tuesday, Oct. 2, when the foundation-stone of the new buildings was laid by Her Grace the Duchess of Devonshire.

After the ceremony, honorary degrees were conferred upon Her Grace The Duchess of Devonshire ; Sir Albert Ernest Bain, chairman of the Finance Committee of the University ; Mr. Alexander Campbell, chairman of the House and Estates Committee of the University ; Mr. Morton Latham, Master of the Clothworkers' Company, 1912–13, and chairman of the Trusts and General Superintendence Committee of the Company, 1915–28.

The Mining Block is the first of the new buildings to be erected under the scheme for the enlargement of the University, which was designed by Messrs. Lanchester, Lucas, and Lodge, the winners of the architectural competition. The Department stands at the extreme north of the University's site and forms the right wing of the new University front as seen from Woodhouse Lane. Towards the cost of this building the Yorkshire Coal Owners' Association has contributed £25,000, and the Miners' Welfare Committee, £10,000. In accordance with a decision reached by the University authorities after very careful consideration, the front of this building, as well as the other buildings, will be of Portland stone. The back elevation will be of a good local brick with stone dressings. The building is 158 feet long. The general width of the building is 44 feet, but the central portion stands farther back in the form of a single storey glass-roofed shed which is capable of easy modification should the necessity arise owing to the development of the work of the Department. In common with the other buildings in the scheme, the block will have a flat roof, and the height of the parapet above ground level is 46 feet.

The work of construction is in the hands of Messrs. William Airey and Son (Leeds), Ltd. The building is in three main floors with a partial basement. In the basement a gallery is being built the full length of the building, especially designed for carrying out experiments in mine ventilation and similar problems. The ground floor accommodates the main laboratory, machinery room, crushing shed, and subsidiary rooms for stores and other purposes. The first floor houses laboratories for research, gas analysis, photometry, and general assay work, together with rooms for the staff. The second floor is devoted to the lecture theatre, drawing office, museum, and staff rooms.

The building will be heated by hot water, unconcealed panels being used partly in the ceilings and partly on the walls instead of the ordinary type of radiator. The department will be equipped with the most up-to-date apparatus and machinery designed to give students a complete scientific training before entry into this important branch of industry.

Cotton Growing in the Sudan.

THE Sudan Government, in collaboration with the Empire Cotton Growing Corporation, has issued the "Report for 1926–27 of Agricultural Work in the Sudan," in which the programmes of work for the following season are included. The Gezira Research Farm, which was established in 1918 in connexion with the irrigation project, comprises an area of more than 400 acres and possesses well-equipped laboratories. Considerable progress has been made during the year in bringing the farm up-to-date, and the establishment of two more stations where similar problems could be tested under different conditions is now suggested.

Cotton is the principal crop dealt with. In the chemical section the salt content, salt and moisture movement, and nitrate content of soils in relation to plant growth, are under investigation. The beneficial effect of heavy applications of gypsum on the permeability of Gezira soil is most marked, the uptake, penetration, and distribution of water being greatly improved ; further work on this important question is in progress.

On the botanical side, the effect of climate and other factors such as time of planting on growth, is being

studied, a close correlation being found between excessive flower bud shedding and water deficiency. Length of lint may be influenced by meteorological conditions, low temperatures tending to induce the production of short lint. Longer lint also appears to be produced by the first formed bolls rather than those developed later. Blackarm and Root rot are the principal diseases, and white ants and thrips the chief insect pests of cotton under investigation.

Developments have been made in the plant breeding section, surveys being carried out to determine the districts most suitable for cotton growing in connexion with the establishment of variety testing stations. The actual composition of the soil appears to be of little importance provided it is capable of holding water and is reasonably penetrable by roots; the natural vegetation affords a fairly trustworthy index of the soil nature. Further, although a sufficiency of water is essential, areas subjected to flooding or undue surface erosion are unsuitable. Variety tests include both Egyptian and American type cottons, and spinning and grading tests are to be included in order to obtain information as to the relative value of the varieties to the grower.

University and Educational Intelligence.

CAMBRIDGE.—W. L. Edge and N. A. de Bruyne have been elected to fellowships at Trinity College.

LONDON.—A course of nine free public lectures will be delivered on Wednesdays, at 5.30 P.M., at King's College, on "The Indebtedness of Industry to Pure Science." The course begins on Oct. 17 with an introductory lecture by Sir Oliver Lodge. Succeeding lectures will deal with the rôle of chemistry in the life of the nation (Prof. A. J. Allmand); electrical science and industry (Prof. Ernest Wilson); the human factor (Dr. F. A. P. Aveling); physiology and national efficiency (Prof. R. J. S. McDowall); electrical communication and its indebtedness to physics (Prof. E. V. Appleton); the practical applications of zoology (Prof. Doris L. Mackinnon); the relation of botany to the grain, rubber, and cotton industries (Prof. R. Ruggles Gates); the influence of geology on modern life (Prof. W. T. Gordon).

Eng. Capt. Edgar C. Smith will deliver a course of three lectures in the Department of Engineering, King's College, at 5.30 P.M. on Oct. 16, 23, and 30, on "A Hundred Years of Naval Engineering." Students of the College Faculty of Engineering are admitted free, and other students at a reduced fee.

THE London School of Hygiene and Tropical Medicine is continuing its courses of lectures and practical demonstrations for employees of business firms and other bodies who are about to proceed to tropical and sub-tropical countries or are home on leave. These courses of instruction, in addition to providing simple rules for guidance in regard to preparation for life in the tropics and personal hygiene, also embrace a short account of some of the more common diseases, with advice in regard to measures of protection against such diseases, and some guidance in simple methods of self-treatment. One such course was given in July, and another has been arranged beginning on Oct. 22 at 11.30 A.M.; an evening course will also be given if there are sufficient applicants. Full particulars can be obtained from the Secretary, London School of Hygiene and Tropical Medicine, 23 Endsleigh Gardens, Euston Road, W.C.1.

THE Royal Technical College, Glasgow, which many of our readers have no doubt visited while attending the meeting of the British Association, is now entering upon its hundred and thirty-third session. The College offers in its day classes four-year degree or diploma courses in all branches of engineering, naval architecture, chemistry, dyeing, sugar manufacture, metallurgy, and building, and a three-year course in textile manufacture. In connexion with its courses of study in engineering, which are held during the winter session, thus leaving students free to spend the intervening summers in works, the College has enlisted the co-operation of a large number of firms interested in the training of engineers. These firms allow selected apprentices facilities for carrying out a scheme of study conjoined with practical work. The studies of the first and second years are common to all branches of the degree courses in engineering, specialisation beginning in the third year in the civil, mechanical, electrical, mining, and chemical branches. By means of a scheme connecting the evening science classes conducted by local education authorities with the corresponding classes of the College, it has become possible for evening students within thirty miles of Glasgow to qualify for admission to third year and even more advanced courses at the College. Last session these affiliated classes were conducted in more than one hundred centres with an enrolment of 4101 students, exclusive of preparatory classes. The David Elder evening lectures in astronomy to be given in the College during the coming session will include courses on "Speculative Astronomy" by Prof. George Forbes, who hopes to develop a speculation as to the existence of an unknown planet outside the orbit of Neptune, beginning Oct. 17, and on "Modern Cosmologies," by the Rev. Hector Macpherson, beginning Jan. 9.

ENGLISH and American secondary schools are to form the subject of a co-operative study organised by the University of Pennsylvania in consultation with prominent educationists in both countries. The scheme, an outline of which appears in the June issue of *School Life*, the official organ of the United States Bureau of Education, embraces not only a comparison of the main facts and tendencies in the recent development of secondary education, but also a detailed comparative study of some thirty schools in each country, namely, twenty public high schools and ten private (independent) schools—five for boys and five for girls—in the United States, and twenty municipal and county secondary schools and ten independent schools in England. An outstanding feature of the scheme is the careful provision for obtaining a factual basis, as complete as possible, for useful comparison of the working out in actual practice of the systems of teaching in force in the two countries. In order to test the results of teaching, English pupils will take American examinations and vice versa, and papers will be graded both by English and American teachers independently; results will be compared and comments exchanged; questions, answer papers, and results of joint matriculation board examinations in England will be compared with those of the college board in America. Prof. E. D. Grizzell, of the University of Pennsylvania, will be in residence in England during the year 1928–29, and will actively participate in the study of the English schools. Any principal of a school of one of the types above mentioned who is interested in the study and, especially, any who would like to co-operate in the detailed plan for comparison of certain schools, is requested to write to Prof. Arthur J. Jones at the University of Pennsylvania, Philadelphia, Pa., U.S.A.

Calendar of Customs and Festivals.

October 14.

PACK FAIR.—At Sherborne, on the first Monday after Old Michaelmas Day. Popular tradition held that it originated at the termination of the building of the church, when all the workmen packed up their tools and held a fair or wake. Up till the beginning of the nineteenth century it was held in the churchyard. For some three or four weeks before the fair, processions of boys paraded the town blowing cows' horns. At twelve o'clock on Sunday night the fair was proclaimed by the ringing of the church bell and the blowing of cows' horns. The streets of the town were paraded and bonfires were lit. At four o'clock the bell rang for a quarter of an hour, and the sale of oxen, sheep, lambs, and pigs began, usually being completed by twelve o'clock. Tradesmen's yearly accounts were settled on this day, when they provided beef and ale for their customers.

October 16.

A customary tenure of Eskdale, Yorks, is connected by tradition with this day, on which, in the year 1140, William de Bruce, Ralph de Percy, and a freeholder Allotson, while bear-hunting, assaulted a hermit with fatal results. As a penalty they held their lands of the Abbot of Whitby on condition that on Ascension Eve they should come to the wood of Strayheads, and at sunrise an officer of the Abbot should blow his horn and deliver to each a certain number of stakes, 'stowers,' or 'yadders,' "to be cut with a knife of penny price," which they were to take on their backs to Whitby before nine o'clock, and at low water fix them at the brim of the water so that they stood for nine tides while the officer shall blow 'out on you' nine times for their crime.

October 17.

St. Ethelreda, daughter of Annas, king of the East Anglia, born about A.D. 630 at Ixning, on the borders of Cambridge and Suffolk. She took the veil, and though twice married by the insistence of her parents, maintained her vow. She is therefore styled "twice a widow and always a virgin." She founded a convent in the Isle of Ely, where she died in A.D. 679. Her name is said to have been corrupted to Auldrey or Audrey, the name given to the annual fair held at the Isle of Ely. The word 'tawdry' is said to be derived from the fact that showy lace and similar articles were sold at St. Audrey's; but an alternative derivation connects it with her death from a swelling in the throat as a retribution for having been addicted to wearing fine necklaces in her youth.

October 17 (O.S.).

This day is regarded in Morocco as favourable for beginning the operations of the first of the two ploughing seasons provided rain has fallen. Of the days of the week, some tribes maintain that Thursday is more favourable than Sunday. With some, only the leading man of the village begins on that day. Certain rites, varying in detail from tribe to tribe, must be performed. A loaf of bread specially baked is taken to the field and either eaten by all present before ploughing begins, or after it has rested between or on the horns of the ox during the day; sometimes it is broken with the plough beam. Before sowing crops, excepting barley, some of the seed is picked up by the plough point, cooked and eaten. Pomegranate juice is sometimes squeezed on the horns of the oxen or rubbed on the neck and back to avert the evil eye. Among the Ait Yúsi, as the farmer is about to set out he says, "Come on and fetch water, O women," and they reply, "O wheat and barley, O Farmer." This is repeated three times. No water is fetched, but the dialogue in itself is supposed to ensure adequate rain and plentiful crops. Pomegranates are crushed on the plough point so that the grain may be as plentiful as the pips. Special magical efficacy is ascribed to the ceremonial meal as a means of securing the well-being of the crops. It is customary at the first ploughing to promise the grain from a certain portion of the field to a certain saint. This grain is presented to the descendants of the saint, who divide it with the scribes of his shrine.

With the Morocco ceremonial may be compared that of the Bhainas of the Central Provinces of India, which is performed at the shrine of Thakurdeo the day before the sowing begins. The priest makes an offering and repeats a charm, then kneeling, strikes the earth seven times with a ploughshare, and sows seven handfuls of rice, sprinkling water over the seed. Then the villagers walk seven times round the altar in pairs, one turning up the earth with a ploughshare, the other watering the seed.

October 18.

ST. LUKE'S DAY.—On this day a fair known as Horn Fair used to be held at Charlton, Kent. The name of the fair was derived from the custom of carrying or wearing horns, which were also displayed conspicuously on each stall. A reference to this custom dates from the year 1593. A long pole with reins woven on it was put on the shore of the river. It was at one time the custom for a procession to go from Bishopsgate Street to Charlton, where the procession marched round the church three times. It included a king, a queen, a miller, a councillor, and other characters, all wearing horns in their hats. On Blackheath females were whipped with furze and other 'indecencies' performed, while it was also customary for men to go to the fair in women's clothes. There is also mentioned a procession from Cuckold's Point, near Deptford, through Greenwich to Charlton. At the beginning of the nineteenth century, when the fair was no longer held on the traditional site of the green opposite the church, but in a private field, horns still continued to be the most prominent article on sale, and most of those at the fair wore masks or dressed as women or some grotesque character.

The fair is evidently an institution of great antiquity. Early writers are prone to regard the fair as an exploitation of the usual jest, while others connect it with the ox, the symbolic animal of St. Luke. While the pole may well have a phallic significance, and the whipping of women and other 'indecent' customs on Blackheath are doubtless fertility rites, it is possible that the horns here, as well as the cow horns used in connexion with Pack Fair at Sherborne, may be connected with cattle sacrifices of the early winter festival.

A divinatory practice for marriage on St. Luke's Day—"fitter for this purpose than St. Agnes"—which strongly suggests its origin in the charm or love potion, is recorded. "Take marigold flowers, a sprig of marjoram, thyme, and a little wormwood, dry them before a fire, rub them to powder, then sift through a fine piece of lawn; simmer these with a small quantity of virgin honey in white vinegar over a slow fire; with this anoint your stomach, breast, and lips, lying down, and repeat these words:

'St. Luke, St. Luke, be kind to me,
In dreams let me my true love see.'"

The charm goes further than most, for the character of the husband will be indicated, that is, whether he will be loving and true or unfaithful.

Societies and Academies.

PARIS.

Academy of Sciences, Sept. 3.—**G. Bigourdan**: The unification of radiotelegraphic time signals. A suggested modification of the time signals, giving an easy identification of each minute.—**Paul Vuillemin**: Relations of the conidial apparatus with the mycelium of *Aspergillus*.—**N. Iarotzky**: A method for obtaining a maximum of short wave ultra-violet rays. A modification of the quartz mercury vapour lamp, in which high tension currents of 80,000 volts are employed. By altering the resistance a mercury spectrum can be obtained giving radiations of 253 $\mu\mu$. The special advantages for therapeutic work are indicated.—**J. Savornin**: The coal basin of Djerada (Eastern Morocco). The coal seam described is anthracitic, and contains 15 per cent of ash.—**Jules Welsch**: Contribution to the knowledge of the Jurassic fauna of Poitou. Oxford-Argovian stage.—**E. Poyarkoff**: The fertility formula in the silkworm. The difference between the average weight of a female cocoon and a male cocoon in the silkworm is the average weight of eggs laid by the female.—**F. Rathery, R. Kourilsky, and Mlle. Y. Laurent**: The reciprocal influence of folliculin and of insulin on the glycæmia of ovariectomised dogs.—**Et. Burnet and D. Olmer**: The transmission of the exanthematous fever of Marseilles to the lower apes.

Sept. 10.—**G. Bigourdan**: The observatory of Delambre at Bruyères (Seine-et-Oise).—**Constant Lurquin**: Some algorithms characteristic of probability.—**Miécislas Biernacki**: Integral functions.—**Farid Boulad Bey**: The geometrical determination of the lines of influence of forces in continuous beams of any form.—**Nemours-Auguste and Martin**: The relation between fertility and high frequency in radio telegraphy stations. It has been suggested that there is a tendency for operators in wireless telegraphy stations to become sterilised. Experiments on mice exposed to high frequency currents for fifteen days continuously negative this view: the fertility of the mice was unaffected by the treatment.—**Philippe Fabre**: The kinetic theory of the neuro-muscular stimulation by short waves.—**Bordas and Neveu**: Public baths. A discussion of the possibilities of infection in public baths. The authors regard this danger as a very real one, and make suggestions as regards the purification of the bath water.—**Et. Burnet and J. Bance**: The properties of purified streptococcus-scarletinous toxin.

CAPE TOWN.

Royal Society of South Africa, Aug. 15.—**Sir Thomas Muir**: Note on Brioschi's treatment of the product of two sums of eight squares.—**W. A. Jolly**: On the action current staircase in skeletal muscle. It is a familiar fact that the twitches of a muscle stimulated by a series of stimuli exhibit at first a progressive increase in size, and this is usually regarded as demonstrating that previous stimulation has an improving effect on the muscle's responsive power. The present paper is concerned with the staircase obtained in the first few responses when the action currents of the muscle are recorded as indicators of its activity. Records have been obtained from the tibialis anticus and gastrocnemius muscles of the pithed *Xenopus* (the S.A. clawed frog or toad) on indirect stimulation through the uncut and also the severed sciatic nerve by means of submaximal break induction shocks. The rates of stimulation employed are 15 and 20 per second. After the staircase phenomenon had been recorded in both muscles by stimulation of the uncut sciatic nerve, the nerve was severed in the thigh central to the stimulating electrodes which were left in place. This procedure, which is known to increase the nerve's irritability, abolishes the staircase phenomenon, suggesting that we are dealing at first with a tissue of slightly depressed irritability and that stimulation improves its condition and increases its responsiveness, so giving rise to the staircase. The shortening of the latent period is consistent with this.—**E. O. Engel**: Notes on two larvæ of South African Diptera belonging to the families Leptidæ and Asilidæ. *Lampromyia sericea*, Westwood, is the larva of a Leptid fly of the sub-family Vermileoninæ, a group represented also in southern Europe and the southern United States. The larvæ of this group make conical pits in loose sandy soil, exactly like the pits of ant-lions and serving in the same way for the capture of ants and other terrestrial insects. *Hyperechia nigripennis* Wied. belongs to the family Asilidæ (the Robber-Flies). Most of the Robber-Flies are long-bodied and long-legged and use their spiked hind legs in capturing other insects on the wing; but *Hyperechia* and other members of the sub-family Laphriinæ bear a striking superficial resemblance to certain of the Carpenter Bees, and their larvæ are parasitic in the nests of the bees which they mimic. The larval mouth-parts are much reduced, presumably in correspondence with the parasitic mode of life.—**Louis P. Bosman and H. Zwarenstein**: The effect of temperature on the blood sugar level and the glucose tolerance in *Xenopus Lævis*. The blood sugar levels at 5°, 10°, 20°, 25° C., are respectively 69, 57, 44·2, 37 mgm. per 100 c.c. 1 c.c. of 2 per cent solution of glucose (= 20 mgm.) was injected into the dorsal lymph sac. This is equivalent to the ingestion of 50 gm. glucose by a man weighing 70 kgm. in carbohydrate tolerance tests. The tolerance curve at 5° C. shows a maximum of 124 mgm. 3 hours after injection and returns to normal 4 hours later. At 10° C.: max. of 119 mgm. ½ hour after injection, normal 5½ hours later. At 20° C.: max. of 173 mgm. ½ hour after injection, normal 6½ hours later. The corresponding figures for man are: normal blood sugar 90 mgm. per 100 cc.; max. of 180 mgm. ½ hour after ingestion of 50 gm. glucose; normal 1 hour later.—**E. J. Wayland**: An account of a pebble industry in the Transvaal. Various artefacts found at Belfast in the Transvaal fall into two industrial groups. The first consists of a number of artificially chipped quartzite pebbles; the second has Mousterian affinities.

LENINGRAD.

Academy of Sciences. *Comptes rendus*, No. 16-17.—**F. Loewinson-Lessing**: Magnetisation as a method for the rapid field determination of iron in bauxites. Artificial magnetisation may be used as a method of quick approximate determination of the content of ferric oxide in bauxites, perhaps also in certain clays and in limonite ores.—**S. Jakovlev**: The Tikhvin sands. An area of sand dunes in the Cherepovetz province is described. The dunes were formed probably before the xerothermic period, but shortly after the Glacial period.—**S. Ognev**: A new form of the steppe cat from the Transcaspian region. Description of *Octolobus manul ferrugineus* sbsp. n. from the Kopet-Dagh mountains in Transcaspia.—**N. N. Jakovlev**: Heredity of acquired characters in the palæozoic corals *Rugosa*. These corals were fixed by one side, and as a consequence their calyx grew unequally. This unequal growth persisted even when the animal had no need to grow in that way; thus an acquired character was inherited.—**N. N. Jakovlev**: Teratology and morphogeny of the abrachiate crinoids. Seven abnormal specimens of *Hemistreptacron abrachiatus* were found amongst nearly a thousand

specimens examined, the anomalies mainly presenting such characters as may be due to an interruption in the individual development; the forms resulting are interesting from the point of view of the ontogeny of the genus.—**D. A. Grave**: The method of magnetic detection of iron ores suggested by Steklov is criticised from the point of view of mathematics, the argument being based on Gauss's theory of earth magnetism.—**P. Schmidt**: A rare Japanese deep-sea fish, *Ereunias grallator*, Jordan and Snyder. Detailed re-description and measurements of the species, based on a specimen in the Academy collection, this being the third known example of the species.—**B. Lichkov**: Contribution to the geological history of the Polesie. Geomorphological studies in the Polesie lead to the conclusion that during the quaternary period there existed on the Dnieper, Pripet, and probably on other South Russian rivers wide inundation areas reaching the area of glaciation. This disposes of the existing idea that desert conditions prevailed in the Polesie during the quaternary period.—**C. Markov**: Ancient continental dunes in the north-west part of the Leningrad province.—**A. Leskov**: *Gagea granulosa Turcz.* Re-description of the species and its distribution in Russia.—**A. A. Birula**: Lower course of the Volga as a zoo-geographical frontier. A central-Asian scorpion *Buthus eupeus thersites* C. Koch is recorded for the first time from the right (western) side of the Volga; since that river is an absolutely impassable barrier for scorpions, the question arises how the species arrived there, and it is suggested that the lower course of the Volga may have changed relatively recently, shifting to the east as compared with the former bed, which may have coincided with the basin of the Sarpa lakes.—**M. Korsakova**: Studies in the chemistry of denitrification processes. Denitrifying bacteria may be divided into two groups: some can develop at the expense of nitrates, while others require the presence of ammonia, nitrogen, or amine nitrogen. For the bacteria of the second group, amino-acids serve also as a source of carbon; these bacteria possess a disamidase which is able to split up the amine nitrogen.—**V. Romanovskii**: The statistical criteria of group characters. Some remarks and supplements to Pearson's theory of coefficients of racial likeness.

Comptes rendus, No. 18-19.—**V. Jasnitskii**: Some results of the hydrobiological investigations in Lake Baikal during the summer of 1925. Benthos and plankton organisms were studied; bottom samples were taken and a map of the distribution of the bottom flora of the southern part of the lake was prepared.—**Th. Pleske**: Description of a new species of the genus *Eulalia* (Diptera, Stratiomyidæ) from Korea. *Eulalia coreana* sp. n. is described and a key to the species of the subgenus *Zoniomyia* given.—**V. Vlodavec**: Two new deposits of alkaline rocks in the Kola peninsula. The peninsula is unusually rich in alkaline rock deposits, there being now ten separate deposits known. Analyses of rocks are given.—**D. Serdjutchenko** and **P. Tchirvinskii**: The palygorskite and pyrite from the Trudov mine in the Donetz basin. The palygorskite has the formula $K_{10}Mg_2Al_2Si_7O_{24}.4H_2O$.—**J. Beliajev**: Classification of the points of longitude determined by astronomical observations. Eight different classes of longitude points are recognised and the permissible limits of error for each class stated.—**B. Kuzmin**: On a problem of Gauss.—**O. Tchekanovskaya**: A modification of the abdominal extremities in *Diogenes varians* Heller (*D. pugilator* Roux) caused by parasitic castration. Hermit crabs, *Diogenes varians*, parasitised by *Peltogaster*, often develop reduced extremities; castrated males in many cases exhibit a tendency to the reduction of the specifically male appendages and to the development of the female ones.—**G. I. Poplavskaya**: A contribution to the flora of the Crimea. A list of species of plants new to the Crimea, and a description of two new species, *Phelipæa helenæ* and *Scrophularia exilis* spp. nn.—**N. Prokopenko**: A seam of nakrite in the eruptive rocks of Totaikoi near Simferopol. Geo-morphological and mineralogical description of the nakrite.—**P. I. Lebedev**: Alutinisation of lavas of Alagoez in Armenia. Both in the crater of Alagoez and on its slopes alutinised lavas are common. There are several varieties of them and their chemical analyses are given.—**F. I. Lebedev**: Contribution to the mineralogy of the Tetjuche deposits of silver, zinc, and lead. Analyses and mineralogical description of smithsonites from two deposits in the Russian Far East.

Official Publications Received.

BRITISH.

Northampton Polytechnic Institute, St. John Street, London, E.C.1. Announcements for the Session 1928–1929 giving particulars of the Evening Courses in Applied Optics. Pp. 26. Announcements for the Session 1928–1929 giving particulars of the Day Courses in Applied Optics. Pp. 20+4 plates. Announcements for the Session 1928–1929 giving particulars of the Evening Classes in Applied Chemistry. Pp. 24. Announcements for the Session 1928–1929 giving particulars of the Evening Classes in Electrical Engineering. Pp. 44. Announcements for the Session 1928–1929 giving particulars of the Evening Classes in Civil and Mechanical Engineering. Pp. 44. Announcements for the Session 1928–1929 giving particulars of the Engineering Day College. Pp. 41+7 plates. (London.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1121 (Ae. 294): The Experimental Determination of the Trajectory of Aircraft Bombs. By H. E. Wimperis. Pp. 25+10 plates. 1s. 6d. net. No. 1138 (M. 53): The Determination of the Elastic Moduli of a Mild and a Medium Steel. By H. E. Smith and H. L. Cox. (E.F. 192 and A.) Pp. 7+3 plates. 6d. net. (London: H.M. Stationery Office.)

Annual Report of the Executive Council of the National Institute for the Blind for the Year ended March 31st, 1928. Pp. 78. (London.)

University of Manchester: Faculty of Technology. Prospectus of University Courses in the Municipal College of Technology, Manchester: Session 1928–29. Pp. 320. (Manchester.)

University of Cambridge. Department of Agriculture: Farm Economics Branch. Report No. 10: An Economic and Financial Analysis of Fifteen East Anglian Farms, 1926–27. By R. McG. Carslaw and W. H. Kirkpatrick. Pp. 22. (Cambridge: W. Heffer and Sons, Ltd.) 1s. net.

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1144 (Ae. 312): Report on the Development of a Hot-Wire Rate of Descent Meter. By G. W. H. Gardner and F. W. Meredith. (T. 2540.) Pp. 16+10 plates. 1s. net. No. 1157 (Ae. 322): On the Horizontal Flight of a Helicopter. By H. Glauert. (T. 2612.) Pp. 12+1 plate. 9d. net. (London: H.M. Stationery Office.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 66, No. 381, September. Pp. 909-1004+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Memoirs of the Geological Survey of India. Vol. 49, Part 2: The Former Glaciation of the East Liddar Valley, Kashmir. By Lieut.-Col. John L. Grinlinton. Pp. iv+289-388+plates 12-38. (Calcutta: Government of India Central Publication Branch). 7.12 rupees; 13s.

Journal of the Indian Institute of Science. Vol. 11A, Part 7: i. Estimation of Iodine in Soils, by Roland V. Norris and D. A. Rama Rao: ii. Carbohydrate Changes during the Ripening of Plantains, by S. Ranganathan, Jr. Pp. 75-83. 12 annas. Vol. 11A, Part 8: i. Oxidation of Sulphur in Suspensions of Activated Sludge and its Influence on the Solubilisation of Mineral Phosphates, by C. V. Ramaswami Ayyar, T. S. S. Perumal and Roland V. Norris; ii. Studies in the Proteins of Indian Foodstuffs, Part 2: The Proteins of Ragi (*Eleusine coracana*); Eleusinin, the Alcohol-soluble Protein, by Nuggehalli Narayana and Roland V. Norris. Pp. 87-95. 1 rupee. (Bangalore.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19, (N.S.), Nos. 1-8. 1: Award of the Boyle Medal for Pure Science to William Ringrose Gelston Atkins, 1928; Report of the Committee of Science and its Industrial Applications; 2: Award of the Boyle Medal for Applied Science to Walter Ernest Adeney, 1928; Report of the Committee of Science and its Industrial Applications; 3: A Simple Form of Photo-electric Photometer, using a Neon Lamp to Measure the Current, by Dr. J. H. J. Poole; 4: Influence of Temperature on Response to Electrical Stimulation, by Prof. Henry H. Dixon and T. A. Bennet-Clark; 5: *Salpingium palinorsum*, a new Carboniferous Coral, by Dr. Louis B. Smyth; 6: Report of the Irish Radium Committee for the Year 1927, by Maurice R. J. Hayes and Dr. Walter C. Stevenson; 7: Spectrographic Analyses of Irish Ring-Money and of a Metallic Alloy found in Commercial Calcium Carbide, by Dr. A. G. G. Leonard and P. F. Whelan; 8: "Blossom-Wilt" of Apple Trees and "Wither-Tip" of Plum Trees, with special reference to two Biologic Forms of *Monilia cinerea*, Bon., by Dr. C. Boyle, M. Murphy and Dr. H. A. Cummins. Pp. 76+5 plates. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6s.

The East Anglian Institute of Agriculture, Chelmsford (Essex Agricultural Committee). Calendar 1928–1929. Pp. 50+xxii. (Chelmsford.)

Board of Education. Report of the Departmental Committee on Examinations for Part-time Students. Pp. viii+74. (London: H.M. Stationery Office.) 1s. net.

North-East Coast Institution of Engineers and Shipbuilders. Handbook. Pp. 30. (Newcastle-upon-Tyne.)

Hull Municipal Museums. 12 Pictorial Postcards of Wilberforce House (with Descriptions). Set B. (Hull.) 1s.

Royal Commission on National Museums and Galleries. Interim Report, dated 1st September 1928. (Cmd. 3192.) Pp. 64+3 plans. (London: H.M. Stationery Office.)

University of London: Board to Promote the Extension of University Teaching. University Extension Lecture Courses and University Tutorial Classes, Session 1928–29. Pp. 39. (London.)

The Institution of Water Engineers. Average and Extreme Seasonal Rainfall over the British Isles. By Dr. John Glasspoole. Pp. 24. (London.)

Proceedings of the Physical Society: from December 1927 to August 1928. Vol. 40. Pp. xxii+229-349. (London: Fleetway Press, Ltd.) 7s. net.

The Institution of Mining and Metallurgy. List of Members (with Topographical Index), Constitution and By-Laws and Royal Charter of Incorporation. Pp. 156. (London.)

Centenary of the Hot Blast. Life of James Beaumont Nelson, F.R.S., Inventor of the Hot Blast. Compiled by Thomas B. Mackenzie. Pp. 35+4 plates. (Glasgow: West of Scotland Iron and Steel Institute.)

Nickel, Brass and Bronze. Series D, Paper No. 1: The Use of Nickel in Non-Ferrous Castings. Pp. 9. (London: The Bureau of Information on Nickel, Ltd.)

Federated Malay States. Annual Report on the Department of Agriculture, S.S. and F.M.S., for the Year 1927. By F. W. South. Pp. ii+18. (Kuala Lumpur.)

Journal of the Indian Institute of Science. Vol. 11A, Part 9: i. Contributions to the Study of Spike Disease of Sandal (*Santalum album*, Linn.), Part 2, Analysis of Leaves from Healthy and Spiked Trees, by A. V. Varadaraja Iyengar; ii. Contributions to the Study of Spike Disease of Sandal (*Santalum album*, Linn.), Part 3, Physico-Chemical Study of the Leaf-Sap, by A. V. Varadaraja Iyengar. Pp. 97-109. (Bangalore.) 1 rupee.

Union of South Africa. Department of Mines and Industries: Geological Survey. The Geology of the Country between Grahamstown and Port Elizabeth: an Explanation of Cape Sheet No. 9 (Port Elizabeth). By Dr. S. H. Haughton; with a Chapter on Underground Water Resources of the Uitenhage Region, by Dr. Alex. L. du Toit. Pp. 45. 5s. (with Map). Memoir No. 19: The Coal Resources of the Union of South Africa. Vol. 3: The Coalfields of the Eastern and South-Eastern Transvaal, Springbok Flats, Waterberg, Zoutpansberg, and of the Cape Province. By W. J. Wybergh. Pp. 176. 10s. (Pretoria: Government Printing and Stationery Office.)

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council for the Year ended 31st March 1928. (M.O. 308.) Pp. 46. (London: H.M. Stationery Office.) 1s. 6d. net.

The Physical Society. List of Officers and Fellows, September 15, 1928. Pp. 28. (London.)

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1928; with Appendices. Pp. 45. (London: H.M. Stationery Office.) 1s. 6d. net.

Department of Scientific and Industrial Research. Report of the Fuel Research Board for the Period ended 31st March 1928; with Report of the Director of Fuel Research. Pp. vi+70. (London: H.M. Stationery Office.) 1s. 3d. net.

The Economic Proceedings of the Royal Dublin Society. Vol. 2, Nos. 23 and 24: Survey of the Waste Land of North County Wicklow suitable for Afforestation, by S. Leonard; A Suggested Method for the Utilisation of Seaweed, by Dr. Thomas Dillon and Edward F. Lavelle. Pp. 391-413+plate 27. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 3s.

New South Wales: Department of Mines. The Mineral Industry of New South Wales. By E. C. Andrews and the Staff of the Geological Survey. Edited by F. S. Mance. Pp. v+432+40 plates. (Sydney: Alfred James Kent.) 7s. 6d.

Journal of the Chemical Society: containing Papers communicated to the Society. September. Pp. v+2305+2630+xii. (London: Gurney and Jackson.)

Birkbeck College (University of London). The Calendar for the Year 1928–29. (106th Session.) Pp. 237. (London.)

County Council for the West Riding of Yorkshire: Education Committee. Report on the Examination for County Minor Scholarships, 1928. Pp. 25. (Wakefield.)

Air Ministry. Aeronautical Research Committee: Reports and Memoranda. No. 1160 (Ae. 325): The Resistance of the International Airship Models measured in the Wind Tunnel of the Royal College of Science, South Kensington, S.W.7. By Prof. F. T. Hill and T. Tanner. (T. 2590.) Pp. 9+6 plates. 9d. net. No. 1161 (M. 56): Report on the Drop of Stress at Yield in Armco Iron. By Dr. A. Robertson and A. J. Newport. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (E.F. 203.) Pp. 7+20 plates. 9d. net. (London: H.M. Stationery Office.)

Southern Rhodesia: Geological Survey. Bulletin No. 13: Reports by the Mining Geologist, February 1927 to May 1928. By F. E. Keep. Pp. 79+4 plates. (Salisbury, Southern Rhodesia.)

Department of Agriculture: Trinidad and Tobago. Flora of Trinidad and Tobago. Vol. 1, Part 1: Ranales. By R. O. Williams. Pp. 22. 1s. Vol. 2, Part 1: Rubiales. By R. O. Williams and Prof. E. E. Cheesman. Pp. 48. 2s. (Trinidad, B.W.I.)

Mines Department: Safety in Mines Research Board. Paper No. 44: The Safety in Mines Research Laboratories, Sheffield; a Description. Pp. 19+11 plates. (London: H.M. Stationery Office.) 6d. net.

Nigeria. Annual Report on the Agricultural Department for the Year 1927. Pp. 13. (Ibadan.)

Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society. Edited by H. Munro Fox. Vol. 3, No. 4, October. Pp. 271-358. (Cambridge: At the University Press.)

FOREIGN.

Conseil Permanent International pour l'Exploration de la Mer. Bulletin hydrographique pour l'année 1927. Pp. 65. Journal du Conseil. Vol. 3, No. 2. Pp. 135-291. (Copenhague: Andr. Fred. Høst et fils.)

Société des Nations (League of Nations): Institut International de Coopération Intellectuelle. Bulletin des relations scientifiques. 3e année, No. 3, Août. Pp. iv+121-166. (Paris: Les Presses universitaires de France.) 8 francs.

International Hydrographic Bureau. List of Lifesaving Stations of the World, with their Equipment and Geographical Positions. By Rear-Admiral A. P. Niblack. Second edition. Pp. 87. (Monaco.) 7·65 francs.

Conseil International de Recherches: Union Géodésique et Géophysique Internationale. Section d'Océanographie, Bulletin N. 11: Réunion plénière de la Section (Prague, Septembre 1927). Pp. 78. (Venezia.)

Ministry of Agriculture, Egypt: Technical and Scientific Service. Chemical Section, Bulletin No. 78: Bordeaux Mixture; its Adhesive Power under Egyptian Climatic Conditions. By Dr. R. R. Le Geyt Worsley. Pp. 5. (Cairo: Government Publications Office.) 5 P.T.

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions. Vol. 48: Report of the Transition Area and Baltic Area Committees concerning the Question of Protection of Plaice, Salmon and Sea-Trout in the Belt Sea and the Baltic. Pp. 125. (Copenhague: Andr. Fred. Høst et fils.)

The Rockefeller Foundation. Annual Report, 1927. Pp. xi+385 (32 plates). (New York City.)

Air Temperature in Tyôsen (Korea). Compiled by the Meteorological Observatory of the Government-General of Tyôsen. Pp. ii+343+50 charts. Annual Report of the Meteorological Observatory of the Government-General of Tyôsen for the Year 1925. Pp. iv+154. (Zinsen.)

The Carnegie Foundation for the Advancement of Teaching. Bulletin No. 21: Present-Day Law Schools in the United States and Canada. By Alfred Zantzinger Reed. Pp. xv+598. (New York City.)

Forty-second Annual Report of the Bureau of American Ethnology to the Secretary of the Smithsonian Institution, 1924–1925. With accompanying Papers: Social Organization and Social Usages of the Indians of the Creek Confederacy, by John R. Swanton; Religious Beliefs and Medical Practices of the Creek Indians, by John R. Swanton; Aboriginal Culture of the Southeast, by John R. Swanton; Indian Trails of the Southeast, by William Edward Myer. Pp. vii+900+16 plates. (Washington, D.C.: Government Printing Office.) 2.75 dollars.

Department of the Interior: U.S. Geological Survey. Water-Supply Paper 571: Surface Water Supply of the United States, 1923. Part 11: Pacific Slope Basins in California. Pp. viii+431. 50 cents. Water-Supply Paper 576: The Ground-Water Resources of Mississippi. By Lloyd W. Stephenson, William N. Logan and Gerald A. Waring; with Discussions of the Chemical Character of the Waters, by C. S. Howard. Pp. vii+515+12 plates. 90 cents. Water-Supply Paper 582: Surface Water Supply of the United States, 1924. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. iv+66. 10 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of the National Research Council. No. 63: Selected Topics in Algebraic Geometry. Report of the Committee on Rational Transformations. Pp. 395. (Washington, D.C.: National Academy of Sciences.) 4 dollars.

Transactions of the San Diego Society of Natural History. Vol. 5, No. 13: A new Fox from the Cape Region of Lower California, Mexico. By Laurence M. Huey. Pp. 203-210+plates 25-26. (San Diego, Calif.)

Sitzungsberichte der Physikalisch-medizinischen Sozietät zu Erlangen. Herausgegeben von Oskar Schulz. Band 58-59, 1926–1927. Pp. xx+435. (Erlangen: Max Mencke.)

Bulletin of the American Museum of Natural History. Vol. 57, Art. 7: Termites of the Belgian Congo and the Cameroon. By Alfred Edwards Emerson. Pp. 401-574+plates 20 38. (New York City.)

Skrifter utgitt av Det Norske Videnskaps-Akademi i Oslo. Matematisk-naturvidenskapelig klasse, 1928, No. 4: Untersuchungen über die Kristallstruktur von Sesquioxyden und Verbindungen ABO_3. Von William Houlder Zachariasen. Pp. 165. (Oslo: Jacob Dybwad.) 12.00 kr.

Japanese Journal of Chemistry: Transactions and Abstracts. Vol. 2, No. 4. Pp. 109-148. Vol. 3, No. 1. Pp. 70. Vol. 3, No. 2. Pp. 71-108. Vol. 3, No. 3. Pp. 109-163. (Tokyo: National Research Council of Japan.)

Department of the Interior: Bureau of Education. Bulletin, 1928, No. 9: Schools and Classes for the Blind, 1926–27. Pp. 7. 5 cents. Bulletin, 1928, No. 10: Industrial Schools for Delinquents, 1926–1927. Pp. 22. 5 cents. (Washington, D.C.: Government Printing Office.)

Conseil International de Recherches, Union Géodésique et Géophysique Internationale: Section Internationale d'Hydrologie scientifique. Bulletin N. 10: Études poursuivies dans les différents pays sur les débits solides des cours d'eau (Égypte, France, Italie). Pp. 44. Bulletin N. 11: Rapports sur l'état de l'hydrologie, Tchécoslovaquie. Pp. 16. Bulletin N. 12: Réunion plénière de la Section (Prague, Septembre 1927). Pp. 67. (Venezia.)

Agricultural Experiment Station: Michigan State College of Agriculture and Applied Science. Special Bulletin No. 178: Michigan Raspberry Diseases. By C. W. Bennett. Pp. 52. Technical Bulletin No. 92: A Study of the Cause of Honey Fermentation. By F. W. Fabian and R. I. Quinet. Pp. 41. (East Lansing, Mich.)

Occasional Papers of the California Academy of Sciences. No. 16: The Amphibians of Western North America; an Account of the Species known to inhabit California, Alaska, British Columbia, Washington, Oregon, Idaho, Utah, Nevada, Arizona, Sonora, and Lower California. By Joseph R. Slevin. Pp. 152+23 plates. (San Francisco, Calif.) 3 dollars.

Proceedings of the Imperial Academy. Vol. 4, No. 7, July. Pp. xxv-xxvii+319-443. (Tokyo.)

Scientific Papers of the Institute of Physical and Chemical Research. No. 156: Effect of a Circular Hole on the Stress Distribution of a Beam under Uniform Bending Moment. By Zirô Tuzi. Pp. 65-89. 45 sen. No. 157: Untersuchung der Dekahydrochinolinderivate. Mitteilung 4: Über den Hofmannschen Abbau des Octohydro-α-methylindols. Von Shin-ichiro Fujise. Pp. 91-98. 20 sen. (Tôkyô: Iwanami Shoten.)

Department of the Interior: Bureau of Education. Bulletin, 1928, No. 11: Educational Surveys. By Arthur J. Klein, Walter S. Deffenbaugh, Timon Covert and Edith A. Lathrop. Pp. 67. (Washington, D.C.: Government Printing Office.) 15 cents.

CATALOGUES.

A Catalogue of Mathematical and Physical Books. (No. 163.) Pp. 63. (Cambridge: Galloway and Porter, Ltd.)

A Catalogue of Scientific Books: including a portion of the Ornithological Library of Dr. A. H. Evans. (No. 444.) Pp. 32. (Cambridge: Bowes and Bowes.)

Diary of Societies.

FRIDAY, OCTOBER 12.

DIESEL ENGINE USERS' ASSOCIATION (at 19 Cadogan Gardens, S.W.), at 5.30.—S. B. Freeman: Marine Oil Engines.

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.30.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Students' Section) (at Armstrong College, Newcastle-on-Tyne), at 7.15.—I. H. Hedley: Chairman's Address.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—F. Squirrell: The Use of Instruments in the Boiler-House.

INSTITUTE OF METALS (Sheffield Local Section) (in Non-Ferrous Section, Applied Science Department, Sheffield University), at 7.30.—R. D. Barklie: Alternating Current Electrolysis.—Dr. E. B. Sanigar: Sodium Cyanide in Silver Plating.

OIL AND COLOUR CHEMISTS' ASSOCIATION (Manchester Section) (at Milton Hall, Manchester), at 7.30.—Dr. V. G. Jolly: Pigment and Vehicle.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—C. H. Walker: Some Recent Changes in the Incidence of Ophthalmic Diseases (Presidential Address).—E. Wolff: Report on a Case of a Large Implantation Cyst of the Conjunctiva, with Illustrations and Pathological Report.

SATURDAY, OCTOBER 13.

MINING INSTITUTE OF SCOTLAND (at Heriot Watt College, Edinburgh), at 3.—D. C. Gemmell and J. Heron: Some Impressions of German Mining.—Discussion on following Papers:—J. A. B. Horsley: Design and Maintenance of Flame-Proof Enclosures, with Special Reference to Coal Face Machinery.—W. Maurice: More about Better Mine Lighting.—J. M. Williamson and J. Bilsland: An Experience of Machine Mining in a Highly Inclined Seam.—G. W. Smith: A Trial Bore for Oil in South Africa, and the Results.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Northumberland and Durham Branch) (at Armstrong College, Newcastle-upon-Tyne), at 3.—Dr. H. Louis: Protection against Damage by Subsidence.

PHYSIOLOGICAL SOCIETY (in Physiology Department, Guy's Hospital Medical School), at 4.—G. P. Crowden: The Recovery-Production of Adrenalin.—H. I. Maister, W. H. Ogilvie, and Dr. M. S. Pembrey: Excretions of the two Kidneys under Different Conditions.—Dr. M. S. Pembrey: Weights of Hearts of Fœtal and Newly Born Animals.—A. St. George Huggett: The Placental Glycogen.—C. M. Burns: The Influence of Guanidine Salts on the Growth and Composition of Bone.—Dr. E. D. Adrian and D. W. Bronk: Apparatus for Demonstrating Nerve and Muscle Action Currents.—Demonstrations:—R. A. Collier: A Simple Photographic Attachment to an Ordinary Drum.—Prof. R. J. S. McDowall: (*a*) A New Volume Recorder; (*b*) A Simple Apparatus for Micro-adjustment in all Directions.—Dr. E. D. Adrian and D. W. Bronk: Impulses in Single Motor Nerve Fibres or in Small Groups of Muscle Fibres.—K. E. Harris, T. Lewis, and J. Vaughan: Urticaria produced by Cold.—B. T. Squeies: The Ultra-Violet Fluorescence of Urine.—E. P. Poulton, W. R. Spurrell, and E. C. Warner: A Convenient Form of Apparatus for Measuring the Respiratory Exchanges of Carbon Dioxide and Oxygen over Short or Long Periods.—H. D. Kay: Class Experiments on Enzymic Synthesis.

MONDAY, OCTOBER 15.

SOCIETY FOR THE PRESERVATION OF THE FAUNA OF THE EMPIRE (at Zoological Society of London) (General Meeting), at 4.—Exhibition by Mrs. C. Akeley of a film dealing with Gorilla Life.

BRITISH PSYCHOLOGICAL SOCIETY (Education Section) (at London Day Training College), at 5.45.—Miss E. Wheeler: Backwardness in Arithmetic.

ELECTRICAL ASSOCIATION FOR WOMEN (at E.L.M.A. Lighting Service Bureau, 15 Savoy Street), at 7.—W. J. Jones: Electric Light in Factories as it affects Production and Hygiene.

BRADFORD ENGINEERING SOCIETY (at Bradford Technical College), at 7.30.—R. A. Thwaites: Electricity Supply in Rural Areas.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Branch—London and District) (at Borough Polytechnic), at 7.30.—Debate on Steam *v.* Hot Water Heating.

HUNTERIAN SOCIETY OF LONDON, at 7.30.—Dr. A. Westerman: Gleanings from the Minutes (1907-1928) (Presidential Address).

INSTITUTE OF METALS (Sheffield Local Section) (conjoint meeting in Non-Ferrous Section, Applied Science Department, Sheffield University), at 7.30.—C. Johns: Influence of Pressure on Rocks and Metals (Sorby Lecture).

TUESDAY, OCTOBER 16.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Associate Members and Graduates Branch—Manchester and District) (at Milton Hall, Manchester), at 7.—A. Hindley: Pipe Sizing for Hot Water Supply Installations.

ROYAL AERONAUTICAL SOCIETY (Leeds Branch) (at Leeds).—Prof. S. Brodetsky: The Aerodynamics of Wing Sections.

WEDNESDAY, OCTOBER 17.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (at Science Museum, South Kensington), at 5.30.—W. H. Deakin: Early Days of Railway Signalling.

ROYAL MICROSCOPICAL SOCIETY, at 7.30.—J. E. Barnard and F. V. Welch: An Electrically Heated Warm Stage with Compressor for Use with High Power Objectives.—Prof. E. Ghosh: Two New Ciliates from Sewer Water.

C.B.C. SOCIETY FOR CONSTRUCTIVE BIRTH CONTROL AND RACIAL PROGRESS (at Essex Hall, Strand), at 8.—Dr. M. Beddow Bayly: Voronoff and his Rejuvenation Experiments.

THURSDAY, OCTOBER 18.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 6.30.—H. Sutton: Light Alloys and their Use in Aircraft.

INSTITUTE OF METALS (Birmingham Local Section) (in Engineers' Club, Birmingham), at 7.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—Exhibition by Lantern of Colour Slides.

CHEMICAL SOCIETY, at 8.—Prof. T. M. Lowry, H. Moureu, and C. A. H. MacConkey: Studies of Dynamic Isomerism. Part XXVIII. Absorption Spectra of the Ketonic and Enolic Forms of an α-diketone.—W. A. Kirkby and Prof. R. V. Wheeler: Explosions in Closed Cylinders. Part I. Methane-air Explosions in a Long Cylinder. Part II. The Effect of Length of the Cylinder.—O. C. de C. Ellis and Prof. R. V. Wheeler: Explosions in Closed Cylinders. Part III. The Manner of Movement of Flame.—B. Flürscheim and E. L. Holmes: Pentanitroaniline.

BRITISH INSTITUTE OF RADIOLOGY, at 8.30.—Dr. L. A. Rowden: The Future of Medical Radiologists.—W. V. Mayneord: A Slide Rule for Radio Dosage Calculation.

INSTITUTION OF MINING AND METALLURGY (at Geological Society).

FRIDAY, OCTOBER 19.

MEDICAL OFFICERS OF SCHOOLS ASSOCIATION (at 11 Chandos Street, W.1), at 5.—Surg. Comdr. S. F. Dudley: Microbic Dissemination in Schools.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Demonstration of Problems in Human Anatomy which arise out of the Identification of a Skull attributed to Lord Darnley—Illustrated by Specimens.

SOCIETY OF CHEMICAL INDUSTRY (Liverpool Section) (in Muspratt Lecture Theatre, Liverpool University), at 6.—B. D. W. Luff: The Rubber Industry.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—R. W. Allen: Presidential Address.

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

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—R. H. Sharp: Technical Advertising.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Newcastle-upon-Tyne).

SOCIETY OF DYERS AND COLOURISTS (Manchester Section) (at Manchester).—G. E. Holden: The Application of Paints to Textiles (Chairman's Address).

PUBLIC LECTURES.

SATURDAY, OCTOBER 13.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Prof. J. R. Ainsworth Davis: The Animal Conquest of the Sea.

TUESDAY, OCTOBER 16.

GRESHAM COLLEGE (Basinghall Street), at 6.—A. R. Hinks: A Study of the Solar System. (Succeeding Lectures on Oct. 17, 18, and 19.)

WEDNESDAY, OCTOBER 17.

ROYAL INSTITUTE OF PUBLIC HEALTH, at 4.—Dr. E. Graham Little: The Health of the Medical Practitioner.

KING'S COLLEGE, at 5.30.—Sir Oliver Lodge: The Indebtedness of Industry to Pure Science: Introduction.

THURSDAY, OCTOBER 18.

UNIVERSITY COLLEGE, at 4.—Dr. D. H. Scott: Aspects of Fossil Botany. (Succeeding Lectures on Oct. 25, Nov. 1 and 8.)

SATURDAY, OCTOBER 20.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Sculpture in Ancient Egypt.

CONGRESSES.

OCTOBER 12-15.

ITALIAN CONGRESS OF INTERNAL MEDICINE (at Rome).—Prof. F. Schupfer, L. Dominici, and M. Gortan: Tumours of the Spinal Cord.—Prof. V. Gabbi: Undulant Fever and Bang's Bacillus.—Prof. L. Ferranini and M. Ghiron: Diuresis and Diuretics.—Major G. D. D'Ambrosio: Functional Cardiac Disorders in Relation to Military Service.

OCTOBER 19.

HOUSING AND HEALTH (at Town Hall, Windsor), at 8.—Dr. W. Butler: The New House.—Miss Joan Sunderland: The Old House.