SATURDAY, JUNE 4, 1932

CONTENTS

Editorial and Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET, LONDON, W.C.2

No. 3266, VOL. 129]

Chemical Warfare and Disarmament

ADDRESSING the House of Commons on May 13 on disarmament, Sir John Simon, Secretary for Foreign Affairs, said that everyone would agree it was desirable to enter into an agreement, and make effective its observance, against the use of poison gas in warfare. It was an example of 'qualitative' disarmament, contrasted with 'quantitative' disarmament, aiming at a limitation of the number and size of ships and the calibre of guns. Sir John Simon's declaration was received with cheers, and his argument was reinforced in the debate by Mr. Winston Churchill, who laid stress on the indiscriminate character of gas warfare, entailing death and wounds not merely to combatants but also to the civil population, men, women, and children, far removed from the area of hostilities. He pointed out that the acceptance among the leading authorities of different countries of the bombing of open towns would introduce a new idea into warfare, "an idea not compatible with any civilised decency". Are we to allow ourselves to be led, step by step, into contemplating such hideous episodes as part of the ordinary give and take of war?

The question is one with which our chemists—and by the same token our physicists and bacteriologists—who create in their laboratories the raw material, *fabrilia fabris*, for scientific warfare, are directly concerned, a question which has caused searchings of hearts and consciences, not resolved by ordinary appeals to patriotism. Dr. Delisle Burns's letter published this week in our correspondence columns affords evidence of these misgivings. But it is safe to say that men of science as a whole would not approve of any limitation of the scope and character of scientific research into poisons or any other branch of science which may find application in warfare. No Pope of Geneva must be allowed to compile an *index expurgatorius* for men of science. "Why, sir," said Dr. Johnson, "that knowledge may, in some cases, produce unhappiness, I allow. But, upon the whole, knowledge, *per se*, is certainly an object which every man would wish to attain. . . ." Moreover, as Major Lefebure points out in "The Riddle of the Rhine", if every chemist in the world became a pronounced pacifist, new chemical warfare substances would undoubtedly arise as a normal outcome of research.

It is well to know, however, that the question of disarmament is being studied in all its aspects, officially and unofficially. The report of the Inter-Parliamentary Union on "What will be the Character of a New War?" (P. S. King and Son) includes

a section on chemical and bacteriological warfare, by Dr. Gertrud Woker, of Switzerland, setting out the general preparations for war, expert views on the effects of chemical warfare, the medical effects of poison gas, and protection of the civilian population. Reference is made to the Report of the American Government on the proposals of the Mixed Committee of the Preparatory Disarmament Commission, in which the view is expressed that the absolute prohibition of training men in the use of chemical weapons in the widest sense would put an end to chemical and medical studies and research, so that such a measure could not possibly be put into practice. In 1924–25, the United States budgeted for an expenditure of 8,700,000 dollars on chemical defence measures. The great chemical industries, that country asserts, are bound together by their common capital and collaborate to supply each State, under the auspices of the military authorities, with the materials for national defence should the need arise.

Retaliation over enemy territory appears at present to be the only effective defence against chemical warfare in its application to cities. Arming the whole civilian population with masks is, according to one expert, "unthinkable". The provision of ventilated underground refuges is also impracticable. Air manœuvres over London have proved incontrovertibly, we are told, that in the case of serious attack, a great part of London would be destroyed. Of 250 aeroplanes taking part in a night attack, only sixteen were discovered by searchlights. Prof. Langevin has come to much the same conclusion in regard to Paris. He estimates that 100 aeroplanes, each carrying a ton of gas, could in an hour cover Paris with a gas cloud 20 metres thick; and if there were no wind, Paris would be annihilated. Prof. Noel Baker in his book "Disarmament" (1926) says that the "Berlin bombs" prepared for use in the 1919 campaign would have killed every person in the open within 600 to 800 metres of the spot where the bombs exploded.

Progress is continually being made not only in the potency of chemical poisons but also in the art of mixing poisons to produce desired effects. Chlorine, the first gas used, is now superseded because its action is too sudden and its presence in the atmosphere too obvious. Mustard gas, used in the production of indigo, still retains its evil pre-eminence, for no method of counteracting some of its effects has been discovered. Dr. Gertrud Woker concludes her report with a statement that, as things stand at present, war mania would aim only at the complete and unscrupulous destruction of the enemy. "How long", she asks, "is the flower of each nation, and even every nation as a whole, to be sacrificed to this Moloch?"

Is the picture as black as painted? Is the gloom as unrelieved as even Sir John Simon—for whose *aequanimitas* in these difficult times the nation has every reason to be grateful—would have us believe? For an answer we may turn to an article by James E. Mills on chemical warfare in the April issue of *Foreign Affairs*, a quarterly review published by the American Council for Foreign Relations. In reality, he says, the propaganda against it notwithstanding, gas is the most humane weapon existing to-day in actual warfare. He proves by statistics that the proportion of deaths resulting from gas is far below the general proportion, as 2 per cent to 24 per cent in the case of American casualties. Gas does not mutilate, and it seldom causes extreme pain, those gases which poison without pain being preferred. Its use can be controlled; for example, tear gas will disperse a mob without fatalities unavoidable by the use of machine guns. It is a relatively cheap weapon, and thus makes for equality between large and small nations. "It is possible to assert", he claims, "that the new and powerful weapons of war made possible by science may be a gain to the world." Gas warfare is particularly powerful as a defensive weapon, for reasons which will be obvious. He thinks the dangers of attacks on cities are overestimated. *Omne ignotum pro magnifico!*

Research on new poisonous compounds cannot be limited, for they play a necessary part in the development of insecticides, fungicides, germicides, disinfectants, preservatives, fumigants, and drugs. It has been estimated that the destruction caused by insect and animal pests in the United States reaches the astonishing total of more than two billion dollars a year. The bubonic plague in India alone cost 8,000,000 lives in the first ten years of this century. As becomes a writer who is able to discuss a question in a scientific spirit, Mr. Mills concludes his article with a constructive suggestion. Whether a nation at war under present conditions would drench with poison gas the great cities of an enemy country, with the full knowledge that retaliation would follow, may be left an open question. No objection should be taken, he suggests, to the use of tear gas in war, owing to its non-fatal character. So far as protection can be afforded by treaty, he thinks that the use of poison gas should be allowed only in a nation's own territory as a means of defence. In this way, civilian

populations would be protected, if treaties were observed.

Disarmament must be studied scientifically—coldly and dispassionately, without "laziness, haziness, craziness", *surtout* without any trace of hysteria. Dr. Cyril Norwood, headmaster of Harrow, in his presidential address last January to the Science Masters' Association, appealed to "scientists" to create a community "which will put spell-binders and slogan-manufacturers of modern politics and journalism out of commission". We are gratified that our own scientific men, with knowledge and experience, have made contributions to the discussion of disarmament satisfying these criteria. Particularly we would cite Major Victor Lefebure's "Scientific Disarmament: a Treatise on the Facts of Armament", reviewed in NATURE of April 4, 1931. Our reviewer sounded a note which finds an echo in the present article. "Our failure to grapple with the facts of disarmament", he wrote, "still allows politicians . . . to find an easy refuge in moral and economic platitudes." Disarmament, as Major Lefebure insists, is a technical matter, requiring close and continuous study by scientific methods, especially to secure the extension of the 'conversion lag' between the issue of war and the exploitation of the vast resources placed at the disposal of the combatants by science and industry. Science has discovered the poison: it will discover the antidote.

Let us continue our journey, holding the dim taper put into our hands, singing songs of comfort as we go along. May it light us to a world where there shall be no more war between nations—and between people living in the same street! Spell-binders, slogan-manufacturers, schoolmen, babbling sophists merely inspissate the gloom.

W. H. Dines's Scientific Papers

Collected Scientific Papers of William Henry Dines, B.A., F.R.S. Pp. x + 461. (London: Royal Meteorological Society, 1931.) 15*s*. net.

THE Royal Meteorological Society is to be congratulated on its decision to reprint the scientific papers of Mr. W. H. Dines as a memorial to that eminent meteorologist. The book, which has now appeared, fulfils its purpose admirably and is a credit to the Society as well as an honour to one of its most distinguished fellows. England owes a great deal to its band of amateur men of science, and meteorology probably owes more to the amateur than any other of the major branches of science. Mr. W. H. Dines was an amateur in the best sense of the word. He took up meteorology because it made its own appeal to him, no doubt influenced to some extent by the meteorological work of his distinguished father, Mr. George Dines. This compilation of his papers brings home to the reader what a large part Dines played in the development of scientific meteorology in Great Britain; but it also helps those of us who knew the man and read each one of his papers as it appeared to see his work as a whole, and to judge how much of it will be of permanent value and how much of it was laying the foundations on which others have built. It is probably in the last respect that Dines made his greatest contribution to science. Throughout his scientific life Dines was a pioneer; he had the instincts of a pioneer, and the methods of a pioneer. His tools were always of the crudest, without any refinement and without any unnecessary accuracy, but capable of doing the job for which they were designed.

Dines's method of measuring wind pressure by the use of a rotating arm driven by an old second-hand steam engine in the open air will appear crude in the extreme to the worker in a modern aerodynamic laboratory with its wind tunnels and delicate balances; but his method of eliminating the velocity by balancing the wind pressure on the plate against the centrifugal force, both of which depend on the square of the velocity, was a stroke of genius. With this crude apparatus Dines provided data of the wind pressure on plates of different sizes and shapes which were used by engineers and meteorologists until the advent of aviation raised aerodynamics to a separate science. The nine papers on anemometry which form the main part of Section I. of the book are valuable records of the first steps in this new science, although they had all been written before aviation had appeared on the scene as a practical proposition. Most of them, naturally, have now only a historical interest, but it would be well if the younger workers in our aerodynamic laboratories would read them to see what can be done without elaborate instruments.

Towards the end of the nineteenth century meteorologists on the Continent and in America had commenced to investigate the upper atmosphere by means of balloons and kites, but no work was being done in the British Isles. This was largely due to the want of money, for the instruments were expensive and many were lost. This was an unknown country which had a great attraction for Dines's pioneering spirit. He took up kite-flying with great energy. The kites used on the Continent were expensive, fragile structures, so he devised his own kites, which were inexpensive

and by comparison unbreakable—in any case, it cost little to repair them. He built a winding gear which was a marvel of ingenuity: but which caused engineers to smile. He bought another steam engine (Dines loved a steam engine, especially the one which sometimes drove his motor-car) to drive the winding gear; and above all, he designed a meteorograph recording pressure, temperature, humidity, and wind which cost less than a tenth of the instruments used in Germany and America. Later on, when the discovery of the stratosphere shifted interest from the lower to the upper atmosphere, he abandoned kites for balloons. Here again he developed an instrument of which the chief characteristic was cheapness combined with sufficient accuracy.

With these simple and inexpensive instruments Dines carried out the work which forms Section II. of the collected papers. The early experiments and instruments are fully described, and a series of papers gives the results obtained, first with kites and then with balloons. Finally, the whole work is summed up in a paper entitled "The Characteristics of the Free Atmosphere", published in 1919, which is still the chief source of our information about the upper atmosphere over the British Isles.

In 1922, Mr. Dines passed on his work on the upper atmosphere to his son, L. H. G. Dines, who is still in charge of this work at Kew Observatory. But Dines could not give up his interest in meteorology; it was only transferred, and this time to another branch which was sadly in need of a pioneer. A great deal of work had been done for a number of years by many eminent men on the part played by radiation in the distribution of heat in the atmosphere; but it cannot be said that they had got very far. It is a difficult subject and one requiring a whole army of pioneers to blaze a way through a very forest of physical difficulties. The third section of the book is devoted to papers describing his work on radiation, which commenced in 1917 and continued to the time of his death. The characteristics of this section are similar to those of the two already described: the approach to a difficult and almost unexplored subject, the design of instruments, the record of careful observation, and a valuable discussion of the results obtained. This work is also being continued at Kew Observatory.

The final section of the book deals with a number of miscellaneous papers, the chief of which is, probably, an address delivered before the Sanitary Institute so long ago as 1895, which received much public attention at the time because of his insistence on the necessity for a low temperature and fresh air if health is to be preserved.

In order to save expense, a method of reproduction of the original papers has been adopted which is somewhat unusual in Great Britain; to quote from Sir Richard Gregory's preface, "To have set up the papers again in a uniform type would have involved the Council in greater expense than was contemplated when the project of publishing the volume was conceived. It was decided, therefore, to adopt the less costly method of lithophotography or 'offset' printing for the work. By this process the original pages are photographed, and the plates thus made are used for printing, with necessary adjustments of portions of pages, and with new or supplementary matter set up in type in the usual manner." I think there will be general agreement that the experiment has been entirely successful. The printing is obviously not quite so sharp as in the originals; but the majority of readers would not notice this unless their attention were directed to it. Personally I welcome this reproduction of the papers in their original form, for many of them made a strong appeal to me when they were first published and it is pleasant to come across the old diagrams and the old familiar type. The pleasure in reading again these old friends would have been much less if they had been re-dressed, even if in better clothes.

G. C. SIMPSON.

Scottish Medical History

History of Scottish Medicine. By Dr. John D. Comrie. Published for the Wellcome Historical Medical Museum. Second edition. Vol. 1. Pp. 400. Vol. 2. Pp. 401-852. (London: Baillière, Tindall and Cox, 1932.) 50*s.* net.

IF the history of medicine in other countries is so full of human interest as Scottish medical history is shown to be in this work, we can understand its fascination. The appeal is not merely medical but also covers the whole range of the allied sciences. Moreover, a nation's medical history is so intimately associated with that of its people and its progress, that laymen, as well as physicians and men of science, will find instruction and enjoyment in these volumes of Scottish medical history.

Dr. Comrie, the author, has been for the past twenty-four years lecturer on the history of medicine in the University of Edinburgh. The book shows him to possess highly specialised knowledge of his subject, combined with the ability to clothe his facts in a fascinating literary garb. He is obviously convinced that illustrations are an

essential adjunct to the appreciation of historical records, serving, as they do, not only to gratify the eye but also to make the retention of facts easier and perusal of the work more pleasurable. His illustrations are lavish ; they are obviously also authentic and apt. A special word of praise may be accorded to their quality and clearness of reproduction. This part of the work, as well as the writing, has obviously been done by a master hand. We refer particularly to this point because it happens, more often than not, that well-written works of this kind are spoiled, or lowered in value, by poor and inadequate illustrations.

The fact that the work is published for the Wellcome Historical Medical Museum indicates that exceptional resources have been available to the author in addition to those he himself could command. Further, it is obvious that the initiation and personality of Sir Henry S. Wellcome, who contributes an interesting foreword, have been moving forces in the production of these two handsome volumes which contain, not merely a clear, concise, and complete historical review of Scottish medicine, but also establish themselves as the standard work on this subject.

The period covered is a very wide one. It goes back to the stone and bronze ages, during which we learn, from photographs of remains discovered in Scotland, that trephining and other complicated operations were carried out at that remote time by means of crude flint and metal instruments.

Early monastic and medieval medicine, with its interesting admixtures of folklore, herbalism, and superstition, affords much interesting reading and the opportunity of reproducing curious Gaelic medical manuscripts, in colour and otherwise. The translations of these early medical writings diplay their quaintness. For example, we read :

"*Margarita, i.e.* a pearl. This stone is cold, dry, and is found in a shell. And it grows in this way : When the shell opens it takes in its fill of poisonous dew, closes around it, and turns it into stone. The pearl that has a natural hollow in it is best, if also white. It is comforting in heart affections, and is put in electuaries. And if you wish to make the pearl white, give it to a pet pigeon to eat, and let it be left in its crop (stomach) for three or four hours. Then cut up the bird and remove the stone, and it will be pure, clear, brilliant thereafter."

In the fifteenth and early sixteenth centuries public health regulations for the prevention of infectious disease were instituted, and it is recorded as a result that plague was stamped out of Scotland in 1648.

Reference is made to the interest taken by James IV. of Scotland in alchemy, in the pursuit of which he was assisted by a physician named John Damian. This leads to a description of the transition from alchemists to chemists.

So the story proceeds, for the maintained interest justifies the use of the word 'story' for this fascinating history. We read of the origins of the Scottish Colleges of Physicians and Surgeons, and of the universities and medical schools which established the reputation of Edinburgh, Glasgow, and other Scottish cities throughout the world. We read about the foibles of the early professors, which are illustrated by anecdotes and contemporary caricatures, and finally we have placed before us, in picture and story, a panorama of Scottish pioneers in medicine and the allied sciences.

The " History of Scottish Medicine " will interest everyone who loves history or science : to the student it will be doubly attractive, because its charm of style is supplemented by a business-like method which provides very full references to all sources of information, and an index which is an example of what this part of a work of reference should be.

A Mycological Classic

Selecta Fungorum Carpologia of the Brothers L. R. and C. Tulasne. Translated into English by W. B. Grove. Edited by Prof. A. H. Reginald Buller and Dr. C. L. Shear. Vol. 1. Pp. xxx + xxv + 247 + 5 plates. Vol. 2. Pp. xxiii + 302 + 34 plates. Vol. 3. Pp. xviii + 206 + 22 plates. (Oxford : Clarendon Press ; London : Oxford University Press, 1931.) 126*s.* net.

THE foundations of knowledge of the fungi as living plants were securely laid in the sixth decade of the last century by the work of Anton de Bary and the two Tulasne brothers. That of de Bary has had the widest influence, aided materially by the English translation, the " Comparative Morphology and Biology of the Fungi, Mycetozoa and Bacteria ", which has been the standard textbook of English-speaking mycologists for more than forty years. The great folio volumes in Latin of the Tulasnes have been, no doubt, dipped into by many an eager young mycologist, and their magnificent plates were widely used, but the Latin is not easy and few can have had the courage to attempt systematic reading of it.

At last, after seventy years, the three folios of the *magnum opus* of the brothers, the " Selecta Fungorum Carpologia ", have been translated into

English in a form and style which challenge comparison with the originals, and are a worthy monument to English learning and English printing. The production of these sumptuous volumes was made possible by the financial support of some half-dozen American and British patrons of science, and in Mr. W. B. Grove a translator was found who combines in an unusual degree Latin scholarship with mycological knowledge. The Oxford University Press has rivalled the original production of the Imperial Press at Paris and faithfully reproduced the work in the almost lost grand manner of typography and in the technically excellent collotype copies of the famous engraved plates. The editors, Prof. A. H. R. Buller of the University of Manitoba and Dr. C. L. Shear of Washington, may well feel satisfied with the result.

Louis René, the skilled microscopist and deeply learned student of fungi, and Charles, the superb draughtsman and scarcely less ardent mycologist, worked, as they lived, in closest harmony. When the first volume of the "Carpologia" was published in 1861, spontaneous generation was still an open question, the fungi being, of all plants, those that were held by some of the famous men of science to illustrate best the origin of organisms from the disordered juices or putrefying elements of the matrix in which they appeared. It was the aim of the brothers to show that every fungus arose from a pre-existing one, reproduced by seed-like spores, however much polymorphism might make it difficult to follow the process. They were the first to study development and to trace through different stages the gradual course of evolution that is characteristic of many fungi. This volume may be considered to have established finally the claims of the fungi to be regarded as separate living plants, propagating their like. It is enriched by a wealth of notes, covering almost the whole range of the fungi and bearing witness to the extensive knowledge of these organisms possessed by the authors.

In the closing pages of the first volume and in the two following ones, more than 200 species of Ascomycetes are described, nearly 150 of these being figured, including all those that were regarded as new to science. Most of the descriptions are based on close field collecting and repeated observation of the association or succession in Nature of the different forms that were linked into the one life-history, supplemented by the excellent microscopic preparations of one brother and the artistic ability in depicting them of the other. Methods of growing the fungi in artificial culture were not then available and the complicated succession of spore forms was perforce followed mainly in the field. It is natural that some of the life-histories have not stood the test of accurate proof afforded by pure culture work, and it is perhaps a reproach to mycology that others must still be classed as not proven. But it is astonishing how many were rightly interpreted and how little escaped these indefatigable workers. The discussion on spermatia and the obvious disappointment of the authors that they were unable to assign to them with certainty the sexual functions that they believed them to possess, is interesting reading after seventy years, when these functions have but recently been established in the rusts and are still only suspected in other fungi.

The "Carpologia" may well be regarded as, in the words of its translator, "one of the supreme triumphs of science. . . . Observers as minute and accurate, artists as dexterous, engravers as wonderful, printing as superb, have indeed existed—but nowhere else can they be found in such a perfect combination." This is high praise, but who shall say that it is not justified?

Photographic Methods

(1) *Photography: its Principles and Practice.* By C. B. Neblette. Second edition. Pp. xxii + 615. (London: Chapman and Hall, Ltd., 1931.) 30*s.* net.

(2) *Wissenschaftliche Photographie: eine Einführung in Theorie und Praxis.* Von Prof. Dr. E. v. Angerer. Pp. viii + 185. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1931.) 12·80 gold marks.

(3) *The Technique of Colour Photography.* By Frank R. Newens. (Blackie's "Technique" Series.) Pp. x + 101 + 6 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1931.) 4*s.* 6*d.* net.

(4) *Photographic Amusements: including Tricks and Unusual or Novel Effects obtainable with the Camera.* By Frank R. Fraprie and Walter E. Woodbury. Tenth edition revised and enlarged. Pp. viii + 271. (London: Chapman and Hall, Ltd., 1931.) 15*s.* net.

(5) *The Amateur Cinematographer's Handbook on Movie Making.* By Robert Dykes. Pp. 109 + xix. (London: British Periodicals, Ltd., n.d.) Paper, 2*s.*; cloth, 3*s.* 6*d.*

IT is a regrettable fact that good textbooks of photography are rare. The first two of the five books in the group under review are, therefore, specially welcome.

(1) Mr. Neblette has been a teacher of photography for some years. His book is already well known and is considered to be one of the best elementary textbooks of photography available in English. It sets out and explains in a straightforward way the principal photographic processes and apparatus. It is therefore invaluable as a reference book. The book also contains a considerable amount of theoretical discussion. The chapters on sensitometry and the theory of development contain an account of the contributions made by Hurter and Driffield to our knowledge of the behaviour of photographic materials. Attention is directed in this new edition to the unsuitability of the Hurter and Driffield (H. and D.) method of computing 'speeds', and the reader is referred to various recent papers in which the difficult problem of the interpretation of sensitometric data is discussed more fully. This method is employed throughout the book: the main principles are stated, as a rule, fairly clearly, and an inquiring student is then referred to a list of more detailed books and papers on special points. Indeed, the book is very well documented; each chapter has a list of related general works, and in the appendix there is a forty-page bibliography of most of the important scientific papers on photographic subjects. In addition, there is a good author and subject index.

Some of the theoretical discussions do not, however, reach a very high level. The chapter on photographic emulsions is confusing. The discussion of the chemical mechanism of development is marred by a few paragraphs which are incomprehensible. We are told, for example, that "The ionised hydrochinon loses two anions which unite with and neutralise the two silver cations forming metallic silver, the two oxygen ions combine to form quinone and the bromine anion unites with the sodium cation to form sodium bromide" (p. 256).

(2) Prof. von Angerer gives us also an excellent introductory textbook of photographic science. It is not really an elementary textbook; the net has been cast far wider than for Mr. Neblette's book, and in a small space a vast collection of facts about photographic materials and apparatus is brought together and discussed in a way which is admirable. The use of photographic methods as aids to research, for example, in spectroscopy, receives considerable attention. In a very considerable degree these two books are complementary.

The remaining three books deal in a practical way with their special branches of photography. (3) That of Mr. Newens is a very clear and pleasantly written account of colour photography as it may be practised by the amateur. The various methods are thoroughly explained by coloured diagrams, and the working instructions are plainly set out. No attempt is made to explain, in anything but the barest qualitative way, the theory of colour photography.

(4) Mr. Fraprie has brought up to date an old book. "Photographic Amusements" has now reached its tenth edition: it was first published in 1896. As its name implies, it describes a variety of photographic tricks. Some of these are, of course, trivial enough, just suitable to amuse a child; but many useful workshop methods are described. Notable among the latter is the process known as 'player type', by which full-size copies of drawings may be made without distortion. Of the newer amusements included in this edition is that of trick cinematography, a field of surpassing opportunity. The book affords ample evidence that photographs are not always truthful.

(5) Mr. Dykes has chosen a rather misleading name for his book. Anyone who imagines that the "Amateur Cinematographer's Handbook" is a handbook of the conventional type, with neatly tabulated, easily found information, will be disappointed. It is merely a somewhat rambling, though quite interesting talk about amateur 'movie' making. There is little attempt at arrangement, and the descriptions of apparatus are not very clear. S. O. R.

Short Reviews

The Fauna of British India, including Ceylon dan Burma. (Published under the Authority of the Secretary of State for India in Council.) Edited by Lieut.-Col. J. Stephenson. *Cestoda.* Vol. 2. By Dr. T. Southwell. Pp. ix + 262. (London: Taylor and Francis, 1930.) 15*s*.

IN this volume, Dr. Southwell gives a systematic account of the super-family Tænioidea (or Cyclophyllidea), which comprises a dozen families, including several of great importance, as they contain parasites of man and of domestic animals. The author regards as untenable the subdivision of the genus *Tænia*, as suggested by Hall, into three genera —*Tænia*, *Multiceps*, and *Echinococcus*, based chiefly on larval characters—pointing out that when a diagnosis is required of a worm passed, for example, by a dog, no information is available whether the larval form is a cysticercus or a cœnurus. He holds that the identification should be possible on the morphological characters of the adult worm. The genus *Tænia* is accepted in its widest sense, and, owing to the impossibility of devising a satisfactory key, a table showing the principal characters of the known species is given.

The cœnurus of *T. multiceps* is well known to

occur in the brain of sheep, and the cœnurus of *T. serialis* in the subcutaneous tissues of the rabbit. Dr. Southwell directs attention to the discovery by Gaiger (1907) of a cœnurus in the connective tissue of the goat, which was held to be that of *T. serialis* (later named by Hall *T. gaigeri*), and the finding by Dey (1909) of the same stage in the connective tissue and also in the brain of the goat in India. He regards the species *multiceps*, and these others, *serialis* and *gaigeri*, as very closely related, and possibly identical, and suggests that the goat provides conditions in both brain and connective tissue for the development of the larval form, whereas in the sheep and in the rabbit the larval form develops respectively in only one of the sites.

For most of the species, Dr. Southwell not only states the principal structural characters but also notes the mode of infection of the host and the site of the larval form in the intermediate host. A classified list of Cestodes from India, with their hosts, a classified list of the hosts with their Cestodes, and an adequate systematic index conclude this useful volume. The illustrations, with the exception of the photograph on p. 27, are clear and adequately lettered.

Fourth Congress of the Universities of the Empire, 1931. Report of Proceedings. Published for the Universities Bureau of the British Empire. Pp. vii + 260. (London: G. Bell and Sons, Ltd., 1931.) 21*s.* net.

IN this volume a number of current university problems are clearly set out and competently discussed with a wealth of illustration and argument from many widely differing points of view. Organised as it was, in the light of experience gained in previous similar congresses, ample opportunities for informal interchanges of views and experiences being provided at London and elsewhere during the week preceding the scheduled meetings which took place at Edinburgh on July 7–10, the fourth quinquennial gathering of representatives of seats of learning in all parts of the Empire was an ideal forum for the discussion of such matters.

The first subject of discussion was the university graduate in commerce and industry. This was introduced by Sir Robert Waley Cohen, of Cambridge, who justified its prominent place in the agenda by reference to the world-wide economic revolution now in progress, necessitating the relaying of the very foundations of commerce and industry, and the consequent need, in this field, of men of high character and trained intellect. In subsequent sessions the Congress dealt with the conditions of admission to universities, facilities for overseas students in British universities, general honours degrees, the Ph.D. and other post-graduate degrees, and post-graduate study in medicine and surgery.

The inaugural addresses, with which each day's proceedings opened, ranged over a wider field, and of one (Lord Meston's "A Layman looks at the University") the chairman observed that the author had put his finger on all the major problems which those responsible for the conduct of university teaching have felt to be pressing upon them in the last few years. Although, naturally, 'laymen' took but a small part in the proceedings, the record as a whole is eminently readable and there are few pages that have no appeal outside university circles.

Úvod do Radioaktivity. Napsali Dr. F. Běhounek a Prof. Dr. J. Heyrovský. Pp. 116. (Praha: Jednoty Čs. Matematiků a Fysiků, 1931.) 24 Kč.

IT was in pitchblende from the mines of Jáchymov (St. Joachimsthal) in Bohemia that Prof. and Mme. Curie first discovered radium. The ores from these mines now yield radium preparations representing two to four grams of the pure element annually. In spite of the interest in the subject, the present volume is the first book by Czech men of science on radioactivity. It deals with the discovery and phenomena of radioactivity, the preparation of radium products and their physiological action, geophysics, cosmic radioactivity, and the technique followed at the Czech mines and extraction plant and at the Prague Radiological Institute.

Prof. Běhounek accompanied General Nobile's expeditions to the north pole in 1926 and 1928, and his experiments on radioactivity of the atmosphere in the arctic and at high altitudes is embodied in the chapters on geophysics and cosmic radioactivity. Prof. Heyrovský is best known for his polarographic researches with the dropping mercury cathode, and this method has found application in the examination of radium-barium salt mixtures.

The authors have introduced several unusual features in their treatment of the subject. Thus, stress is laid upon the experimental aspect of radioactivity and theoretical considerations are dismissed very briefly. The general reader will be particularly interested in the account and photographs of the methods of extracting radium from the large quantities of ores needed, and in the procedure in studying the use of this element in medical treatment.

J. G. F. D.

The Annual Register: a Review of Public Events at Home and Abroad for the Year 1931. Edited by Dr. M. Epstein. Pp. xv + 316 + 169. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1932.) 30*s.* net.

THE history of the world, which it is the main function of this annual volume to place on record, has gone through a troubled year, with many changes and upheavals in the old order of things, but the "Annual Register" maintains its old form and arrangement. British and Imperial history occupy, in a most readable narrative, about one-third of the book. Then comes the history of foreign States in about the same compass, followed by the usual chronicle of events, surveys of literature, art, drama, science, finance, and commerce, and finally the short biographies of eminent men and women in the year's obituary. The Constitution of the new Spanish Republic is given in full. The survey of the year's science occupies about eleven pages, divided between the biological and physical sciences. It is noteworthy that this work of reference has now reached its hundred and seventy-third year of issue.

The Hereditary Transmission of Acquired Characters*

By Prof. J. B. S. HALDANE, F.R.S.

"Enfin les efforts faits par le besoin pour obtenir des facultés nouvelles, se trouvant aidés du concours des circonstances favorables, créent avec le temps les organes nouveaux qui sont propres à ces facultés, et qu'ensuite un long emploi développe."

LAMARCK, *Discours d'ouverture de l'an XI.*

"Nil ideo quoniam natumst in corpore ut uti
Possemus, sed quod natumst id procreat usum."

LUCRETIUS, *De Rerum Natura*, iv. 834.

THE tendency of men, animals, and plants to resemble their parents has been known for some thousands of years, although it is only since the time of Mendel that it has been realised that this is only half, and not necessarily the most important half, of genetics. Given that principle, men naturally argued somewhat as follows: A fat pig generally has fatter children than a thin pig. If we fatten up this thin pig, his children will be fat. This is a straightforward argument, as good as most used in politics. But it is, as we shall see, fallacious. The difference between a fat and a thin pig may be due to two causes. The two pigs may be of the same breed, but have had a different diet; or they may be of different breeds, but have had the same diet. Finally, of course, both causes of difference, external and internal, may be operating. Now, those who, like Lamarck, believe in the hereditary transmission of all acquired characters, take the view that if fatness has been produced for some generations by the external cause of diet, it will later go on being produced by internal causes when the external cause is removed. There is nothing impossible in this supposition, but if we put it that way, its *a priori* probability appears less.

As the result of experimental work, some of which I shall summarise, the majority of geneticists take the view that characters acquired as the result of external influences are rarely inherited, so rarely that the exceptions are of little importance either for the explanation of evolution or the practical problems of the breeder or eugenist.

Last year Prof. E. W. MacBride restated the case for Lamarckism in a discourse under the title of "Habit, the Driving Factor of Evolution".† Prof. MacBride's contributions to the science of embryology have been most distinguished, and his apparently heretical views on the historical process of evolution, for example, concerning the descent of the vertebrates from a common stock with the echinoderms, have been confirmed by subsequent work. But just as the best of historians may not be the best judge of the politics and economics of his own day, so an eminent student of the history of evolution may conceivably be mistaken as to its causes. These must be decided on by observing the changes which actually occur in living organisms under controlled conditions.

I shall begin by giving an example of one of the rather rare cases where an acquired character is unquestionably inherited. If we cut off the growing point of a young tomato plant it produces new shoots. A few of these regenerated shoots are somewhat abnormal. The leaves are larger, and if these shoots are cut off and rooted, a new race of tomato is produced. It differs from the original stock in the following respects. The leaves are thicker, less dissected, and have more anthocyanin. The fruits are smaller but more numerous. The whole *tempo* of the plant is slower. It does not start growth so quickly, but continues for a longer time, and finally reaches a larger size.‡ What is more, not only do the abnormal plants transmit the character by vegetative propagation, but if their flowers are self-fertilised the seedlings resemble the abnormal parents. They can only be crossed with the original type with great difficulty, and the hybrids are extremely sterile.

Now, if we examine a dividing nucleus of the ordinary tomato, we find 24 chromosomes. The abnormal type has 48, or double this number. Such plants are called tetraploids, because they have four similar sets of chromosomes, instead of two as in normal tomatoes. We know that the chromosomes are responsible for most, if not all, of the heritable differences between different tomatoes. By our injury we have provoked a stable and self-perpetuating rearrangement of the physical basis of heredity. Where this is possible, acquired characters are inherited.

Induced tetraploidy has doubtless been of some importance in plant evolution, and possibly in animal evolution. But it does not produce very striking changes. Moreover, there is no suggestion that they are adaptive, that is to say, that the tetraploid plants are better off than the diploid in any way; in particular, they do not appear to resist mechanical injury any better. The importance of the Lamarckian hypothesis for evolution lies in the possibility that adaptive changes, such as undoubtedly occur in the life of an individual, are handed on to its offspring.

It is also worth noting that in this case the change is only found in the descendants of a particular cell the nucleus of which has failed to divide. It is not transmitted to other parts of the plant. Now, in the higher animals the cells which will form the future germ cells are cut off at an early stage from the rest of the body, and are carefully shielded from change by a series of processes regulating the temperature and chemical composition of the blood going to them. This argument appealed to Weismann. But it does not apply to the higher plants, where the cells of any growing point may give rise to germ cells. In any event, it is not a very sound

* Friday evening discourse delivered at the Royal Institution on April 22. (Since the lecture was written, I find that Prof. W. E. Agar has covered much of the same ground and anticipated many of my conclusions in the Brailsford Robertson memorial volume of the *Australian Journal of Experimental Biology* (1932).—J. B. S. H.)

† NATURE, **127**, 933, June 20, 1931.

‡ I must thank Dr. Sansome for permission to quote his unpublished observations.

argument, even in higher animals, as the environment of the germ cells is not absolutely constant.

I will now cap my positive example with some negative ones. If plants or animals are inbred for many generations, they approximate to what is called a pure line. Within any such line, differences are not inherited. All members have the same hereditary make-up. The differences between them are due to environment, and are not handed on to the offspring, as appears from Table I. (from Johanssen). The progeny of the heaviest beans chosen within the line were no heavier than those of the lightest. Within such a line neither Lamarckian transformation nor Darwinian selection produces any measurable effect.

Exactly the same results were obtained by Wright within pure lines of guinea-pigs. The guinea-pigs born of old mothers had more white in their coats and fewer toes than the average, but their offspring did not resemble them in these respects. Clearly a transformation of a pure line would be a much more notable achievement than anything done in a mixed population, because in the latter case selection is known to be effective, and it is up to the Lamarckian to prove that he has not exercised selection.

TABLE I.

Year.	No. of Beans.	Mean Weight of Parents.			Mean Weight of Offspring.		
		Light.	Heavy.	Difference.	Parent Light.	Parent Heavy.	Difference.
1902	145	600	700	100	631·5 ± 10·2	648·5 ± 7·6	+ 17·0 ± 12·7
1903	252	550	800	250	751·9 ± 10·1	708·8 ± 8·9	− 43·1 ± 13·5
1904	711	500	870	370	545·9 ± 4·4	566·8 ± 3·6	+ 20·9 ± 5·7
1905	654	430	730	300	635·5 ± 5·6	636·4 ± 4·1	+ 0·9 ± 6·9
1906	384	460	840	380	743·8 ± 8·1	730·0 ± 7·2	− 13·8 ± 10·8
1907	379	560	810	250	690·7 ± 7·9	676·6 ± 7·5	− 14·1 ± 10·9

After Johanssen. Weights in milligrammes.

The two experiments which have lasted the greatest number of generations have both been performed on quickly breeding arthropods. Agar bred the little water-fleas *Simocephalus* and *Daphnia* for 101 and 79 generations respectively. These animals reproduce by parthenogenesis, under the conditions of Agar's experiment, the life-cycle being completed in a week or a little longer. They swim by means of their second antennæ. If one branch of these is cut off when the animal hatches, the feather-like setæ are usually, though not always, regenerated. It might have been expected that after a hundred generations the progeny of the operated animals might have shown an increased aptitude for regeneration. This was not the case. If anything, they regenerated very slightly worse than the controls, but the difference was not significant. Agar also tried the effect of selecting those animals which regenerated best. He got no effect at the end of forty generations. This was to be expected, as he worked with a clone, within which, as within a pure line, there are no heritable differences.

It might be hoped that better effects would be obtained where the character studied was of a more psychological kind. The fly *Drosophila melanogaster* generally moves towards a light. This may be called an instinct, a tropism, or a reflex, according to taste. Now, it is a well-known fact that cave-dwelling animals are often blind and colourless. Payne bred *Drosophila* in darkness for 69 generations. After ten generations he believed that he had diminished their tendency to fly towards a light. But after 69 generations there was no change in colour or structure, and the effect on behaviour, as measured on 1000 flies, was negligible. The flies were given ten minutes or more to adapt themselves to light, and were then placed at one end of a dark tube nine inches long, the other end of which was illuminated. About a quarter of the flies did not react within a minute, and were 'counted out'. This proportion was not altered by breeding in darkness. On the other hand, the speed of reaction was very slightly increased. There is certainly no suggestion that the flies had lost the tendency to move towards light through disuse.

The alternative explanation of blindness in cave-dwellers is that animals suffering from hereditary blindness have no tendency to leave a cave, and hence their descendants populate it. It is interesting that a race of the same fly, selected on account of a peculiar body colour, does not move towards light, and might therefore remain in a cave where normal flies would tend to leave it.

We now turn to some of the experiments on which the neo-Lamarckian case is based. Except those of McDougall, which are in a class by themselves, none of these has been conducted on approximately pure lines. Since we know that in a mixed population selection is effective, we shall see whether this cannot account for the observed changes. I will therefore consider the experiments cited by Prof. MacBride.

Dürken worked with *Pieris brassicæ*, the cabbage white butterfly, the pupæ of which become green when the larvæ are kept under yellow, orange, or green glass. This discovery was not made, as MacBride states, by Dürken, but by Wood in 1867, and very fully described by Poulton in 1887. In a typical experiment of Dürken's, 4 per cent of the pupæ reared in normal light were green, as were 63 per cent of those reared in orange light. Only the moths emerging from the green pupæ were bred from, and these gave 98 per cent green when the caterpillars were kept in orange light, and 48 per cent in normal daylight. Now, one cannot prove that Dürken had not observed the transmission of the effect of the light. But there is no evidence for this hypothesis. He had selected the green fraction of the pupæ, and naturally enough he got more greens in the next generation. Selection is generally quite effective except within a pure line, and there is not a shadow of evidence that Dürken observed anything but the effects of selection.

For comparison, let us study a more scientifically

conducted experiment of the same kind, namely, the late Dr. Bateson's experiment (posthumously published from his notes by Sir Daniel Hall) on 'bolting' in sugar beets and mangolds. On an average, about 5 per cent of the plants in a field of sugar beets bolt, that is to say, they throw up a stem and set seed during their first year, so that the roots are denuded of sugar and worthless. The rest behave as biennials. Mangolds show a similar phenomenon. It was known that early sowing promotes bolting. Now, Bateson, we may assume, started out with the hypothesis that bolting may be due to internal or external causes. So, instead of sowing mangolds in the open in April, he sowed them under glass in December or January, and planted them out in April. Thus any plant with an inherent tendency to bolt was given the fullest opportunity to do so. Sutton's Prize Globe mangold gave only 2 bolters out of 390 when sown in April. But when sown in December, 8 out of 19 bolted. The 11 non-bolters were used for seed, and none of their progeny bolted, even when sown in January. However, some seedlings from this family were subjected to severe temptation to bolt by sowing in December. Ten out of 136 (a much smaller proportion) bolted; but 213 of the progeny of the non-bolters refused to bolt when sown in January. In the case of sugar beet, the proportion of bolters was greater, and four generations were needed to eliminate the habit.

Bateson also made the converse experiment of trying to establish a race which always bolted. He did not get any appreciable increase of bolting when he selected the progeny of plants which had bolted as the result of early sowing. But by sowing seed of 12 plants out of 312 which had bolted when sown in April, he got 41 per cent of bolters. All this is entirely intelligible on the theory that bolting, in so far as it is an acquired character, is not inherited. If Dürken had bred from the pupæ which refused to turn green even in orange light, he would no doubt have been able to eliminate the tendency to turn green; and if he had bred from those which turn green in ordinary light, he would presumably have obtained a more striking change in the next generation than was actually found. In order to prove the Lamarckian theory, it would be necessary either to start with a pure line or not to practise selection. Harrison, who worked with the turnip white butterfly, *Pieris rapæ*, which normally gives about 20 per cent of green pupæ, obtained more striking effects than Dürken, as he only appears to have eliminated 7 per cent in one generation and 5 per cent in the next, and yet obtained 31 pupæ, all green, in normal daylight. While Harrison's case is thus far stronger than Dürken's, it cannot be regarded as conclusive unless similar results are obtained without selection, either artificial or natural.

(*To be continued.*)

The Transport Problem in the United States

IN the century and a half which has elapsed since the American steam-boat pioneers, Fitch and Rumsey, began their experiments on the Delaware and Potomac rivers, transport in the United States has undergone many remarkable changes. From the work of those pioneers, in the course of years, came a magnificent fleet of river steamers; her engineers next gave the country the most extensive railway system in the world; while to-day the automobiles are so numerous that there is one for every five of the population, and transport by air is making rapid progress.

America is what it is largely because of its transport, without which its prairies would still be uncultivated and its mines unexploited. One of the landmarks in the history of that transport was May 10, 1869, when the last spike—a golden one—was driven in the railway which connected the Atlantic coast with the shores of the Pacific. On that occasion Philadelphia rang the old Liberty Bell, New York fired a hundred guns, Buffalo sang "The Star-Spangled Banner", and there was even a thanksgiving service in Trinity. There then seemed no end to the benefits to be gained from the railways, which to-day, by the irony of fate, are faced almost with bankruptcy.

Like our own railway system, that of the United States was built up entirely by private enterprise, and the present position of the railways is much the same as our own; some think it is somewhat more complex. What that position is, and what remedies are suggested so that the railways can continue to fulfil their part in the national economy, are well stated in three contributions printed in the first issue for the current year of the *Proceedings of the American Philosophical Society*. The three papers are entitled: (1) "The Railroad Situation: Some Suggestions as to the Way Out"; (2) "A Way for the Railways to Keep Out after they are Out"; and (3) "Co-ordination as a 'Way-out' of the Transportation Crisis"—the respective authors of which are Dr. E. R. Johnson, Mr. A. B. Johnson, and Mr. G. L. Wilson. Of the three papers, the first is much the longest and gives a record of all the factors of the problem.

The United States railway system has some 250,000 miles of track, and the rolling stock includes about 67,000 locomotives, 57,000 passenger cars, and 2,500,000 freight cars, the results of the development of a hundred years. The public roads include 3,000,000 miles of highways, of which some 700,000 miles are surfaced and about 128,000 miles are mainly of concrete. About 50,000 miles of streets are constructed or rebuilt annually, the expenditure on which reaches 2,000,000 dollars.

The number of automobiles of all kinds registered in the United States at the end of 1931 reached the astonishing figure of 23,042,840, the result of thirty years' development; and the number of companies engaged in freight traffic services runs into thousands. There are no complete statistics of the freight carried by motor vehicles, but not only are

fruit, vegetables, and live stock now conveyed by road, but also such things as coal and cotton. Of the 4,000,000 bales of cotton grown in Texas in 1930, 1,200,000 reached the ports by motor vehicles. But severe as is the inroad made on the freight traffic of the railroads by motor wagons, still more severe is that due to the private motor car and the motor buses. In 1920 the passenger earnings of American railroads were nearly 21 per cent of their total operating revenues, but in 1930 this figure had fallen to 13·8 per cent, and the showing for 1931 was even worse.

Added to the competition from the roads is that due to the carriers by water, for inland and coastwise traffic. At the time the Panama Canal Act of 1912 was passed, several railroad companies had steamship lines on the Great Lakes and on the Pacific and Atlantic seaboards. By that Act, however, the companies were prohibited the use of the Canal for vessels owned by them, and other restrictions were placed on their maritime activities. At the close of the War, too, the United States possessed a large surplus of ships. Many of these were sold at a low figure and placed in service, while the Government itself entered the business of inland water transportation. The schemes have never paid their way, and, says Dr. Johnson, "it is hard to justify the continuance of business operation on this basis by the Government in competition with private enterprise".

Traffic has not only been leaving the rails for the roads and waterways, but also for underground pipelines for distributing oil, natural gas, and gasoline. Formerly nearly all petroleum was sent by freight cars, and it involved a large tonnage. In 1929 only 4·5 per cent of the production was transported by rail. There are now 100,000 miles of crude oil pipelines in the United States, 65,000 miles of pipelines for the distribution of natural gas, and in 1931 there were also 3800 miles of gasoline pipelines. The rapid increase in the use of oil and gas has had a marked effect on the coal output of the country, and it has been estimated that in 1929 natural gas was substituted for about 77,500,000 tons of bituminous coal.

As to civil aviation in the United States, a recent return shows that American air transport companies now operate over routes with a total mileage of 51,000 miles, and the machines cover a total distance of 150,000 miles every twenty-four hours.

The problem of co-ordinating the great and varied transportation services of the United States, it will thus be seen, is a very complex one. It is one dealt with by Dr. Johnson and Mr. Wilson in their respective papers, both of which are worthy of the attention of the authorities in Great Britain. In reviewing the constructive and corrective measures required, Dr. Johnson mentions the reduction of unprofitable train services, the operation by the railways of both passenger and freight motor services, a reduction in the competition among the railways themselves, the consolidation or grouping of the railways into a limited number of systems, the co-ordination of rail, road, water, and air services, and the regulation of all transport agencies by the Government, according to a sound and equitable national policy. What co-ordination means and how it can be effected is dealt with fully by Mr. Wilson, who says: "The trend towards co-ordination has proceeded to the point that we can predict that the great railroads, steamship companies, electric railways, and other specialised carriers will tend to become *transportation* companies . . . offering a variety of transportation services to shippers and travellers that will supply the needs and fit the pocket-books of their patrons".

Polar Lights*

By Prof. S. CHAPMAN, F.R.S.

MANY of the principal facts concerning the polar lights, or aurora, have long been known. For example, John Dalton, the great chemist, who observed the lights carefully for many years, and thought deeply upon them, was well aware of their close connexion with the earth's magnetism: as shown by their occurrence mainly in regions centred at the magnetic (rather than the geographical) poles, by their tendency to be extended in the direction transverse to the magnetic meridian, by the near agreement between the direction of auroral rays and the local direction of a freely poised magnetised needle, and by their parallelism, in time of occurrence and in intensity, with magnetic disturbances or storms. His ideas as to their height, on which Cavendish had made careful measurements, were also in general accord with modern determinations.

Modern observations of auroræ have advanced our knowledge chiefly by establishing the height and situation with incontrovertible accuracy, by the methods of Størmer and his followers; and by the interpretation of the beautifully coloured auroral light, with the aid of the spectroscope and the great body of modern knowledge concerning atomic and molecular spectra.

Much remains to be done before the full fruits of the study of the auroral spectrum are garnered, but two main facts are established: a large part of the spectrum consists of bands due to singly ionised nitrogen molecules, while the famous green line, a standing challenge to spectroscopists for many decades, has been shown by McLennan to be emitted by neutral atomic oxygen; he, his colleagues, and others have traced the line in detail to its source in a particular transition occurring in the oxygen atom. Through the initiative of another active investigator of the auroral spectrum, Vegard, the Rockefeller Foundation has instituted an auroral observatory, maintained by the Norwegian Govern-

* Substance of a lecture delivered at the annual general meeting of the British Science Guild on May 25.

ment, at Tromsø; special attention will be devoted at this well-equipped and favourably situated observatory to this side of auroral research. A further remarkable observational discovery concerning the aurora, due to Størmer, is the recognition that the specially high auroræ, sometimes seen in the west after sunset, or in the east before sunrise, are in the part of the atmosphere, beyond the earth's shadow, still traversed by the sun's rays.

On the side of theory, the advances have been of comparatively recent date. Birkeland laid the foundations, by his speculations and experiments, on which Størmer has reared a great mathematical superstructure, developing the hypothesis that the aurora is due to electrically charged particles from the sun; these are deflected by the earth's magnetic field towards the polar regions, thus explaining the geographical incidence of auroræ. Størmer has deduced from this hypothesis the existence of the two auroral zones, and many other observed features of the aurora. But valuable and successful as the present theory is, it suffers, as Schuster indicated, from a great and deep-lying defect. Of the forces which guide the particles, the theory considers only the electromagnetic, whereas there will also be important electrostatic forces, which the theory ignores; the latter arise from the mutual influence of the particles, which must be partly positive and partly negative, in nearly equal numbers. A new theory must be built up, taking both sets of forces into account; this promises to be exceptionally difficult, and only the merest beginning has yet been made. It is to be hoped that, in the future development of the work, much of the existing theory will find a place, being preserved in a larger structure, as has happened in many other branches of physical theory; but of this it is still too soon to judge.

At the present time we stand, it is hoped, on the eve of a further advance in the observation and theory of the aurora, and of its associated phenomenon, magnetic disturbance. Expeditions are now proceeding to take up their stations at many points in and near the arctic circle, in connexion with the new International Polar Year for scientific research on magnetism, auroræ, and meteorology. With modern instruments and methods, a great extension of the knowledge afforded by the first Polar Year, 1882–83, may confidently be looked for. The British magnetic and meteorological expedition, led by Mr. J. M. Stagg, left for Fort Rae early in May; among other items of its programme is included the determination of auroral heights, from two stations connected by cable or radio. Another British expedition, under Prof. E. V. Appleton, will leave shortly for Tromsø, to determine, by radio methods, the amount, distribution, and changes of ionisation near the auroral zone; its results should be of extraordinary interest and value for both auroral and magnetic research.

Obituary

Sir Thomas Legge, C.B.E.

THE death on May 7 of Sir Thomas Morrison Legge, late Senior Medical Inspector of Factories, deserves more than a formal note; for his official record in this capacity was coterminous with the chief reforms in factory hygiene which have occurred. In securing these he played an essential part.

Legge was the son of a distinguished Chinese scholar. After taking his degree with honours at Oxford, he investigated public health conditions in European countries, and described their municipal administration in a volume which may still be referred to with advantage. After serving as secretary of the Royal Commission on Tuberculosis, 1896–98, he worked in public health in Brighton, and afterwards was appointed the first Medical Inspector of Factories and Workshops, a post held by him for nearly thirty years. In this capacity he undertook many important investigations; among others, the relation of cataract to the glare in a glass-blowing factory, the causation of nystagmus, and the origin of various other industrial conditions, in which questions of compensation arose.

Legge gave the Milroy lectures before the Royal College of Physicians on anthrax; and some years later his distinction in industrial medicine was indicated by his receiving from the same College the Bisset Hawkins medal as a pioneer in public health. He was instrumental in securing the establishment of an official disinfecting station for wool coming from anthrax-infected countries.

Legge's life-work was largely concerned with investigations of industrial lead poisoning and with securing regulations against these risks; and the record of steadily diminishing incidence of cases of lead poisoning year by year is eloquent testimony to the success of his work and that of his colleagues. In 1921 at Geneva thirty countries, including Great Britain, had agreed to a draft Convention, under which it was intended to prohibit the use of lead paint for internal painting. In 1927 Great Britain, however, while regulating the employment of lead paint, did not make its prohibition absolute, and Legge resigned his post at the Home Office in protest, a year or two before his appointment lapsed by flux of time.

Before and after his retirement Legge did valuable work in promoting industrial hygiene, by lecturing on his subject in America and in Great Britain. He held very strongly that for medical students industrial hygiene and poisoning were left almost entirely out of the medical curriculum. He was also insistent that the psychology of the worker should be more fully studied and considered.

Throughout his life, Legge took great interest in the artistic side of the worker's work; and outside his daily work he delighted in discovering examples of old church and other stained glass. In this subject he was, indeed, an authority, and had at one time a valuable collection.

Legge's outstanding personal characteristics were modesty and unyielding integrity. He was concerned with his work, not with credit that might come from it; and it is most satisfactory, therefore, that we can now recall with gratitude his extremely important contribution to the welfare of industrial workers in Britain and in other countries. A. N.

PROF. OTTO FISCHER

WE regret to record the death on April 4, after a prolonged illness, of Prof. Otto Fischer, who was associated for many years with his more famous cousin, the late Emil Fischer. From the *Chemiker-Zeitung* we learn that Otto Fischer was born in 1852 at Euskirchen, near Cologne. On leaving school, he studied for a short time with Kekulé at Bonn before proceeding to Strassburg, where he began his researches on the synthesis of hydrocarbons under Adolph von Baeyer, and where Emil had already begun his career. After graduating in 1874, Otto proceeded to Charlottenburg to work with Liebermann, but two years later he rejoined von Baeyer, who had in the meantime been called to Munich. In Munich the cousins Fischer worked upon the preparation of organic hydrazines and upon the dyestuffs of the triphenylmethane group. In 1882, Emil was appointed to the chair at Erlangen, but his health broke down and, in 1884, Otto was sent to act as his substitute. In the following year, Emil accepted the chair at Würzburg, and Otto was appointed to succeed him at Erlangen. This post he held until his retirement in 1925.

In conjunction with his assistants and students, Otto Fischer published a considerable number of papers on organic chemistry—his favourite field of research being dyestuffs. In conjunction with Dr. E. Hepp, of the Höchster Farbwerke, he investigated nitrosamines and nitroso-bases, the reactions of the iminazol-group, the safranines, indulines, and fluorindines. Later he worked upon the photo-sensitising dyestuffs of the cyanin group. He also investigated derivatives of pyridine, quinoline, and anthracene, and he discovered the drug kairine.

WE regret to announce the following deaths:

Prof. Fritz Drevermann, professor of palæontology in the University of Frankfort-on-Main, and editor of the *Paläontologischen Zeitschrift*, on March 16, aged fifty-seven years.

Dr. Carl Leo Mees, president emeritus of the Rose Polytechnic Institute at Terre Haute, Indiana, who was twice vice-president of Section A of the American Association for the Advancement of Science, on April 20, aged seventy-eight years.

Dr. Roland Thaxter, emeritus professor of cryptogamic botany at Harvard University, and honorary curator of the Farlow Herbarium, who was a member of the National Academy of Sciences and foreign member of the Linnean Society of London, on April 22, aged 73 years.

News and Views

Sir Henry Wellcome, F.R.S.

AT a meeting of the Royal Society on May 26, Sir Henry Wellcome was elected a fellow of the Society under Statute 12, which provides for the recommendation by the Council for election of "persons, who . . . either have rendered conspicuous service to the cause of science, or are such that their election would be of signal benefit to the Society". Sir Henry, who was knighted last January for his public services, has been a generous and frequent benefactor of scientific research. In 1899 he founded the Wellcome Tropical Research Laboratories in Khartoum, where the late Sir Andrew Balfour worked for many years; he established in England in 1913 his Bureau for Scientific Research and Historical Medical Museum, and in 1914 the Museum of Medical Science, including Tropical Medicine and Hygiene; in 1920 he founded the Wellcome Entomological Field Laboratory. Last year, Lord Moynihan laid the corner-stone of the Wellcome Research Institution, where the Historical Medical Museum and Museum of Medical Science will be brought together under one roof, and facilities provided for research in medical zoology, parasitology, entomology, tropical medicine, and hygiene—the corner-stone, as Lord Moynihan remarked, of a long life's work. Sir Henry Wellcome's election to the Royal Society is a fitting acknowledgment of one who has done as much as anyone in Great Britain to promote the advance of the science and art of medicine.

Scope and Needs of Medical Research

SIR WALTER MORLEY FLETCHER delivered the Friday evening discourse at the Royal Institution on May 27, taking as his subject "The Scope and Needs of Medical Research". He pointed out that medical research covers immensely wide and varied fields of scientific activity, indefinitely wider than the important part of it which concerns the healing profession as such. Its scope has been defined for Parliamentary purposes as dealing with "the proper development and the right use of the human body in all conditions of activity and environment, as well as with its protection from disease and accident, and its repair". The development of the body includes the relatively new and rapidly growing studies of genetics on one hand, and of nutrition on the other. For the right use of the body we are concerned with personal hygiene as well as with the intricate group of problems belonging to industrial life. Here research is organised under the Industrial Health Research Board. Protection from disease covers the two great fields of preventive and of curative medicine. It deals with the genetic and nutritional control of disease, as well as with studies of infective disease at home and in the tropics. This infinitely varied field of work calls at every point for the intensive application of the primary sciences. This is well illustrated by the study of rickets, the detection of its dietetic basis, and the discovery of the relationship of light radiation to the fat-like substance

in the skin from which vitamin D is produced. Further development has involved intensive team work by physicists, chemists, and biologists, leading to the production of calciferol, the actual substance of vitamin D. This has not only made important contributions to organic chemistry as such, but also has brought improved practical powers to the medical administrator.

ANOTHER example of intensive work has been in the study of the so-called viruses, which cause widespread and often ruinous diseases in men, animals, and plants. New physical methods have been devised for their optical study and their separation and measurement by means of filters. The better study of these minute particles has not only an obvious utilitarian value, but also has extreme intellectual interest. They are units, apparently alive and reproductive, yet far smaller than any living cell which has hitherto been regarded as the minimal organisation capable of displaying life and reproduction. The whole story of medical research, whether viewed in its wide extent or followed to its intensive studies, illustrates the absurdity of the artificial boundaries that at present tend to separate the different sciences. In the schools, as Lord Chelmsford's Committee has reported, the cleverer boys are ' caught ' for physics and chemistry, while the scholarship system, especially at Oxford and Cambridge, encourages a narrow specialisation which is, unfortunately, continued during undergraduate life. Most physicists and chemists proceed throughout school life and to a university degree without ever becoming acquainted with the interest of matter endowed with life. Many students lose opportunities they might have welcomed for fruitful work in the biological field, and the whole cause of medical progress suffers. Of students who proceed to medicine, many are again lost from the research field because of the great attraction offered by the natural human interest of professional work, or because of financial needs or desires.

Institute of Physics

LORD RUTHERFORD, presiding at the annual general meeting of the Institute of Physics, said that in the short time since its foundation, remarkable progress has been made towards the achievement of the original intentions of its founders. There has been a rapidly growing recognition of the importance of the physicist, not only in the academic world, but also in industry, and Lord Rutherford considers that the Institute can justly claim some of the credit for this. The properly trained physicist has the power to form his judgment by performing experiments, and if it be a subject where little is known, the cost of the investigation may only be a matter of a few shillings. It is very important that such an Institute should include every type of physicist among its members, and naturally to physicists in some of the sheltered posts, such as colleges and universities, it is not quite clear what particular advantages can be gained by joining the Institute, when they already have so many facilities at their own door. But taking a long view, Lord Rutherford said, it is the duty of every physicist to join the Institute, wherever he may be, and so help on the recognition of the profession that he represents. He looks forward to the time when membership of the Institute will be considered a necessary professional qualification. The standing of the physicist in the scientific world, not only of to-day, but also of to-morrow, depends upon the support that the Institute receives.

Reading Rooms at the Institute of Physics

PRIOR to the annual general meeting, Lord Rutherford opened the new reading rooms at the Institute of Physics. Through the generosity of the Royal Commissioners for the Exhibition of 1851, some rooms have been allocated to the Institute for this purpose, and these have now been comfortably furnished. The Joint Library Committee set up by the Institute, the Physical Society, and the Optical Society has arranged that the libraries shall be combined for the mutual benefit of all, and thus a large number of periodicals and other books are already available for the use of members of the Institute and its participating societies. In addition, a limited number of textbooks and reference books are included in the library. In the course of his remarks, Lord Rutherford said that the opening of these rooms is another example of the co-operation of the participating societies through the Institute, which was one of the purposes for which the Institute was founded. Some of the rare old books belonging to the Physical and Optical Societies were open for inspection during the afternoon. It is hoped that authors and publishers will present suitably inscribed copies of their books, and in this way those whose attention has been directed to new books by the reviews published in the various journals of the Institute and its participating societies will have an opportunity of examining the books more carefully before procuring their own copies.

Game Animals of the British Empire

THE new gallery at the Natural History Museum, which is intended for the exhibition of whales, in replacement of the temporary building erected thirty-four years ago, was finished last autumn, but the economic crisis has interfered with the original plans, and, owing to lack of money, the Trustees have been unable to arrange for the renovation and removal of the large whale models. They decided that, in the circumstances, the gallery might usefully be employed for a comprehensive exhibit of the game animals of the British Empire. The open floor of the gallery has been divided into three parts, devoted to specimens from Africa, Indo-Malay, and Canada and Newfoundland respectively, the first of them being about as large as the other two combined, they themselves being equal. On the walls are suspended more than five hundred horns and skulls, some of the former being the ' record ', that is, the largest known for the particular animal. Among the horns shown is the magnificent pair of the Indian buffalo which were included in the Sir Hans Sloane collection received in 1753 and are prominent among the limited number of

zoological specimens which have lasted to our day. With the exception of a white giraffe which has been lent by Rowland Ward, Ltd., all the specimens are drawn from the Museum collections. They show to much greater advantage in their present setting than crowded together in glazed cases in the Mammal Galleries. The exhibit, which has been arranged by Capt. J. G. Dollman, was opened to the public on May 31.

New Botanical Collections

THE Department of Botany, British Museum (Natural History), has received some noteworthy additions during the last two months. His Majesty the King has placed on permanent loan a further collection of Nepal plants presented to him by His Highness the Maharaja of Nepal. The present consignment numbers 253 specimens, which were collected by Prof. K. Sharma; Major L. Dhwoj, who was responsible for the previous collections, died during the expedition. The value of the collection is that it is from previously unexplored mountains. Another collection which will add to our knowledge of the floristics of the Himalayan region has been presented by Capt. F. Kingdon-Ward. It consists of 1233 specimens, and is from the Upper Irrawaddy and the Burma-Tibet frontier. A valuable addition is the gift of the Boswell-Syme British Herbarium by Mr. Frederick J. Hanbury. This contains about 20,000 sheets, in fourteen mahogany cabinets, and will be kept as a separate collection. Boswell-Syme (1822–1888) was the editor of the third edition of "English Botany", and the specimens on which his remarkably accurate descriptions were based are in the collection. The herbarium was purchased by Mr. Hanbury on Boswell-Syme's death, and is in excellent condition. British botanists will now be free to consult the remarkably long series of species which are rarely well represented in modern herbaria. Mr. A. Vernay has presented a set of plants obtained on the Vernay-Lang expedition to the Kalahari desert. This area is very poor floristically, and the 264 species, including twenty type gatherings, are consequently of value in extending our knowledge of distribution.

Acquisitions at the Natural History Museum

AMONG the chief recent acquisitions in the Zoological Department of the British Museum (Natural History) are 60 mammals and 590 birds obtained by the Vernay-Lang Expedition to the Kalahari Desert, presented by Mr. A. S. Vernay; the mammals include specimens of 11 forms recently described as being new to science by Mr. Austin Roberts of the Transvaal Museum. Another important gift received from Mr. Vernay is a collection of 184 mammals, 29 reptiles, 34 fishes, and 500 butterflies obtained by Capt. Beresford Holloway, who accompanied Mr. Vernay on his recent expedition to the Malay Peninsula. This collection comprises many rare species, including a specimen of the rare *Rhinoceros sondaicus*, which is now being mounted, at the expense of the donor, for exhibition in the Museum. Purchases for the Department of Geology include a specimen of the teeth of an extinct shark, *Edestus*, from Devonian rocks of Rhenish Prussia. The median teeth of *Edestus*, instead of falling away after use as in all other sharks, remained attached to their successors, forming in the course of time an external dental spiral which must have hung over the point of the jaws and sometimes contained no less than 150 teeth. Prof. G. Vibert Douglas has collected and presented to the Department of Minerals a large series of rocks illustrating the geology and mineralisation of several mines in the 'copper belt' of Northern Rhodesia and Katanga. Samples of volcanic dust which fell after the recent eruptions (April 11-12) in the Andes have been presented by the *Times* Publishing Co. and by Messrs. H. W. Nelson, Ltd.

British Science Guild

AT the annual meeting of the British Science Guild held on May 25, Sir Samuel Hoare was re-elected president for the ensuing year, and affirmed his faith in the aims of the Guild. The annual report shows a year of useful work. Perhaps its most interesting feature is the attempt which the Guild is making, in conjunction with the Association of Scientific Workers, to provide an adequate channel for bringing before Parliament the views of scientific men. A Science Advisory Council is being set up, and it is intended that this Council shall be in some sense comparable with the Federation of British Industries, in the sense that it shall be the liaison body for providing contact with Parliament in connexion with scientific and technical matters coming before the House. The success of the projected Council will, of course, depend on the degree in which it enjoys the co-operation of scientific and technical societies, a number of which have already agreed to participate. The extent of its activities, however, will be mainly determined by that of the funds placed at its disposal, and in this aspect the matter has yet to be put on a satisfactory basis.

Research and Industry

IN a recent article in the *Journal of the Textile Institute*, on "Cotton Research and Academic Physics", Dr. F. T. Peirce points out that the tendency of men of science to get into ruts of thought is partly responsible for the tardiness of the academic mind to appreciate and interpret the problems of technology in a way that is essential for the interpenetration of science and industry. On the other hand, while as one consequence of specialisation every research worker is accustomed in his reading to slur over matter which he cannot or need not understand, the industrialist is apt to be offended if he encounters matter which is incomprehensible to him even though the practical conclusions are clear. Without claiming that scientific research is a complete cure for all the troubles of industry, Dr. Peirce urges that it is a method of securing the most effective use of available resources, and shows how, within the experience of the cotton industry, impersonal scientific methods have succeeded in saving efforts and resolving difficulties in the relations of firms or branches of the industry with

employees and between service departments. Co-operation may ultimately lead the ideal of team work to merge in that of 'group work', groups having only their own ignorance or inefficiency as enemy, and in organisation by technical processes rather than by sciences.

THE matter of publication is not without concern to the relations of science and industry, as pointed out by Dr. Peirce, and a generous policy of publication for lines of pure scientific interest has a stimulating effect on the research staff from which the industry itself is the first to benefit. Publication assists in securing the recognition and interest from the universities, which are essential for open discussion, for combating the natural secretiveness of industry, and for creating a technical literature in which systematic cross reference becomes possible. These and other problems relating to the scientific reputation of the individual, the place of individual initiative and originality in co-operative research, are aspects of the relations between science and industry which are a modern phase of the conflict between authority and liberty. Much also remains to be done in redressing the present neglect of the borderland sciences, and cotton itself is of special interest in the borderland of physics. Finally, Dr. Peirce suggests that by overcoming the technical difficulties of industry the scientific worker may remove obstacles to the development of beauty, and thus contribute to the artistic as well as to the humane aspect of industry.

Social Discontent and its Remedy

IT is not altogether a new explanation of the social ills of the day to find a psychological rather than an economic explanation, but the theme is one that may well be stressed, and is ably expounded by Mr. H. A. Bruce in a paper on "The Sources of American Discontent" (*Proc. Amer. Acad. Arts and Sci.*, vol. 67, No. 3, Feb. 1932). The social evils and discontent which Mr. Bruce cites as being prevalent in America to-day are no less evident in many parts of Europe, and he finds the chief cause to lie in modern industrialisation, which not only narrows and starves the needs of the individual life, but also results in that crowding which leads to crowd mentality and all its drawbacks. The present state of affairs leads to discontent, adds to the prison population, the numbers of mental and nervous wrecks, and takes a mounting toll of suicides and lives shortened by bodily diseases promoted by mental stress. Mr. Bruce admits the seriousness of the problem and the difficulties of solution when national policies are determined by majorities infused with the crowd spirit and on an arrested level of mental activity, but he makes the suggestion that the crowd spirit may itself be used to contribute to the acceptance of a wiser philosophy of life than is summed up in making money, spending money, and amusing oneself. Intensive education of a far-spreading kind is the agency to apply in changing the outlook of industrialised peoples, and leading them to an appreciation of values other than those which prevail to-day.

Hydrogen and its Uses

DR. E. F. ARMSTRONG recently delivered a lecture on hydrogen and its uses before the Royal Society of Arts (*J. Roy. Soc. Arts*, May 6). Two important methods of preparation of hydrogen are from water gas and coke oven gas. The carbon monoxide in water gas is oxidised to carbon dioxide by passing a mixture of the gas and steam over a catalyst containing iron oxide, the hydrogen of the reacting steam being set free. The small residue of carbon monoxide is removed by absorption under 200 atm. pressure. The preparation from coke oven gas depends on purification by washing and fractional cooling, whereby first the methane and then the carbon monoxide is removed. The cost of production by either method under the most favourable conditions is about 1*s.* per thousand cubic feet of hydrogen. The principal uses of hydrogen are for the hydrogenation of fats, in which liquid oils are converted into solid fats by taking up hydrogen in the presence of small quantities of nickel; the hydrogenation of other organic materials, including mineral oil, tar, and coal; and the production of synthetic ammonia. The conversion of coal into oil by treatment with hydrogen under pressure involves the use of an elaborate and costly plant; and so far as the production of petrol is concerned, the cost is put down at 7*d.*–8*d.* per gallon, as compared with a price of less than 2*d.* per gallon at the oilfield. The prices may alter in future in favour of petrol from coal. If hydrogen is ever required in larger quantities by the oil industry, it could be obtained from the methane of natural gas or refinery waste gas, which readily reacts with steam to form hydrogen and carbon dioxide.

The National Physical Laboratory

THE Report of the National Physical Laboratory for the year 1931 is an illustrated quarto volume of 131 pages (London: H.M. Stationery Office, 15*s.* net). As usual, it gives a readable and interesting account of the progress of the work of each department without introducing technical details, and equally as usual, that progress must be gratifying to the Board and to the staff. The new physics building is now in use and the old quarters of physics are occupied by electrical standards. The compressed air tunnel building is completed, the new tank will be completed this year, and the new acoustics building has been commenced. Dr. W. Rosenhain has left to take up other work, Prof. C. H. Desch of Sheffield succeeds him, while Dr. W. E. Dye has been lost by death. Ninety-seven official papers by members of the staff have been published during the year in the scientific or technical journals or in the proceedings of societies. We note the determination of the yard and metre in terms of the wave-length of the red cadmium line, the accurate measurement of time for radio frequencies, and an international agreement as to colour standardisation. Routine tests of almost all types have, with few exceptions, decreased. In the watch tests, the success of one Swiss firm is very remarkable.

Land Conditions in Iraq

SOME valuable information regarding the irrigated and non-irrigated land in Iraq is contained in a report by Sir Ernest Dowson on "Land Tenure and Related Questions" (Baghdad: Iraqi Government, 4*s*. 6*d*.). These statistics, which are shown also on large scale maps accompanying the report, were collected by the Irrigation Department, and show the immense possibilities for the extension of agriculture when conditions are favourable. It would appear that about twenty per cent of the total area of Iraq can be regarded as productive. This includes a northern rainfall zone covering about nine per cent, and a southern irrigation zone covering about eleven per cent. Not more than a fifth, and often as little as a tenth, of these zones are cultivated in any one year. An estimate of the rural population, for which complete accuracy is not claimed, puts the density of population so low as 19 per square kilometre in the rainfall zone, and about 35 in the most typical areas of the irrigation zones. These figures, especially the latter, are far below the potential population of the land, and compare unfavourably with the far greater density of population and higher productivity of similar lands in Egypt. Sir Ernest Dowson also comments on the lack of accurate topographical surveys in Iraq and the incompleteness of even the major triangulation. The report contains various recommendations regarding methods of land tenure, and naturally stresses, in this connexion, the need of further surveys.

The Harpy at the London Zoo

OF the two well-known and remarkable neotropical birds of prey, the condor is a familiar menagerie exhibit, but the harpy always rare: the specimen the London Zoological Gardens has recently received being only the third exhibited during this century, although the species was shown early in their career. Although commonly called an eagle from its large size, the harpy is in form, coloration, and habits a giant goshawk, allied to the tropico-politan group of hawk-eagles (*Spizaëtus*). Like these, it presents the remarkable peculiarity of showing much more white in the immature plumage than in that of the adult; in fact, the present specimen, in its gull-like livery of white and grey, is curiously like a very different bird which is lodged next door to it in the Birds of Prey Aviary—the East Asiatic and Australasian white-bellied sea-eagle (*Cuncuma leucogaster*). The ruff and crest of the harpy, however, give it a character quite unique among the Falconidæ, and it is this species, rather than the golden eagle, which is the analogue of the lion among beasts, especially as its feet and talons are unrivalled for size and power in the whole series of birds of prey.

A 'Deaf Speaker'

A NEW device which will aid the deaf to hear radio and gramophone music has been invented by Prof. F. Bedell, the well-known physicist of Cornell University. He calls it the 'deaf speaker' because it serves a function similar to a 'loud speaker' in a radio set. It does not broadcast sound, but carries vibrations of the requisite amplitude and frequency to anyone who holds the receiving part of the apparatus with his teeth or pressed against his forehead or a cheekbone. From a summary of a radio talk reported by Science Service of Washington, D.C., on May 5, we learn that Prof. Bedell, working on the theory that most people who hear badly have a defective middle ear, sought to bring the sound waves to the inner ear by some other channel. He found that it could be done by bone conduction to the inner ear of the listener. It was not sufficient to transmit vibrations of the same frequency as the actual sound waves to the inner ear of the listener. They must first be adjusted to the requisite loudness and frequency. It is stated that this adjustment is substantially what takes place in the normal middle ear. Prof. Bedell's deaf speaker steps up the force of the sound waves very appreciably. Since some people are deaf to high tones and others cannot hear lower tones, the deaf speaker is provided with a device for altering the frequency. At a recent demonstration at the National Academy of Sciences, Prof. Bedell showed two kinds of receiving instruments, in one of which the receiver is held between the teeth and looks like a long tube, while the other consists of a flat disk held against the forehead or a cheekbone. The disk type has made it possible for deaf people with the aid of a microphone to hear their own voices. This apparatus is said to be very useful for teaching the deaf. It is portable, but is rather too large for everyday use.

Earthquake in the Western Pacific

A STRONG earthquake occurred in the western Pacific on the morning of May 14. Its records were confused with those of another earthquake in the West Indian region, but the position of its epicentre has now been determined with the arrival of additional records from seismological stations surrounding and in the Pacific. It lies in about lat. 4° N., long. 130° E., as determined by the seismologists of the U.S. Coast and Geodetic Survey (Wire Report of Science Service, Washington, May 16). This point lies at sea, south-east of the island of Mindanao in the Philippines. The earthquake was clearly a severe one, as it is reported to have been felt distinctly to a distance of about 600 miles from the epicentre.

Congress of Quaternary Geology

A MEETING of the Association for the Study of the European Quaternary will be held in Leningrad on Sept. 1–7. There will be two short excursions during the Congress and a long excursion from Sept. 8 until Sept. 29. Special arrangements have been made by the organising committee for the reception of members, and it is requested that geologists, archæologists, and others who wish to attend should send in their names to the Secretary, Mr. K. Lebedev, V.O. Sredny Pr., 72-6, Leningrad 26. Particulars relating to the Congress, with programme of excursions, etc., can be consulted in the Library of the Museum of Practical Geology, 28 Jermyn Street, London, S.W.1, or at the Office of Intourist, Bush House, Aldwych, W.C.2.

Announcements

PROF. W. A. BONE, professor of chemical technology in the Imperial College of Science, will deliver the Bakerian Lecture before the Royal Society on June 9, taking as his subject "The Combustion of Hydrocarbons".

AT the anniversary meeting of the Linnean Society of London held on May 24, the following officers were elected: *President*, Prof. F. E. Weiss; *Treasurer*, Mr. F. Druce; *Botanical Secretary*, Mr. J. Ramsbottom; *Zoological Secretary*, Lieut.-Col. J. Stephenson. The Linnean Gold Medal was presented to Prof. E. S. Goodrich.

THE second conversazione of the Royal Society this year will be held in the rooms of the Society on Wednesday, June 22.

AT the annual general meeting of the Institute of Physics held on May 24, the following were elected to take office on Oct. 1 next: *President*, Lord Rutherford; *Honorary Treasurer*, Major C. E. S. Phillips; *Honorary Secretary*, Prof. A. O. Rankine. The other vacancies on the Board were filled by the election of Prof. H. S. Allen and Dr. C. V. Drysdale as vice-presidents, and Mr. R. A. Watson Watt and Mr. D. Orson Wood as non-official members. Sir Frank Dyson and Sir William Bragg were elected honorary fellows of the Institute.

FROM the interest derived from the invested capital of the Sir George Beilby Memorial Fund, at intervals to be determined by the administrators representing the Institute of Chemistry, the Society of Chemical Industry, and the Institute of Metals, awards are made to British investigators for distinguished original work in science, preference being given to investigations relating to the special interests of Sir George Beilby, including problems connected with fuel economy, chemical engineering, and metallurgy. Applications must reach the Convener, Sir George Beilby Memorial Fund, Institute of Chemistry, 30 Russell Square, London, W.C.1, not later than June 14.

THE eighty-fifth annual meeting of the Palæontographical Society was held in the rooms of the Geological Society, Burlington House, on May 27, Dr. F. L. Kitchin, vice-president, in the chair. The report announced the completion of the monograph of fossil Macrurous Crustacea, by Mr. Henry Woods, and recorded the publication of further instalments of the monographs of Corallian Lamellibranchia, Gault Ammonites, and Cambrian Trilobites. During the year, the Society received a small bequest from the estate of the late Dr. Charles W. Andrews. Mr. L. R. Cox, Prof. A. Morley Davies, Prof. W. B. R. King, and Mr. H. Woods were elected new members of council, and Dr. F. A. Bather, Mr. Robert S. Herries, and Sir A. Smith Woodward were re-elected president, treasurer, and secretary respectively.

THE Institute of Physics announces that the British Optical Instrument Manufacturers' Association (B.O.I.M.A.) Prize for the best paper published in the *Journal of Scientific Instruments* during the year 1931 is to be equally divided between Mr. H. C. H. Townend, of the National Physical Laboratory, for his paper on "A Daylight Factor Integrator", and Prof. E. W. Marchant, Mr. J. K. Burkitt, and Mr. A. H. Langley, of the University of Liverpool, the joint authors of the paper, "A Portable String Galvanometer for use at Moderate Frequencies"; and the Institute of Physics Prize for the best contribution to the laboratory and workshop notes in the *Journal* has been awarded to Mr. F. W. Kirkby, of the Royal Aircraft Establishment, Farnborough, for his note, "Improved Method of holding Mirrors for Sextants and other Instruments".

THE next series of eight lectures and demonstrations at the London School of Hygiene and Tropical Medicine on tropical hygiene, for men and women outside the medical profession proceeding to the tropics, will be given by Lieut.-Col. G. E. F. Stammers on June 14–23. Particulars can be obtained from the Secretary of the School, Keppel Street, Gower Street, W.C.1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A temporary assistant teacher of nautical subjects at the Nautical School and School for Fishermen, Boulevard, Hull—The Education Offices, Guildhall, Hull (June 11). A University reader in education at the Institute of Education (incorporating the London Day Training College)—The Academic Registrar, University of London, South Kensington, S.W.7 (June 13). Evening teachers in fitting and machining and workshop processes and planning at the Wandsworth Technical Institute—The Secretary, Technical Institute, Wandsworth (June 13). A full-time lecturer in civil engineering in the Building Department of Rutherford Technical College—The Director of Education, Education Office, Northumberland Road, Newcastle-upon-Tyne (June 13). An assistant instrument maker in the Department of Physiology of University College, Cardiff—The Registrar, University College, Cathays Park, Cardiff (June 15). A professor of bacteriology in the University of Durham College of Medicine, Newcastle-upon-Tyne—The Registrar, University of Durham College of Medicine, Newcastle-upon-Tyne (June 18). A lecturer in the chemistry department of the Heriot-Watt College, Edinburgh—The Principal, Heriot-Watt College, Edinburgh (June 20). An assistant master at the Mining and Technical Institute and Boys' Junior Technical Day School, Neath, with the qualifications of an industrial chemist and possessing a degree in applied science, including metallurgy—The Director of Education, County Hall, Cardiff (June 21). A professor of medicine in University College, Galway—The Secretary, University College, Galway (June 30). Junior assistants under the directorate of explosives research, and a junior assistant under the directorate of ballistics research, of the Research Department, Woolwich—The Chief Superintendent, Research Department, Woolwich, S.E.18. A full-time junior teacher for engineering subjects at the Oldham Municipal Technical College—The Director of Education, Education Offices, Oldham.

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.*]

Eland-Ox Hybrid

THE crossing of the eland and domestic cattle has been reported fairly frequently, and some years ago several cases were alleged in Southern Rhodesia. After a prolonged correspondence (1923), in which assistance was given by the local magistrate, the late Mr. W. Farrer, it was concluded that the reported hybrids were not authentic. The owner stated that they were almost indistinguishable from domestic cattle, and the fact that tame bull elands will readily serve domestic cows seemed a sufficient explanation of the alleged hybridism.

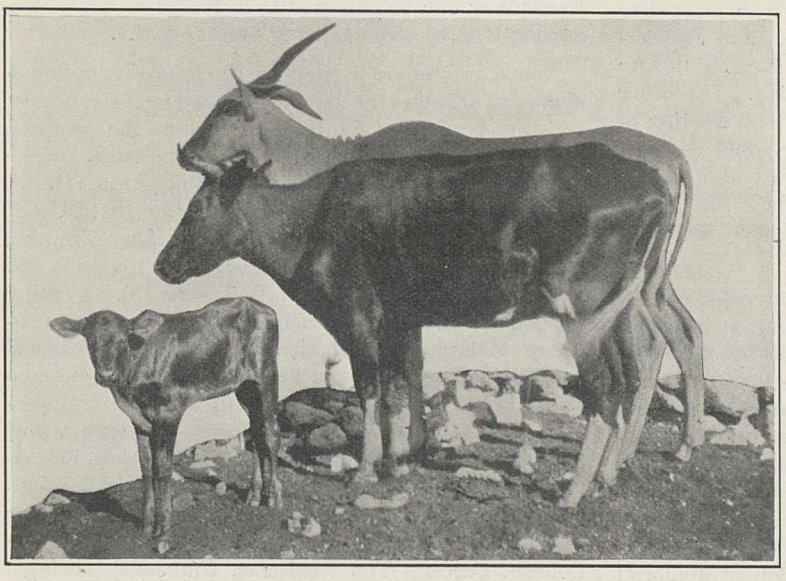

FIG. 1.—Bull eland, Afrikander cow, and hybrid calf, Malpas Farm, Orange Free State.

At the Government Experimental Farm at Cedara, Natal, attempts at crossing have had no result.

It would appear, however, that a successful cross has now been obtained (March 1932) at Malpas Farm, owned by Mr. R. E. Helme, Westminster, Orange Free State, under conditions which would seem to preclude any possibility of doubt. On this farm there were half-a-dozen Afrikander cows, but no bull of any description, except a bull eland which had been obtained from the Zoological Gardens, Pretoria, some three years ago, and this animal had been bred in the Gardens. Mr. Helme, who is a Cambridge graduate and a scientific man, assures me that he has no doubt whatever as to the paternity of the male calf, and in a personal letter states, "It looks extraordinarily like an Afrikander. The chief points of difference are the small pointed ears, slender limbs, heavy dewlap and a fawn colour mark on the side." (Fig. 1.)

The rhinarium would appear to be like that of the ox, but there is some development of the dorsal hump of the eland.

It is, of course, doubtful if the hybrid will prove fertile; but the cross is of considerable scientific interest, since the eland is really very different from the genus *Bos* in many important anatomical characters: and, so far as I am aware, a successful cross between two mammalian species of different genera has not previously been recorded.

From the general aspect of the young calf it would appear that the *Bos* characters will be markedly prepotent over the eland characters.

In this connexion it would be interesting to ascertain as to how far the chromosome complex of the eland differs from that of domestic cattle, but I do not know if any observations have been made even on the latter.

ERNEST WARREN.

Natal Museum,
Pietermaritzburg,
April 12.

Origin of Insects from Crustacea

THE problem of the origin of insects has for long remained unsolved. In recent years, interest in it has considerably increased and I have myself brought forward arguments [1] which, while still admitting the *possibility* of a descent from Crustacea, tend rather to the view that insects and Crustacea have no very close relationship.

The supporters of the theory of a crustacean origin for insects rely chiefly upon the attempt to prove that the insect leg was originally a biramous appendage of the type found in the Malacostraca; in other words, that it originally possessed a true exopodite as well as an endopodite (the main shaft of the leg). It has long been known without a shadow of doubt that the lobes of the insect maxillæ are merely endites or gnathobases developed from a uniramous stalk. The only structures which can reasonably be claimed to be exopodites are the *coxal styles* found on the middle and hind legs of the family Machilidæ. These styles closely resemble the *abdominal styles*, found in Machilidæ and other Thysanura, and believed to form part of the reduced abdominal appendages.

So far as I know, nobody has ever succeeded in hatching any Machilid from the egg or in otherwise discovering the first instar of these insects. Heymons once stated (1897) that the abdominal styles of *Lepisma* did not appear until after the insect had hatched from the egg; but he was silent about the coxal styles of *Machilis*.

The position has become something of a 'stalemate', and further argument has appeared to me useless until such time as the first instar of a Machilid could actually be discovered. I have, therefore, fixed my attention on this point for the past two years. Thanks to the co-operation of Mr. Royce Cannon, a student of the University of Queensland, success has at last been attained. Machilidæ are very rare insects in Australia, but Mr. Cannon succeeded in discovering a locality near Brisbane where, amongst deep rubble and decaying leaves below a sheltered wall of rock, a species of *Allomachilis* could always be found. He has recently sent me specimens of the first, second, and many subsequent instars. I am now able to state definitely that this insect hatches from the egg with its abdominal styles fully formed, but *without any sign of coxal styles*. The second instar, like the first, is devoid of coxal styles, and it is only in the later instars that these organs are formed. At no time do they possess muscles, whereas the abdominal styles are provided with muscles from the very start.

We are, therefore, justified in concluding (1) that the abdominal styles are *not* serially homologous with the coxal styles in Machilidæ, (2) that the abdominal styles are parts of the original embryonic appendages, and (3) that the coxal styles are certainly *not* parts of such original appendages, but are merely

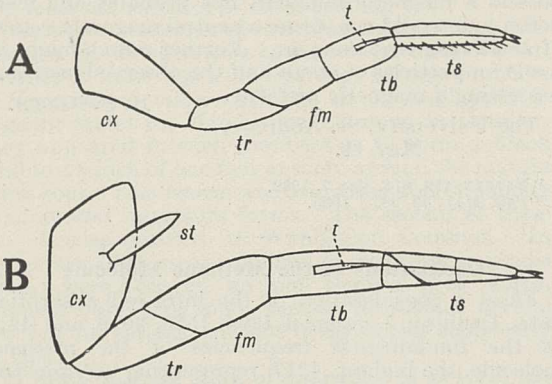

FIG. 1.—*Allomachilis* sp., Brisbane, Queensland. *A*. Middle leg, first instar. *B*. Middle leg, from specimen two-thirds grown. *cx*, coxa; *fm*, femur; *st*, coxal style; *t*, tendon of claw; *tb*, tibia; *tr*, trochanter; *ts*, tarsus (unjointed in *A*, three-segmented in *B*). *A*, ×40; *B*, ×75.

secondarily developed *spurs* without any muscle supply and having a deceptive resemblance in form to the abdominal styles.

For the benefit of those interested in the general problem, I append herewith a table showing the correct interpretation of the various limb processes in insects which, at one time or another, have been claimed by supporters of the theory of crustacean origin of insects to be true exopodites:

Appendages.	Process claimed to be Exopodite.	Correct Interpretation.
First maxillæ .	Lacinia	Endite (Gnathobase).
	Galea	Endite (Gnathobase).
Second maxillæ.	Glossa	Endite (Gnathobase).
	Paraglossa	Endite (Gnathobase).
Middle legs .	Coxal style (Machilidæ only)	Coxal spur without musculature.
Hind legs . .	Coxal style (Machilidæ only)	Coxal spur without musculature.
Gonapophyses of ninth abdominal segment	Inner valve (female) (Claimed by Crampton only)	Either (*a*) telopodite (endopodite), the dorsal valve then being the limb-base carrying a style, or (*b*) secondary process of the limb-base, the style representing the reduced telopodite.
Cerci . .	Paraproct (Claimed by Crampton only)	Secondary outgrowth of the eleventh sternite, *not part of an appendage*, the cerci being the *complete appendages* of the eleventh segment.

I think the accompanying table shows conclusively that there is now not a shred of evidence left, from a consideration of the appendages, that insects were ever derived from ancestors possessing biramous limbs of the Malacostracan type. That being so, it seems to me that the theory of the crustacean origin of insects is now effectively disposed of, and attention should be directed to more promising lines of inquiry.

R. J. TILLYARD.

Canberra, F.C.T., Australia,
Feb. 28.

[1] NATURE, **126**, 996, Dec. 27, 1930.

Nuclear Spin of Phosphorus from the Band Spectrum

THE extensive band system of P_2 in the ultra-violet is easily produced with considerable intensity by an uncondensed discharge through pure phosphorus vapour contained in a quartz tube. Regularities in the frequencies of the band heads were first found by Geuter, but the correct quantum designation of the bands has only recently been established by the work of Jakowlewa [1] on the absorption and fluorescence of the more refrangible part of this system. Two years ago, Herzberg reported, in a letter to NATURE, that a sudden breaking off occurs in the band progressions associated with various upper vibrational levels (at $v' = 11$ with the present assignment of vibrational quantum numbers), which can only be attributed to predissociation.[2] Herzberg also found that the rotational lines of the bands of highest observed v' stop suddenly, as was to be expected in consequence of the predissociation.

Since an alternation of intensity in the band lines should be observed in the spectra of molecules composed of two like atoms, provided the nuclear spin is finite and not too large, we have obtained high-dispersion spectrograms of the P_2 bands in an attempt to detect this. Although no alternation has been mentioned by previous investigators, our plates showed clearly that the intensities alternate in a ratio which we estimated at 3 : 1 in our first report on this work.[3] Since then, we have obtained better plates in the second order of a 21-foot grating, and carried through the analysis of the rotational structure by means of the combination principle. The newer results leave no doubt that the alternation of intensities is real, and that the nuclear spin of the phosphorus atom must be $\frac{1}{2}\frac{h}{2\pi}$, as required by the alternation ratio of 3 : 1. Quantitative intensity measurements, which are now in progress, will almost certainly confirm this. Furthermore, we find that the *odd* numbered rotational levels ($K'' = 1, 3, 5 \ldots$) of the lower state have greater statistical weight, and since this state is $^1\Sigma_g^+$, like the normal state of nitrogen, the complete wave-function of the molecule must be antisymmetrical, *An*, and the nuclei obey the Fermi-Dirac statistics.

A great many of the bands in the longer wave-length part of the spectrum, which can be studied with the grating, show marked perturbations of the rotational structure. Some of those which are sufficiently regular to yield reliable values of the band constants have been measured, including the following: 6,22 (λ *head* 2970·75), 6,23 (3028·00), 8,27 (3166·14), 8,28 (3228·65), and 9,28 (3183·84). From these we find, as preliminary values: $B_v'' = B_e'' - \alpha(v'' + \frac{1}{2}) = 0{\cdot}3045 - 0{\cdot}00152(v'' + \frac{1}{2})$; $B_v' = 0{\cdot}2410 - 0{\cdot}00165(v' + \frac{1}{2})$. The value of B_e'' gives the moment of inertia of P_2 in its normal state as $90{\cdot}8 \times 10^{-40}$ gm. cm.^{2}, and the internuclear distance, $r_e'' = 1{\cdot}88 \times 10^{-8}$ cm. The latter figure is unexpectedly large, if we compare it with the r_e'' of S_2 ($1{\cdot}603 \times 10^{-8}$ cm.) and with that predicted by Morse's empirical rule ($1{\cdot}5 \times 10^{-8}$ cm.). There is no ambiguity, however, in the determination of our values of B_v. The bands are of the simple $^1\Sigma, ^1\Sigma$ type, consisting of singlet

P and R branches, and only one assignment of rotational quantum numbers fulfils the combination principle exactly. Our conclusion as to the type of electronic transition involved agrees with that reached by Herzberg [4] as the result of unpublished work. A cursory examination of the breaking off of the rotational structure for bands with $v'' = 10$ and 11 also confirms his statements in this connexion. We do not propose to investigate the detailed effects of predissociation in this spectrum, as we understand that Dr. Herzberg is continuing his work in this phase of the problem.

F. A. JENKINS.
MURIEL ASHLEY.

Department of Physics,
University of California,
March 17.

[1] *Z. Physik*, **69**, 548; 1931.
[2] NATURE, **126**, 239, Aug. 16, 1930.
[3] *Phys. Rev.*, **39**, 552; 1932.
[4] *Erg. exakt. Naturw.*, **10**, 273; 1931.

Disintegration of Atomic Nuclei

THE epoch-making results as to the disintegration of atomic nuclei recently obtained in the Cavendish Laboratory serve to recall the experiments of Prof. J. N. Collie and his fellow-workers made twenty years ago. In some of these experiments it was thought that helium and neon were produced by sending powerful electric discharges through exhausted tubes. Sir William Ramsay observed the presence of helium in an old X-ray tube. Little information is available in the published accounts as to the potential difference employed in the experiments or as to the previous history of the (aluminium) electrodes. It was generally supposed that the balance of evidence was against such transformations, but it is possible that the failure of other investigators to reproduce the results of Collie may have been due to the fact that the precautions which they took resulted in an insufficient supply of swift protons in the discharge tube.

Be that as it may, taking into consideration the old and the new experiments, I should like to suggest that the aluminium nucleus, for example, may yield *neon* on disruption, in accordance with the process

$$Al^{27} + H^1 \longrightarrow 2He^4 + Ne^{20}.$$

In his report [1] of the discussion on the structure of atomic nuclei at the Royal Society, Dr. Ellis emphasises the uncertainty in speculating about such processes as

$$Al^{27} + H^1 \longrightarrow He^4 + Mg^{24},$$

but, in view of the possibility of the nucleus being built up of shells in a fashion somewhat resembling the electronic structure of the chemical atom, the suggestion that the neon nucleus is present in aluminium seems worthy of consideration.

In the second place, I should like to enter a caution as to accepting the particles of mass unity discovered by Dr. Chadwick in beryllium 'radiation' as representing the ultimate neutron. In a paper [2] on quantum magnetic tubes in rotation, published in 1925 and described in my book on "The Quantum and its Interpretation", I developed a suggestion due to Prof. E. T. Whittaker, that the difference between positive and negative electric charges might be interpreted as arising from different directions of rotation of the tubes. In the admittedly crude model there described, the mass of the neutron, in which there is no rotation of the tubes, would be the arithmetic mean of the masses of the proton and the electron. It therefore seems possible that the corpuscle of mass unity is composed of *two* neutrons. For, according to the hypothesis mentioned, the neutron is a magneton, and magneton pairs are likely to occur. Electron pairing is now recognised as an important factor in molecular structure, and may be attributed to the magnetic properties of the electron.

Experiments in an inhomogeneous magnetic field may serve to show that the corpuscles of Dr. Chadwick possess a magnetic moment, but probably the magneton pair would constitute a neutral magnetic system of small magnetic moment. Further search might be made for particles of about half the observed mass and possessing a magnetic moment.

H. S. ALLEN.

The University, St. Andrews,
May 11.

[1] NATURE, **129**, 674, May 7, 1932.
[2] *Phil. Mag.*, **49**, 981; 1925.

Oscillations of the Methane Molecule

FROM a consideration of the infra-red absorption data, Dennison [1] assigned 1304, 1520, 3019, and 4217 as the fundamental frequencies of the methane molecule, the highest, 4217, representing a symmetric expansion of the tetrahedron. In the Raman spectrum of methane, however, 4217 fails to appear, and we have instead a frequency 2918 recorded as an intense and sharp line, which is inactive in infra-red absorption and is therefore to be identified with a symmetric oscillation of the tetrahedron. I have accordingly suggested in a recent paper [2] that the fundamental frequencies of methane are 1304, 1520, 2918, and 3019, the frequency 4217 being merely a combination of the first and the third fundamentals.

Striking evidence in support of the new assignment is now forthcoming from observations made by me on the state of polarisation of the Raman lines. It is found that 2918 is nearly completely polarised ($\rho = 0{\cdot}08$), whereas the line 3019 is nearly unpolarised ($\rho = 0{\cdot}8$), thus presenting a complete analogy with the state of polarisation already ascertained for the third and fourth fundamentals in the case of the tetrachlorides. It is interesting to note that in the Raman spectra, 3019 appears accompanied by vibration-rotation components, while the more intense 2918 fails to exhibit them.

S. BHAGAVANTAM.

210 Bowbazar Street,
Calcutta, India,
April 1.

[1] *Astrophys. J.*, **62**, 84; 1925.
[2] *Ind. J. Phys.*, **6**, 595; 1931.

Swarming of Collembola in England

THE swarming of certain species of Collembola has been previously noted in Europe by several authors, notably Nicolet,[1] Löw,[2] Linnaniemi,[3] Latzel,[4] and Handschin,[5] and more recently J. M. Brown,[6] in a paper in the *Naturalist* for 1921, recorded several instances of this occurring in the north of England. The species in which he observed this phenomenon were *Podura aquatica* L., *Hypogastura viatica* (Tullb.), *Hypogastura purpurescens* (Lubb.), *Anurida maritima* Lab., *Isotomurus palustris* (Mull.), *Sminthurides malmgreni* var. *elegantula* Reut., *Sminthurinus aureus* var. *ochropus* Reut. All except the *Sminthurinus* and *Hypogastura purpurescens*, which were found on an old stone wall, are recorded as occurring on water.

In January this year I found two instances of the swarming of *Onychiurus armatus* (Tullb.). On Dec. 4, 1931, considerable numbers, mostly of the adult form of the species, were noted in a heap of dead leaves in a garden in Balham. By Jan. 18, 1932, the numbers

had greatly increased, so that parts of the heap were covered over with a creamy-white layer of the insects. The swarm was at the time composed of a very high percentage of immature forms. From about two cubic inches of mould I obtained some 130 individuals. The species is one which, as Brown observes, is known to be gregarious in its habits, but this is, I believe, the only recorded instance of its swarming.

Two other instances of this phenomenon were witnessed in the London area in the late autumn of 1931. The first of these was the occurrence of large numbers of *Hypogastura viatica* (Tullb.) on a small pool of stagnant water on Wimbledon Common in October. They appeared in such numbers as to form a black band to a width of one foot or more around the margin of the pool. This swarm was composed almost equally of adult and immature forms. The second of these two likewise occured on Wimbledon Common. In September 1931 great numbers of *Sminthurus viridis* (Linn.) were seen on an old wooden post which, although only 4 ft. high, had on its surface several hundred individuals, one side being almost completely covered.

In most of these cases of swarming (if not all) the factor producing this phenomenon would seem to be the relative abundance of the food supply. It may be supposed that an exceptionally suitable food supply of small extent and, in the case of winter breeding species like *Onchiurus armatus*, a spell of mild weather, increases the reproductive activities of the species, resulting in large numbers of immature forms which on a habitat of limited extent cause the appearance of the swarm. Other explanations of this swarming of Collembola would seem to be those of migration, as suggested by McNamara,[7] or possibly the sudden cessation of controlling influences. This last *may* perhaps go some way towards accounting for the swarming of *Sminthurus viridis* recorded above, as Lubbock[8] states that it is attacked by a small red mite which if fairly numerous in any locality might become a controlling factor of a very potent kind.

It is a significant fact, and one having some bearing on explanations, that all the species in which swarming has been recorded are gregarious.

F. A. TURK.

18 Fernside Road,
Balham, S.W.12.

[1] Nicolet, H., "Recherches pour servir à des Podurelles"—N. Denkschr. Schweiz. Ges. Naturw.; 6: 1-88, 9 pls., 1841.
[2] Löw, J., *Verh. Zool. Bot. Ges. Wien*, 8, p. 564, 1858.
[3] Linnaniemi, W. M., "Die Apherygotenfauna Finlands", I. Allgemeine Teil, *Acta Soc. Sci. Fenn.*, 34, No. 7; 1907.
[4] Latzel, "Papers on Collembola occurrlng in Snow: Carinthia Klagenfurt", 97.
[5] Handschin, E., "Über die Collembolenfauna der Nivalstufe", *Rev. suisse Zool.*, 1919, and others.
[6] Brown, J. M., "The Swarming of Collembola", *Naturalist*, 1921.
[7] McNamara, *Canadian Naturalist*, Nov. and Dec. 1919.
[8] Lubbock, Ray Soc. Monograph on Collembola, 1873.

Internationalism and Science

WHEN in South Africa last year, I tried to understand the politics of that country, turning largely on the differences between the British and the Dutch South Africans. Discussing the relative merits of two great South African leaders, I was told that one stood for the Empire, the other for South Africa, or that one was a practical politician, the other was not. But the substance of the matter seemed to be this, that one was predominantly intellectual, the other predominantly emotional. Now, when crossing the ocean, I much prefer a captain who guides the ship by means of his intellect, to one who does it by his emotions. We can scarcely think otherwise of the ship of State. Yet the emotions are very precious to us all, and to a very great extent we live by and for them.

Science, belonging to the intellectual sphere, must from its very nature be international. The scientific fraternity is the true International. But the emotional part of our nature is necessarily personal, or local, or national, rather than international. The arts serving our emotional needs should be similarly personal or local, and when they lose that quality they often deteriorate.* A very good example is the world fashion in clothing, causing 'well-dressed' young women to appear alike, whether in Central Asia or South America. On this basis we can understand why the Dutch South Africans cling to their peculiar language, a thing at first appearing so perverse and so useless. They do not wish their 'culture', the emotional side of their nature, to be submerged by the tide of Anglo-American 'civilisation'. I will not say that this justifies the use of Africaans in South Africa or Irish as the standard language of Ireland, but at any rate the motive has a genuine basis in the desire to preserve something of value.

In the field of religion we have a similar conflict. The Churches serve as an outlet for the emotional nature of man on a high plane, and are in that sense a necessity for his well-being. But on the intellectual side they offer us a conflict of doctrines having a traditional basis, which for the most part wither away when exposed to the light of modern science.

The general outcome is this, that science is and must be the leading international cult, and must be our guide in the practical affairs of life. But scientific men must recognise the limits of internationalism on the emotional side, and the positive disadvantage of trying to make all people *feel* alike. Thus the British should adopt and absorb everything of value in American science, but would be quite justified in excluding the American cinema, which tends to create an emotional attitude which is not British, or at any rate not in accordance with the ideals on which the future of Britain should be established. I recently heard a very able speaker, just returned from Europe, discuss what the students of Europe *think*. His discussion was very illuminating, but he was principally describing what they *feel*. That they should feel keenly and ardently is well enough, but it is dangerous to the public peace when they have only *felt*, but imagine themselves to have *thought*. To separate these two great functions of the mind, and give each its proper place, appears to be fundamental for human progress on sound lines.

T. D. A. COCKERELL.

University of Colorado,
Boulder, Colorado,
April 11.

* Rare masterpieces may be so elemental or fundamental in their appeal that they have little relation to time or place.

Stokes's Formula in Geodesy

I QUITE agree with the opinion expressed by Mr. Gulatee of the Survey of India [1] that Stokes's formula for the elevation of the geoid above the spheroid of reference is rather sensitive to systematic errors in gravity. The proper course seems to be, however, not to abandon Stokes's formula but to try to rid of error the reduced values of gravity, so that the results of applying the formula may be trusted.

The reason for this statement is that Stokes's formula furnishes the only known method—accurate or not—for obtaining the absolute elevations of the geoid referred to the spheroid without making some hypothesis as to the distribution of densities within the earth. The deflexions of the vertical can, in the nature of the case, give relative elevations only. Further-

more, until we can perform at sea operations equivalent to our triangulation and astronomical measurements on land, Stokes's formula furnishes the only means of obtaining the distance between the geoid and the spheroid over the oceans, that is, over nearly three-quarters of the area of the globe, unless again we resort to hypothesis. For example, the geoid may be computed for any region, whether on land or sea, by assuming a definite theory of isostasy. Interesting specimens of the contours of the geoid computed on the theory of isostasy may be found in the "Geodetic Reports of the Survey of India", vol. 5, and in the *Geophysical Supplement to the Monthly Notices of the Royal Astronomical Society* (vol. 3, No. 1, Jan. 1932).

Even with the admitted sensitiveness to the effect of error in reduced values of gravity, and with the consequent uncertainty in the geoid heights, the formula may be accurate enough to give valuable information about certain geophysical questions to which even a rough answer may be of value. For example, is the geoid over the deeper parts of the oceans depressed below the spheroid of reference, as the theory of isostasy would require, or is it raised above the spheroid, as certain observations of gravity at sea, admittedly too few to be conclusive, would seem to suggest? Is the form of the geoid more nearly a triaxial ellipsoid than an ellipsoid of revolution? Or more accurately stated, does the ellipsoid most nearly representing the earth as a whole deviate from an ellipsoid of revolution sufficiently for the deviation to have substantial geophysical significance?

Of course, as Mr. Gulatee suggests, Stokes's formula may be useful for determining relative or differential elevations of the geoid above the spheroid. It seems to me, however, that in regions where triangulation and astronomical observations are available the deflexions, as determined from these, ought to give a better idea of the differential elevations from Stokes's formula. The main value of the latter is for absolute elevations.

WALTER D. LAMBERT.

U.S. Coast and Geodetic Survey,
Washington, D.C.,
March 21.

[1] NATURE, **129**, 279, Feb. 20, 1932.

Errors in Thermal Measurements

PROF. PARTINGTON directs attention[1] to errors which are likely to be present when resistance thermometers are used in measurements of heats of adsorption. He does not refer to thermocouple thermometers directly, but he includes in his references papers which describe their use. Although calorimeters in which such thermometers are used are far from perfect, the situation is not quite so black as his letter might lead one to believe. For example, results have been obtained with these thermocouple calorimeters which agree with those of the ice calorimeter.[2]

The nature of the errors met with in measurements of heats of adsorption depends to some extent on the type of adsorption studied. Where adsorption is very rapid, care must be taken that the following conditions hold. It is essential that (*a*) the calorimeter be *completely* surrounded with objects at a constant temperature, (*b*) that the gas be admitted to the centre of the adsorbent and not to the sides of the mass, and (*c*) that sufficient length of the thermocouple leads be immersed in the adsorbent. (*a*) and (*c*) can be tested by the admission of an inert gas which will change the temperature in the neighbourhood of the junction unless the enclosure is at constant temperature, or if appreciable quantities of heat are conducted away by the thermocouple leads outside the calorimeter. When such precautions are taken, no maxima are obtained on the differential heats of adsorption curves similar to those recorded in results of earlier work.[3] When a high vacuum is obtained after adsorption, as is the case for the adsorption of oxygen on charcoal, the rate at which heat is distributed throughout the calorimeter is slow. In this case, it takes two to five minutes before the rate of cooling obeys Newton's Law. This causes an uncertainty in the value deduced for the heat of adsorption of not more than 5 per cent, and in some cases the error may be much less than this.

Where adsorption is not very rapid, (*b*) is an unnecessary precaution.[4] Since adsorption is slow, it is, however, necessary to make continuous measurements of pressure and temperature simultaneously in order that suitable corrections can be made to the cooling curves. In such cases, however, since adsorption usually occurs at high pressures, the thermometric lag is generally small.

The development of thermocouple calorimeters for measurements of heats of adsorption is of importance since these afford the best means of measuring these values at temperatures other than room temperature.

W. E. GARNER.

Department of Physical Chemistry,
University, Bristol,
May 2.

[1] NATURE, **129**, 615, April 23, 1932.
[2] Bull, Hall, and Garner, *J.C.S.*, 839; 1931. Marshall and Bramston-Cooke, *J.A.C.S.*, **51**, 2019; 1929.
[3] Bull and Garner, NATURE, **124**, 409, Sept. 14, 1929.
[4] Garner and Kingman, *Trans. Far. Soc.*, **27**, 322; 1931.

Free Ethyl

THE demonstration by Paneth and his collaborators of the existence first of the methyl[1] and quite recently of the ethyl[2] radicals in the free state has not, so far as we are aware, received independent confirmation. As apparatus capable of giving high streaming rates at suitable pressures being available in connexion with other researches which are engaging our attention in these laboratories, it appeared of interest to repeat the thermal dissociation of lead tetraethyl.

The material supplied by British Drug Houses was fractionated in a vacuum before use, and the operations were carried out in hydrogen, especial precautions being taken to ensure the absence of oxygen and moisture in the gas or on the surface of the apparatus. The velocity of the gas stream was 7·5 metres per second at pressures varying from 1-3 mm. through the transparent silica tube of 6 mm. internal diameter in which the phenomena were observed. So far as they went, our results confirm entirely the experiments of Paneth and Lautsch,[2] namely: (1) the removal of lead mirrors was readily detectable 10 cm. away from the source of the aggressive agent, (2) there was reformation of material which in turn yielded a mirror on heating, (3) an approximate measurement of the life period gave a result of the same order as that found in the original experiments.

T. G. PEARSON.
P. L. ROBINSON.
E. M. STODDART.

University of Durham,
Armstrong College,
Newcastle-upon-Tyne,
April 7.

[1] Paneth and Hofeditz, *Ber.*, **62**, 1335; 1929.
[2] Paneth and Lautsch, *Ber.*, **64**, 2702; 1931: *idem ibid.*, 2708.

Carbon Monoxide from Carbonates

IN the course of an investigation of the stability of certain ketylic derivatives we have found that carbon monoxide is produced in quantitative yield through the interaction of metallic sodium with certain non-polar carbonates. Thus, sodium reacts readily with a warm xylene solution of diphenyl carbonate with the formation of sodium phenoxide and carbon monoxide, as indicated by the following equation :

$$Ph_2CO_3 + 2Na = 2PhONa + CO.$$

The evolution of carbon monoxide proceeds quite smoothly and the gas is obtained in a state of high purity. In fact, the reaction is well adapted for the laboratory preparation of pure carbon monoxide. It is also interesting to note that the gas as thus prepared is so dry that it does not explode on ' sparking ' with dried oxygen.

The above reaction also occurs with alkyl carbonates, such as ethyl carbonate.

We have obtained evidence to show that the reaction occurs through the intermediate formation of ketylic derivatives. The dimeric forms of these derivatives, containing the phenoxy group, are unstable and suffer rapid decomposition with the elimination of sodium phenoxide. On these premises, it is interesting to note that the immediate precursor of carbon monoxide is the unknown oxide, C_2O_2.

Work along these lines is in progress in this laboratory, and further details will be published elsewhere.

S. T. BOWDEN.
T. JOHN.

The Tatem Laboratory,
University College, Cardiff, April 15.

Electrostatic Explanation of the Phenomenon of Flotation

PROF. KAMIENSKI suggests [1] that the adsorption of certain organic substances at the surfaces of platinum, graphite, and galena is due to an electrostatic attraction between them and globules of an emulsion formed by the organic substance. It is claimed that these solid surfaces are positively charged and that the emulsion is negatively charged. He then proposes that such an action is the basis of flotation.

This explanation of the basis of flotation is unsatisfactory. Adsorption of xanthates occurs readily from true solutions of their alkali salts, and flotation is possible in the absence of any emulsification. Moreover, the author himself states that there is a decrease in the potential of the surface, even when the emulsion is so dilute that its character is lost. It is uncertain what is meant by this change, but if it means a transition to true solution, the experimental results become very interesting in another connexion. They would then hint that adsorption from solution is accompanied by a decrease in the potential of the surface, from which it might be argued that negative ions—presumably xanthate ions—are adsorbed. This conclusion has been reached on other grounds.

IAN W. WARK.

Department of Chemistry,
University of Melbourne, Feb. 19.

[1] NATURE, **129**, 59, Jan. 9, 1932.

The Cry of Tin

THE experience of Dr. Chalmers [1] with regard to the ' cry ' emitted by cadmium and tin during plastic deformation agrees exactly with that of Mathewson and Phillips [2] obtained in coarsely crystalline zinc. In 1927 they recognised and discussed a silent process of simple slip which was unproductive of twins, and, furthermore, a type of deformation which caused both a ' crackle ' and multiple twinning.

In his letter, Dr. Chalmers states that he has " . . . not been able to produce a cry with any metal crystallising in a cubic system, for which twinning does not take place ". Lest there be any ambiguity, it may be said that cubic metals sometimes show mechanical twinning, the Neumann bands of α-iron being a case in point. During experiments involving the cold-rolling of crystals of iron containing 1·8 per cent of silicon, I distinctly heard a crackling sound from the metal, and subsequent examination showed the presence of twins.[3] That this is no unique observation is evident from the work of Mathewson and Edmunds [4] on silicon-bearing iron, but they take the matter somewhat further. In their 1928 paper we read : " Single crystal strips with cubic planes nearly parallel to the surface, crackled noticeably when pinched between rolls but produced only a few bands. When rolled on dodecahedral planes, virtually all the deformation occurred by a quiet slipping process." It may be pointed out here that compression or rolling of iron crystals on (011) faces produces much more strain-hardening than compression on cubic faces.

Dr. Chalmers observes that the ' cry ' was only noticed in aggregates which exceeded a certain crystal grain size. I have observed that in α-iron the larger the grain size the greater is the ease of production of Neumann bands, and the smaller the resistance of the metal to failure by shock.[5] Ordinary fine-grained iron only twins at room temperatures by impacting, but the addition of certain other elements both enlarges the grain size and permits of the production of twins by static deformation. The elements which behave in this way are phosphorus, tin, silicon, and aluminium, and it is perhaps not without significance that metallurgically they may roughly be described as deoxidisers.

HUGH O'NEILL.

The Victoria University of Manchester,
May 9.

[1] NATURE, **129**, 650, April 30, 1932.
[2] *Amer. Inst. Min. Met. Eng.*, 143 ; 1927.
[3] *Amer. Inst. Min. Met. Eng.* (Iron and Steel), 229 ; 1928.
[4] *Amer. Inst. Min. Met. Eng.* (Iron and Steel), 311 ; 1928.
[5] *J. Iron and Steel Inst.*, I, 417 ; 1926.

Isotopic Constitution of Lead

As described in a previous communication,[1] we have found from the hyperfine structure of the lead spectrum that the ordinary element contains, in addition to Pb^{208}, Pb^{206}, and Pb^{207}, a fourth isotope, Pb^{204}, with an intensity of 1 per cent. Owing to the presence of mercury (particularly Hg^{204}) in the discharge, the first analysis of lead by means of the mass spectrograph could not detect this new isotope. Recently, Aston [2] has repeated his analysis and reported Pb^{204}, together with four other weaker isotopes (209, 203, 205, and 210).

As our communication was not mentioned by Aston, we wish to point out that his data concerning Pb^{204} are in good agreement with ours. Although, according to Aston's results, 209 is just sufficiently intense to be observable by our method, our plates show no indications of its presence. With regard to 203 and 205, which are also the mass-numbers of the thallium isotopes,[3] it should be mentioned that thallium was always present in spectroscopically appreciable quantities in all our samples of ordinary (' accumulator ') lead. We therefore consider that the possibility of a contamination of the sample by traces of thallium should not be overlooked before the mass numbers 203 and 205 are finally attributed to lead. This point illustrates an advantage of the spectroscopic method, as the wave-lengths of the spectral lines are determined

chiefly by the external electron configuration of the atom—the isotopic effect enters only as a part of a hyperfine structure of the individual multiplet lines.

On account of the increased attention now being given to the study of very rare isotopes (abundances less than 1 in 1000) we would like to suggest that, in investigations where the isotopes of neighbouring elements (present as impurities) might cause difficulty, the preparations should be submitted to a spectroscopic analysis before the results are considered as final. As is well known, the sensitivity of the spectroscopic method surpasses that of any chemical test.

H. SCHÜLER.
E. GWYNNE JONES.

Astrophysikalisches Observatorium,
Einstein-Institut, Potsdam,
May 4.

[1] H. Schüler and E. G. Jones, *Naturwiss.*, **20**, 171; 1932.
[2] F. W. Aston, NATURE, **129**, 649, April 30, 1932.
[3] H. Schüler and J. E. Keyston, *Z. Phys.*, **70**, 1; 1931; confirmed by F. W. Aston, NATURE, **128**, 725, Oct. 24, 1931.

Activated Adsorption of Hydrogen

THE great revival of interest in adsorption measurements, carried out in connexion with catalytic experiments, which is manifested by the Oxford meeting of the Faraday Society, and by other similar publications, has prompted us to announce some results which we have obtained.

The adsorptions of hydrogen, hexane, cyclo-hexane, and benzene, at temperatures up to 450°, have been measured on a large number of metallic oxides. Attention has been primarily concentrated on substances which have known catalytic activities in hydrogenation, and on those which have not already been inspected by Prof. Taylor in Princeton. We have discovered that extensive 'activated' adsorption of hydrogen occurs with oxides of molybdenum, vanadium, chromium, and tungsten, and with metallic tin and cadmium.

Adsorption of hydrocarbons at high temperatures (up to 450°) is now found to be a still more general phenomenon, and takes place with every metal or metallic oxide which we have inspected so far (Cr, Ti, Fe, Cu, Mo, Zn, Cd, Ca, Zr, Mg, Sn, Co, Al, Mn, and W). The velocity and extent of the adsorption vary greatly in different cases, and are also considerably influenced by the presence of impurities; complications due to interaction of hydrogen with the solid have been avoided by pretreatment of the latter.

It is hoped to give an account, *in extenso*, of these experiments in the near future, as they should provide an interesting contribution to the study of catalysis.

H. HOLLINGS.
R. H. GRIFFITH.

Fulham Laboratory,
The Gas Light and Coke Co.,
London, May 12.

Interaction of Flavones and Anthocyanins

ROBINSON and Robinson [1] have recently directed attention to the existence of 'co-pigments' which, entering into loose combination with anthocyanin pigments, modify their colour.

In the course of my genetic experiments on *Dahlia variabilis*, it was found that the ivory flavone in the flowers apparently had the property of changing the anthocyanin colour in the direction of blue; for example, cyanin alone gives almost a chocolate colour but with ivory flavone the colour is bluish-purple. Apparently ivory flavone acts as a co-pigment for cyanin and pelargonin in *Dahlia*.

Recently I have tested, *inter alia*, the crude pigment extracts from flowers of widely different plants (for example, *Dahlia*, *Primula* spp., *Pelargonium*, *Tulipa*, and *Pulmonaria*). In a number of cases the ivory flavone pigments, *independent of hydrogen ion concentration*, have been found to bring about modification of anthocyanin colour. The blueness disappears on heating the solution, but returns on cooling. The ivory flavone effect may be additional to that of co-pigments, other than flavone, already present. Reciprocal differences were found in certain cases.

Further, in *Dahlia* there is an inverse correlation between the production of flavones and anthocyanins, the interaction being reciprocal, but to the advantage of the flavones; thus if much flavone is produced, then little anthocyanin is formed. The same phenomenon occurs in other plants. Anthocyanin intensity, therefore, may depend to a considerable extent on the presence or absence of flavones.

Changes in the hydrogen ion concentration of the sap have long been known as one cause of flower colour variation. Differences in the specificity of the anthocyanins constitute another. In view of the universal distribution of flavones, it seems probable that they will be found to comprise an important and hitherto unrecognised source of variation in both flower colour and intensity. A full account of these experiments will be published elsewhere.

W. J. C. LAWRENCE.

John Innes Horticultural Institution,
Merton Park, London, S.W.19,
April 30.

[1] Robinson, G. M., and R. Robinson, *Biochem. J.*, **25**, 1687; 1931.

Science and Disarmament

AN article in NATURE of April 4, 1931, pointed out the connexion between science and the preparation for war, in reference to Major Lefebure's book, "Scientific Disarmament". I understand from friends of mine, who are scientific workers, that in all countries some men of science regard as important the problem of their own moral responsibility for the use of scientific knowledge in preparation for war. Deliberate application of science in the development of armaments is transforming the nature of weapons and the general character of war. As Major Lefebure has shown, the gravest problem is the development of new types of weapon; and yet neither the official policies of governments nor the proposals of unofficial bodies seem to envisage this problem.

Would it not be possible to form a small group of chemists, physicists, and other scientific workers of standing, in Great Britain—and also in France, Germany, and the United States—in order to make some public statement against the application of research to the improvement of gunnery, bombing, and chemical warfare? Such a statement would have influence in directing the minds of students of science towards their moral responsibility for the use of new knowledge; and the Disarmament Conference, now in session at Geneva, would be assisted if scientific workers, who provide the means for increasing the destructiveness of war, were to indicate publicly the gravity of the danger. It is obviously quite useless to abolish old armaments, if new and more deadly types of weapon are to be produced by the application of scientific research to such an end.

C. DELISLE BURNS
(Stevenson Lecturer in Citizenship).

University of Glasgow,
May 16.

Research Items

Mummers' Plays.—Mr. H. Coote Lake has published a study of English mummers' plays with reference to the *Sacer Ludus*, in *Folklore*, **42**, No. 2. The mummers' plays are performed by villagers and others over the whole of England, the south of Scotland, and the north of Ireland; but there is no standard version and all sorts of perversions have crept in. A large number of versions—one collection contains thirty-three—have been printed, and probably many more have not been collected. Although they differ verbally and incidentally, the essential structure is the same, conforming, it is suggested, to the formula of an old European ritual dance or *Sacer Ludus*, a primitive magic rite in which the death and resurrection of summer was acted, in order that, as the actor who took the part of summer was slain and revived, so the summer, which had been slain by winter, might be revived. The comic doctor, who revives the hero, is a characteristic feature of the English play, and also appears in a folk play of Thessaly. He is a survival of the primitive medicine man. The Turkish knight, who in the English play fights with St. George, is represented in the Thessalian version by a character with a black face who molests the bride and slays the bridegroom. He is often thought to be derived from a dark character representing winter. A Thracian play represents a blend of a mummers' play and the Plough Monday celebration. In a considerable proportion of the plays there is a 'recognition' of the dead man, which dramatically is unnecessary. If, however, the mummers' play is to be identified with the mimetic rite, this recognition becomes the very germ of the drama.

Marriage Conditions in Palestine.—Dr. Hilma Granqvist has made a close and detailed study of marriage in the Mohammedan village of Artās over a period of three years between 1925 and 1931, of which the results have been published by the Societas Scientiarum Fennica, Helsingfors (*Commentationes Humanarum Litterarum*, **3**, 3). Dr. Granqvist's method has been to work by concrete examples, and she quotes her informants' words in verbatim translation, so that her information and deductions may be checked against one another. The subject is studied under three heads: age of marriage, choice of a bride, and marriage by consideration. The births of a boy and of a girl are greeted with a blessing on the 'bridegroom' or 'bride' as the case may be, and it is a usual practice for the girl thereupon immediately to be bespoken by the father of a boy. Provided the boy, or his parents on his behalf, make the customary gifts at the great feasts in after years, this promise, which has been guaranteed by witnesses and ratified by the gift of a handkerchief or the like and a present of money to the bride's father, is never broken, unless in exceptional circumstances. The marriage takes place at an early age—formerly even before puberty, until government action intervened. One of the reasons for early marriage which carried great weight was the fact that the Arabs have no female servants and it was desirable that the mother of the household should have additional female help. It also afforded the mother-in-law an opportunity to mould her son's wife to the ways of herself and the family. The marriage of the children of two brothers was the type of alliance most favoured, the interests of the family or clan being best served by such a marriage. The fathers arranged the marriages, and individual choice or love played no part.

A Red Indian 'Buffalo Drive'.—In the ages before the domestication of cattle and the cultivation of crops, an outstanding problem for the ill-armed hunter must have been the provision of the community's food supply. Special interest, therefore, is attached to devices for supplementing the food-supply, particularly where they involve co-operative action or careful planning. Both are commemorated in an ancient Indian 'buffalo drive' on Ox-Bow Ranch on Strickland Creek, not far from the boundary of Yellowstone Park. It was used perhaps only two or three hundred years ago, but the fifteen hundred stone arrow-heads found at the spot indicate a people whose culture was still that of a stone age. The drive was formed by two lines of stone piles approximately a quarter of a mile apart at the open end and converging over a mile of prairie until they ended some fifty feet distant from each other. The bison were herded into the open end and constrained to follow the smooth track between what seemed to them natural barriers, and these instead of terminating in a circular pound as was usually the case, ran sheer to the edge of a precipice in the lava rock, over which the stampeded herd rushed to its doom. The distribution of stone arrow-heads beneath the cliff showed how the Indians finished off the maimed animals. A steatite bowl and the arrows from the excavations made on the spot by Barnum Brown and his party (*Natural History*, vol. 32, 1932, p. 75) indicate that the hunters were the Shoshone Indians and not the Blackfoot tribe which inhabited that territory at the advent of white men.

Salmon of the West Coast of Scotland.—The extensive investigations made by the Fishery Board for Scotland into the life-history of the salmon have been devoted mainly to the rivers of the east coast. Observations made in the Grimersta district in the Isle of Lewis indicated that a significant difference might be found in the biology of the salmon on the west coast. Accordingly, a number of examinations have been made by Mr. P. R. C. Macfarlane of salmon from the River Dee in Kirkcudbrightshire in the years 1928 and 1929 (*Fisheries, Scotland, Salmon Fish.*, 1931, No. 2). The results indicate that there is slightly more growth shown by the west coast fish in their first year in the sea than by the east coast fish. This is taken as a possible indication that salmon from the two coasts of Scotland frequent different feeding grounds in the sea, and do not migrate to a common ground in the ocean. The parr from the river under survey also showed a considerably greater growth than do those of the Spey and Aberdeenshire Dee.

Chromosomes of *Sorghum*.—In a study of the somatic chromosomes of the genus *Sorghum*, Prof. C. L. Huskins and Mr. Stanley G. Smith (*J. Genetics*, vol. 25, No. 2) find that the wild species and cultivated varieties examined all have twenty chromosomes, except the Johnson grass, *S. halepense*, which has forty. All, without exception, have a single pair of *A* chromosomes of peculiar character. The cultivated sorghums came from tropical Africa, while *S. halepense* is Mediterranean. Since it has but one pair of *A* chromosomes, it is probably an allotetraploid, having arisen from a cross between a diploid *Sorghum* and some other genus without an *A* chromosome. The evidence indicates that all the diploid wild and cultivated species of *Sorghum* will cross readily, while there is great difficulty in crossing Johnson grass with the diploid forms, and the progeny from such crosses are almost sterile. In the root tips examined, a number of tetraploid segments and one

octoploid segment were found in diploid roots. The general results are in accordance with and confirm the views already held by systematists regarding the relationships of these forms.

Loch Doon 'Granite' of Galloway.—The igneous complex of Loch Doon has been described by C. I. Gardiner and S. H. Reynolds (*Quart. J. Geol. Soc.*, 1932, pp. 1-34). The authors find that the plutonic rocks range from true granites in the central ridge to norite at certain parts of the margin, the major portion of the mass being tonalite. These three types seem to be the result of three successive intrusions in order of decreasing basicity. Numerous minor intrusions penetrate the complex and the sedimentary rocks surrounding it. They include relatively large bodies of hybrid or dioritic character and small dykes of porphyrites and mica-, hornblende-, and augite-bearing lamprophyres. Some of the dykes, however, are metamorphosed and thus appear to be pre-plutonic. Metamorphism of the sediments has resulted in the production of mica-cordierite-hornfels. The spreading out of the metamorphic aureole to include the Burnhead mass indicates an underground extension of the plutonic rocks at no great depth, and suggests that the mode of emplacement of the complex may be laccolithic.

The Humboldt Current.—The generally accepted explanation of the Humboldt Current of the Pacific coast of South America, as being derived mainly from the westerly drift of the Southern Ocean and only partly by upwelling of cold water, is questioned by the researches of the R.R.S. *William Scoresby*. In a note in the *Marine Observer* for June, it is recorded that this ship was engaged in surveying the Humboldt Current during the winter of 1931. The current was not found, at that season, south of Valparaiso, which seems to dispute the view that the surface drift of the Southern Ocean feeds it, and favours the secondary cause, namely, the upwelling of cold water due to prevailing south-east and southerly winds. The current reaches its maximum width and greatest strength, about twenty-five miles a day, off Peru. It finally disappears about five degrees south of the equator, underneath the warmer waters of the El Niño current that sets south. The El Niño waters occasionally pass inside the cold Humboldt waters, with disastrous consequences to the climate of Peru. It must be remembered, however, that the Humboldt Current has always been known to be very variable from year to year, and its seasonal fluctuations take it well south of Valparaiso in summer and even in winter, but at that season at a considerable distance from the coast.

Air Movement and Weather.—Sir Napier Shaw has contributed a paper entitled "St. Martin's Summer in England in 1931" to *Beiträge zur Physik der freien Atmosphäre* (Band 19). It was written in commemoration of the birthday of V. Bjerknes, whose name is familiar to meteorologists mainly on account of his important contributions to dynamical meteorology. The extraordinary spells of unseasonable warmth that occurred during the last two months of 1931 were due largely to the occurrence of long spells of southerly or south-westerly wind of subtropical if not of tropical origin; this paper discusses a part of this period centring around Nov. 3. It is shown that the gales experienced in the south-east of England on that day travelled from west of Portugal in 24 hours, that the motion of the air stream underwent acceleration, and that the adjustment of horizontal pressure gradient to velocity at once took place. This air-stream reached Scandinavia and Finland a day later. There was nothing very abnormal in the circumstances attending these events, the value of the paper lying chiefly in the discussion of the dynamics of moving air that centres around them. Sir Napier's views on these matters, particularly in regard to the greater importance to be attached to the air movement than to the distribution of areas of high and low pressure to which the movement gives rise, have nowhere been more clearly expressed. It is shown that under the conditions existing in an atmosphere that is almost unconfined, the energy represented by the pressure distribution is of secondary importance in atmospheric circulations.

Demonstration of Wave Groups.—A description of an apparatus for explaining the nature of wave groups has been sent us by Dr. D. B. Macleod of Canterbury College, Christchurch, New Zealand. A circular aluminium disc of about 20 cm. diameter was hollowed out and a sine wave cut on the inner portion so that a given number of waves fitted into the circle. A second disc was left solid, and a wave cut on the outer edge. The discs were then mounted, one in front of the other, and rotated at a speed great enough to eliminate flicker. Arrangements were made so that the speed of each could be varied separately. The discs were illuminated by a beam of parallel light from a lantern, and thus silhouetted on a screen. A wave group then appeared on the screen, and its velocity, forward or backward, could be controlled by adjusting the speeds of rotation. The number of waves on a disc may be so few as one, the curve then being a cardioid, or so many as eight or nine. The apparatus can be used to make clear many properties of wave groups, and, by suitably choosing the number of wave-lengths on each disc, can be made to give general ideas of the application of these properties to the electron and to quantum orbits.

Superconductivity for Alternating Currents.—The work of Prof. J. C. McLennan and his associates on superconductivity at high frequencies (NATURE, Dec. 12, 1931, p. 1004) has now been described more fully (*Roy. Soc. Proc.*, May). Measurements were made on lead, tin, and tantalum by the reactions of oscillatory circuits made of these, and immersed in the refrigerant, on a tuned oscillator outside the Dewar flask. The effect of using the high-frequency current instead of direct current is twofold: the abruptness of the transition from ordinary conduction to superconduction as the temperature is progressively lowered is markedly diminished, and the temperatures of both onset and effective completion of superconduction fall. With increase in frequency, the transition temperature becomes lower, and it is calculated by extrapolation of the experimental results for tin that the transition would not occur until the absolute zero was reached for a frequency of about 10^9 cycles per second. The apparent failure of metals to become superconductors at sufficiently high frequencies is supported by the fact that no evidence of an abrupt change corresponding to superconductivity has ever been observed with light waves. A number of additional experiments which had to be performed to verify that the frequency effect was not due to some subsidiary cause are also described.

The Red Nitrogen Band Spectrum.—The partial analysis of the rotational structure of these bands by S. M. Naudé (*Proc. Roy. Soc.*, May) is interesting both for the information which it furnishes about the nitrogen molecule and for the time during which these bands, which are amongst the best-known of spectra, have defied complete analysis. Even now, only a section of the system, in which there is com-

paratively little overlapping, has been analysed, an idea of its complexity being given by the fact that a resolving power of 180,000 was not sufficient to show all the existing fine structure. Each band consists of three groups of nine branches, the electronic transition being of the $^3\Pi$–$^3\Sigma$ type, and the usual information has been derived from the data for the size and other properties of the molecule. Consecutive lines of the branches have alternating intensities in the ratio of approximately two to one, thus showing that the nitrogen nucleus is spinning with unit angular momentum, a conclusion which has also been reached from the study of some bands of the ionised nitrogen molecule. In making this analysis, much assistance was obtained from the quantum theory of molecular structure, which, as with atomic spectra, permits of prediction of the types of terms and, for molecules, the details of rotational structure likely to be encountered.

Artificial Production of a Penetrating Nuclear Radiation.—Mr. Webster's observations on the secondary radiation produced in beryllium and other light elements by bombardment with polonium α-particles (*Roy. Soc. Proc.*, May; see also NATURE, March 12, p. 402) are an excellent example of the type of work which is usually required now to obtain new knowledge of atomic nuclei, and has only become possible through recent advances in technique with special precautions to eliminate spurious effects. The low efficiency of production of the secondary radiation, which ranges from 0·5 quanta per million α-particles for magnesium to 30 quanta for beryllium, is here aggravated by the small ionising power of the product; the intensity of the effect ultimately measured when this is cut down by screens to measure its penetrating power is very small indeed. A strong α-particle source is necessary, and the measurements must be made in a place free from serious radioactive contamination. Two detecting instruments, both highly sensitive, have been used, a Geiger-Müller tube counter and a high pressure ionisation chamber, the latter being usually preferred. The counter does not appear to be fulfilling the high expectations it aroused when it was first devised—at least in the form usually employed—and is usually described as somewhat erratic in action. The full interpretation of Mr. Webster's results must remain uncertain, until it can be decided how much of what he has observed is due to neutrons and how much to γ-rays, but his extensive experiments will certainly serve as a sound basis for future work.

Biological Test for Rhamnose.—Aldo Castellani and F. E. Taylor in 1917 described a 'mycological' method for the identification of various sugars and other carbon compounds, based upon the fermentations exerted on these substances by diverse species of *Monilia*. Castellani now describes a bacillus which ferments rhamnose with gas production, but does not produce gas from twenty-eight other substances tested; these included eight other sugars, six alcohols, two glucosides, inositol, dextrin, inulin, and several starches (*Ann. de l'Institut Pasteur*, T. 47, p. 297; 1931). This bacillus, obtained from human fæces, is a small aerobic, non-sporing, non-motile, Gram-negative organism which is named *B. rhamnosifermentans*. If this organism ferments a solution which reduces Fehling's solution, in all probability it contains rhamnose. The method employed is to prepare a sterile one per cent solution of the substance to be tested in peptone water in a Durham's fermentation or other tube, inoculate with the *B. rhamnosifermentans*, and incubate at 37° C. for four days; gas production indicates the presence of rhamnose. Suggestions are given whereby a mixture of sugars, etc., might be identified by the use of this and other fermenting organisms.

Astronomical Topics

Detection of Kopff's Comet.—Another of the numerous periodic comets due this year has been detected. Mr. Bobone found Kopff's comet at Cordoba (Argentine) in the following position:

	R.A. (1932·0).	S. Decl.	Mag.
May 25·0788 U.T.	15h 11m 18·8s	26° 11′ 12″	12

It is rather brighter than was expected. The concluded date of perihelion is Aug. 21·40 U.T.; this is 0·24d later than Mr. Kepinsky's prediction, and 1·08d later than Mr. Cripps's in the "B.A.A. Handbook". This comet was discovered in 1906, and seen again in 1919 and 1926.

Cometary Observations at Yerkes Observatory.—Prof. G. van Biesbroeck gives much attention to observations of comets, chiefly by photography with the 24-inch reflector. *Harvard Card* 189 contains a series of observations of Nagata's comet made by him during February, more than eight months after perihelion. It was of magnitude 15½ and had a faint coma, 25″ in diameter, with a central condensation. The positions indicate that the period of 267 years, found by Crommelin in the autumn, is somewhat too short, but the orbit is definitely elliptical, with a period of a few centuries.

A telegram distributed by the I.A.U. Bureau, Copenhagen, announces that Prof. van Biesbroeck detected Grigg-Skjellerup's comet on March 6 at 1h 30·3m U.T. Its position for 1932·0 was R.A. 5h 31m 49·3s, S. Decl. 5° 3·0′. Magnitude 16. This is the fourth observed apparition of the comet, the others being 1902, 1922 (when its periodicity was discovered), 1927. As the period is very close to five years, the circumstances of each return are nearly the same.

Distribution of Stellar Luminosities.—The distribution of absolute magnitudes for stars brighter than magnitude 6·0 has been investigated by Strömberg in a series of papers in the *Astrophysical Journal*. These have dealt separately with groups of stars within narrow limits of spectral type, using a valuable new statistical method which employs peculiar motions, parallactic motions, and radial velocities. He now summarises his previous results (*Astrophys. J.*, **75**, 115) and brings together on one diagram the luminosity curves for all the different spectral types. Several very interesting features which had been suggested in the earlier investigations now appear more definitely in the assembled results. The distinction between normal giants and dwarfs (or 'main sequence' stars) is, of course, evident; but the existence of an intermediate group ('faint giants') also appears for the types M_0 to F_0. At type A all these three groups merge together and carry on the main sequence to a maximum luminosity of −2·9 for early B stars. On the side of greater luminosity, two other fairly well defined sequences occur, termed respectively 'bright giants' and 'super-giants', which are found throughout nearly the whole spectral range. The latter attain absolute magnitudes as bright as −8 for early B stars. The gap between bright giants and normal giants is very definite, and the author suggests that this may represent a region of instability connected with cepheid variation and outbursts of novæ.

The Mond Photographic Equatorial of the Norman Lockyer Observatory

ON Saturday last, May 28, in the presence of a distinguished assembly, Sir Frank Dyson, Astronomer Royal, opened at the Norman Lockyer Observatory, Salcombe Hill, Sidmouth, a new building containing a unique photographic equatorial presented to the Observatory, together with the dome and building itself, by Dr. Robert L. Mond. The Observatory was founded nearly twenty years ago by Sir Norman Lockyer and Sir Francis McClean, and it first bore the name of the Hill Observatory. It was afterwards formed into a corporation under the Companies (Consolidation) Act of 1908, and Norman Lockyer's name was given to it as a memorial of the great work done for science by that renowned astronomer.

The site of the Observatory, at a height of 560 feet on the top of Salcombe Hill, and with an unbroken horizon in every direction, was presented to the Observatory by Sir Norman and Lady Lockyer. Hitherto, the two main instruments have been a twin telescope with object glasses of 12 and 10 inches aperture, presented by Sir Francis McClean, and a telescope of 10 inches aperture, presented by Sir Norman Lockyer. Each of the two telescopes is fitted with a prismatic camera—one 12 in. and the other 9 in.; and the Observatory now possesses a collection of 6458 spectra taken with these cameras. From the beginning, the Observatory has been built, equipped, and maintained entirely by private contributions, and one of its most generous supporters is Dr. Mond, who has now added to his gifts the new photographic equatorial illustrated in Fig. 1.

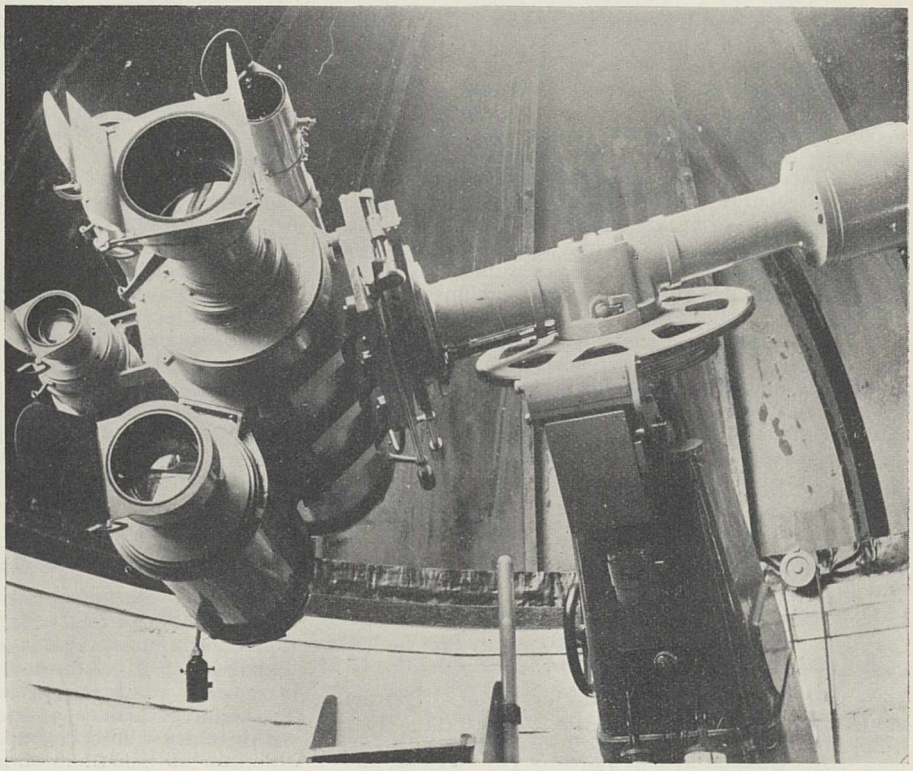

FIG. 1.—The Mond Photographic Equatorial.

The construction of this instrument was suggested by the director of the Observatory, Dr. W. J. S. Lockyer, and the work has been carried out by Messrs. Cooke, Troughton and Simms. Dr. W. H. Steavenson made a thorough optical examination of the Zeiss lenses selected for mounting to form the photographic battery, and he afterwards again visited the Observatory to complete the very accurate adjustments required of the optical axes of the lenses in relation to the planes of the photographic plates. The following are extracts from his report on the new telescope and the kind of work it is capable of doing:

"The instrument has been designed for the photography of relatively large regions of the sky on a small or moderate scale. This particular class of instrument may be said to have been introduced by the late Prof. Barnard, and to have its prototype in the famous Bruce photographic equatorial, designed by him and used for his well-known photographs of the Milky Way. As will be seen, the Mond equatorial is in many respects similar to the Bruce. Details of the optical equipment are shown in this accompanying table:

	Lens.	Focal Length. Cm.	Aperture. Cm.	Size of Plate. Inches.	Area Covered in Degrees.	Scale of Plate per Inch.
1.	Zeiss Triplet	120	17·1	10 × 12	14 × 12	1·1°
2.	Zeiss Triplet	70	14·0	8½ × 6½	17 × 13	2·1°
3.	Zeiss Triplet	50	10·4	6½ × 4¾	18 × 13	2·9°
4.	Zeiss Anastigmat	25	7·0	5 × 4	30 × 24	6·4°

There is also a 4-inch guiding telescope fitted with double sliding eye-end with bright and dark illumination to field.

"The equatorial mounting, which is of the German type, is of very massive construction, the lower half of the mounting weighing 1 ton 6 lb. That part of the casting which holds the polar axis overlaps the vertical portion very considerably, as in the Bruce mounting. This allows of complete and uninterrupted circumpolar motion at all declinations. The driving circle is very accurately cut, and is of generous proportions, its diameter being 27½ inches. The polar axis is mounted in ball bearings, and the whole instrument, when unclamped, will move at the lightest pressure of one finger.

"Setting in R.A. can be done very comfortably from floor level, the circle being let into the south side of the mounting and geared to the lower end of the polar axis. This circle is divided to five minutes of time, and the Declination circle to single degrees. Both circles are read by simple pointers, verniers and fine divisions being unnecessary for this type of instrument.

"The clock, which is driven by a weight falling in

a steel frame outside the Observatory, will run for about $2\frac{3}{4}$ hours without re-winding. It is controlled electrically by a seconds pendulum mounted in the vestibule. Slow and rapid motions in R.A. are provided by means of a specially geared electric motor, working on the driving-worm independently of the clock.

"In recent years several American and continental observatories have added small-scale photographic instruments to their equipments, but it is believed that the Mond equatorial is the first of its kind to be erected in Great Britain.

"The uses to which the instrument can or will be put include the photography of meteors, comets, and large nebulosities of the galactic type. In addition, the search for new minor planets, comets, variable stars, and novæ can be undertaken with such an apparatus with a greater hope of success than where an instrument of greater power but smaller field of view is used. Even unsystematic work with this battery of cameras may be of considerable ultimate value."

At the opening ceremony, Sir Richard Gregory, chairman of the Council of the Observatory, said he hoped that the wide and intelligent public interest now shown in astronomical subjects would lead to increased support for the Observatory, in which valuable work in astronomy is being carried on with instruments and funds provided by private donors, and without the aid or control of State or other official institutions. Private benefactions have provided the United States with the finest observatories in the world, with the result that we owe to American astronomers some of the most important observations made in recent years in solar and stellar astronomy, particularly in the field of astronomical physics. It is perhaps too much to expect similar munificent support for astronomical research in Great Britain, but it ought not to be too much to hope that an observatory like that on Salcombe Hill, in which many notable contributions to progressive knowledge have been made, should be placed in such a financial position that the maintenance of its activities will be ensured.

In the course of his remarks, Sir Frank Dyson said: "It is now ten years since I had the honour of unveiling here the tablet to Sir Norman Lockyer. There can be no doubt that his spirit pervades the Observatory. Constant observation seems to be the rule, and there are more fine nights here than we have at Greenwich. Dr. Lockyer produces for us with regularity valuable papers on stars with bright hydrogen lines. He is making constant observations of stars in which the intensity of the components of these lines varies. A star in Camelopardalis, Bradley 448, he observed through the entire cycle 1925–30 of its variability. He has also discussed φ Persei and a number of other stars, and has discovered a number of new stars with bright hydrogen lines. Mr. Edwards is repeatedly bringing out spectroscopic parallaxes of early type stars. The influence of the Observatory is felt as far away as Canberra, where Mr. Rimmer is carrying on valiantly under difficult financial conditions. I am quite sure Sir Norman would have been delighted to see how the work, in which he was so greatly interested, is being developed."

Dr. R. G. Atkin, director of the Lick Observatory, said that he always read with great interest the papers describing the spectroscopic and other observations and results achieved at the Observatory, and he congratulated the Council upon the addition of a most useful instrument to its equipment. Dr. Mond, in his reply, referred to his long association with Sir Norman Lockyer and Dr. Lockyer, and said that he regarded the new instrument as an astronomical 'robot' which would faithfully record celestial appearances and events over wide fields of view while the staff of the Observatory was carrying on the routine spectroscopic work on individual stars; and the photographs thus obtained would be of permanent value for astronomical reference and discovery.

International Committee of the History of Science

THE fourth annual conference of the Comité International d'Histoire des Sciences was held in Paris on May 13–16, under the presidency of Prof. Karl Sudhoff. Among those present were Mme. Hélène Metzger, Prof. P. Diepgen, Prof. F. Faddegon, Dr. E. J. Holmyard, Prof. Louis Massignon, Prof. Aldo Mieli (permanent secretary), Prof. E. Mittwoch, Prof. A. Reymond, and Prof. D'Arcy W. Thompson. The meetings were held at the Centre international de Synthèse (12 Rue Colbert), and, apart from formal business, were devoted entirely to the history of the sciences in medieval Islam. The president, Prof. Sudhoff, read a paper on Constantine, the first to transmit Muslim science to the West, and described the part played in this transmission by Maurus and Urso, two early schoolmen of Salerno. Prof. Massignon, in a brilliant discourse, pointed out the contrast between Greek and Muslim conceptions of numbers, and suggested the importance of Manichæan ideas in early arithmology.

The present state of research into Arabic mathematics, astronomy, and physics was fully described in a report by Prof. Faddegon, and similar reports on geography, cartography, and medicine were presented by Profs. Ferrand, Renaud, and Mittwoch. The chairman of the sub-committee for Arabic studies, Prof. Julius Ruska, was unfortunately not able to attend the conference, but his report on Arabic alchemy was read by Prof. Diepgen. Though much has been done in recent years, particularly on the Jabir problem, the Emerald Table of Hermes, and the Turba Philosophorum, it was evident from Prof. Ruska's report that the full elucidation of Muslim alchemical ideas and practice will require many years of intensive effort. In the course of the discussion, it was suggested that an urgent need is the detailed investigation of the numerous works of Aidamir al-Jildaki, while a catalogue of Arabic alchemical manuscripts in Spain is greatly to be desired. The possibility was mooted of establishing a central card index of Arabic technical and scientific terms, to supplement the meagre information on this subject contained in the standard dictionaries of Lane, Dozy, etc. A collateral index of alchemical and other signs was also considered desirable.

A further problem that the Comité regards as worthy of close attention is the assessment of the influence upon Muslim scientific thought of the doctrines of Gnosticism, Neoplatonism, and Manichæism; the latter in particular, according to Prof. Massignon, has left very distinct traces in Muslim alchemical theory. The question of the systems of transcription of Arabic words gave rise to considerable difference of opinion, but it was generally felt that no single system is likely to attain universal adoption, however desirable such uniformity may be.

On Saturday, May 14, members of the conference were given a delightful reception at the Sorbonne, by the Institut d'études islamiques and the Institut d'histoire des sciences. The next annual meetings of the Comité will be held at Warsaw (1933) and Berlin (1934).

The Provincial Universities of Great Britain

IN the October (1931) issue of the *Universities Review*, Prof. E. R. Dodds opened a discussion on the question, "What is Wrong with the Modern Universities?" Further articles in the April issue carry the matter on another stage. These outspoken essays are in general agreement as to there being ample grounds for the implied assumption of failure to realise an ideal, and incidentally testify to the value of Dr. Abraham Flexner's recent work, "Universities: American, English, German", in stimulating thought on the subject.

Most students of the modern universities are, according to Prof. W. M. Tattersall, whose presidential address to the Association of University Teachers is reproduced in the April issue of the *Review*, uncivilised and, in a broad sense, uneducated. They are conspicuously lacking in that *bildung* which Flexner holds to be characteristic of the product of the ancient universities. Prof. Tattersall attributes this largely to the fact that only a small percentage of the students are able to live in colleges or hostels, the larger number living either at home or in lodgings. Pending or failing the provision of a complete and compulsory residential system, an organised effort should be made to promote informal and social contacts between staff and students. He suggests, and the scheme is not without precedents, that the students should for this purpose be allotted in groups to members of the staff, each of whom would act in the capacity of 'moral' tutor to the group assigned to him (or her).

In an article headed "University Uniformity", in the same issue, Prof. R. C. McLean observes that the root of the trouble with our local universities is that they are so intensely local. He is in favour of spells of wage-earning during the study years and migration between universities. Two other articles discuss the same problem with special reference to the large proportion of the students of the modern universities who are destined for the teaching profession.

The teacher-training departments occupy in the modern provincial universities a position peculiarly favourable for estimating the effects of the educational processes at work in the arts and pure science departments. The diploma course of these departments includes graduates from many different schools of the university, and while pursuing it they show 'the mettle of their pasture'. It is fitting, therefore, that there should be two articles by members of the staffs of teacher-training departments, namely, Profs. F. A. Cavenagh and J. F. Duff. Both are of opinion that students suffer from being over-taught in the effort to cover the whole of the ground defined by an elaborately prescribed syllabus, with the result that they have little time for spontaneous learning.

Since lectures cannot be dispensed with or the lecture programme greatly reduced while the students are so numerous in proportion to the staffs, the remedy, suggests Prof. Cavenagh, lies in improving the lectures. Too many university teachers give but little thought to their teaching as an art in itself, regarding skill in teaching as something that comes by itself or is beneath the notice of a competent scholar. The 'research' fetish, moreover, has largely ousted the ideal of the well-educated, well-read student with more than one intellectual interest. Both articles direct attention to the evil results that follow in many cases the choice by students of a highly specialised course merely because it seems the only avenue to the goal of a 'good honours degree', notwithstanding that a less specialised course would be more congenial and of greater practical utility.

University and Educational Intelligence

CAMBRIDGE.—The Managers of the Balfour Fund have made the following grants: (1) £100 to I. T. Sanderson, of Trinity College, for an investigation of the land vertebrate fauna of the Cameroons; (2) £30 to D. L. Serventy, of Gonville and Caius College, for a biological survey of the East Anglian estuaries.

W. E. Candler, scholar of Trinity College, has been elected to the Sheepshanks Exhibition.

The Council of the Senate recommends that the readership in ethnology be discontinued, and that there be established a William Wyse professorship of social anthropology, which shall be held in the first instance by Col. T. C. Hodson, of Christ's College.

The General Board recommends that the subject of pharmacology be placed under the superintendence of the professor of physiology in the Department of Physiology, and that the University lectureship in pharmacology be transferred from the Faculty of Medicine to the Department of Physiology in the Faculty of Biology *B*.

The Board of Research Studies has approved Mr. U. R. Evans, of King's College, for the degree of Sc.D.

A Research Studentship at Emmanuel College, of the maximum annual value of £150, will be awarded in July. Preference will be given to candidates who have already completed one but not more than two years of research. Applications, including a statement of the proposed course of research, must reach the Master, Emmanuel College, Cambridge, not later than June 30.

OXFORD.—On May 24, Congregation passed a decree acknowledging with gratitude the offer of the Rockefeller Foundation to contribute a sum not exceeding 2,300,000 dollars, together with an additional 10 per cent of the estimated cost of construction, towards the extension of the Bodleian Library; on condition that the University shall have received for the same purpose a total of £377,720 before the end of 1936. In proposing the adoption of the decree, the Warden of New College mentioned that the scheme included the addition of a new wing to the Radcliffe Science Library at the Museum.

THREE post-graduate scholarships in pure and applied science are being offered by University College, Nottingham. The value of each is £100, and they are tenable for one or two years. Forms of application, returnable by July 21, can be had from the Registrar of the College.

Calendar of Geographical Exploration

June 5, 1594.—Barents in the Arctic

A Dutch expedition, with William Barents (Willem Barentszoon) in charge of one ship, the *Mercurius*, sailed from Texel to search for the North Sea route to the east. Barents on this voyage discovered and explored the northern part of Novaya Zemlya. Two of the other vessels that left the Texel on that date were in charge of Jan Huyghen van Linschoten, a distinguished Dutch mariner, and they penetrated into the Kara Sea. Linschoten's report resulted in the sending of a second Dutch expedition in 1595, which, however, was compelled by ice and contrary winds to return when it had barely entered the Kara Sea. A third Dutch expedition, this time organised by the city of Amsterdam, sailed on May 10, 1596, with William Barents as chief pilot. They discovered Bear Island and part of Spitsbergen, which Barents, however, thought was Greenland. On returning to Bear Island, Barents sailed south and the other ship

north. Barents and his party were compelled to winter at Ice Haven, the first record of western Europeans wintering in the arctic. They suffered severely, though a lucky find of driftwood prevented them from dying of cold. In early June they started their return journey, their boats being in constant danger from floating ice. Barents, enfeebled by his winter hardships, died, but de Veer brought the vessels home in November 1597, being much helped by meeting the companion ship which had left them at Bear Island and now brought them supplies of food.

June 5, 1866.—Valley of the Mekong

An expedition sent out by the French Government left Saigon to explore the Mekong, Doudart de Lagrée being in command and F. Garnier accompanying him as geographer. They went up the Mekong to Pnom-Penh and examined the ruins of Angkor. Thence they reached the confluence of the Se-khong, which was examined as far as Siempang. Bassac was made a centre for expeditions to the Boloven plateau, the Se-don, and the divide between the Se-don and the Se-khong. From Bassac they continued up the Mekong to the Se-mum, and from Ubun, on that stream, Garnier made an overland traverse through Siemreap to Pnom-Penh. After other expeditions, the party reached Chieng Kong, but could proceed no farther because of rapids. They went north-east, and reached Yunnan on Dec. 21. De Lagrée died before the expedition ended, but Garnier made his way to the Yangtse-kiang and returned by sea to Saigon. This journey is memorable alike for the immense amount of new country opened up and for the wealth of geographical, ethnological, and economic data collected and afterwards published.

June 7, 1576.—Rediscovery of Greenland

Martin Frobisher sailed from the Thames in search of a north-west passage to China, the effort being a result of a pamphlet published by Sir Humphrey Gilbert arguing that such a passage must exist. On July 11 he sighted Friesland (Greenland), and in August reached 63° N., where he entered Frobisher Bay. He believed that this was the strait for which search had so long been made. Descriptions of the Eskimo and their customs are included in the narratives of this and subsequent voyages. Frobisher's interest in discovery was diverted to a search for gold in the region. On his second voyage in search of that metal he discovered, apparently accidentally, the channel now called Hudson Strait. Frobisher may be considered the pioneer of arctic navigation.

June 8, 1924.—Mt. Everest

G. L. Mallory and A. C. Irvine left Camp 6, altitude 26,800 ft., for their attempt on the summit of Mt. Everest, and N. E. Odell caught a glimpse of them before the mists enshrouded them. They never returned. Bad weather had been experienced on the march, and Norton, Somervell, and Mallory had, after heroic efforts, rescued four porters who had remained on the North Col and been cut off by a hurricane. Norton on June 4 had been attacked by snow-blindness, but Hingston and Hazard led the blind man successfully down the steep and difficult descent. A Gurkha officer and a Tibetan follower lost their lives. The attempts on Mt. Everest in 1921, 1922, and 1924 resulted in the survey of the Rongbuk glacier region, and in much new topographical information about the region. The work of Major R. W. G. Hingston threw much light on the struggles of animals to exist in high altitudes, while that of Heron and Odell contributed to the knowledge of the geology and glaciology of the region.

June 11, 1774.—Nootka Sound

Juan Perez sailed from Monterey in the *Santiago*, and reached lat. 55° N. On the return voyage he touched the harbour now known as Nootka Sound, in 49° 35′, naming it San Lorenzo. In 48° 10′ he sighted a peak which he called Santa Rosalia, the modern Mount Olympus.

ERRATUM.—In NATURE of May 28, p. 805, the date of Livingstone's death is given as April 30, 1830; this should read April 30, 1873.

Societies and Academies

LONDON

Royal Society, May 26.—**E. V. Appleton and R. Naismith**: Some measurements of upper atmospheric ionisation. Experimental work on the reflexion of wireless waves by the upper atmosphere has shown that if the frequency of waves, projected vertically upwards, is steadily increased, the Kennelly-Heaviside layer (Region *E*) is ultimately penetrated and reflexion takes place at the upper region (Region *F*). The critical penetration frequency varies diurnally and seasonally. From measurements of the critical penetration frequency made in south-east England, the maximum ionisation content of the Kennelly-Heaviside layer is at noon, and a minimum occurs just before dawn. The diurnal variation curves correspond very closely to the theoretical curves obtained by S. Chapman in his study of the atmospheric ionisation produced by a solar stream of monochromatic radiation. Summer noon ionisation is found to be about 2·5 times as intense as winter noon ionisation.—**J. D. Cockcroft and E. T. S. Walton**: Experiments with high velocity positive ions (1 and 2). In order to obtain high steady potentials for the acceleration of protons, a method has been developed by which the voltage of a transformer can be rectified and multiplied several times by an arrangement of valves and condensers. A rectifier system has been built consisting of four glass cylinders placed end to end and arranged in the form of a tower 12 ft. high, the cylinders containing suitable electrodes and hot filaments and being evacuated continuously. With this apparatus and four condensers, a potential of more than 700 kv. has been obtained, which is steady to within a few per cent. The method used is a special case of a more general method of transforming steady potentials from low to high voltages and in the reverse direction. The voltage of the rectifier is applied to an experimental tube which is built to allow positive ions to be accelerated by the full voltage available. Positive ions of hydrogen are directed down the axis of two glass cylinders and focused by suitable electrodes, current of the order of 10 microamperes being obtained. Protons having energies up to 710 kv. have been produced, and have been transmitted through a mica window into an experimental chamber at atmospheric pressure, where their ranges are measured (see also NATURE, April 30, p. 649).

PARIS

Academy of Sciences, April 18.—**H. Douvillé**: The formation of flints. The properties of colloidal silica suffice to explain the formation of flints, without the necessity of assuming a true solution of the silica. The same explanation may apply to pyrites.—**C. Matignon, Dodé, and Mlle. Langlade**: Urea phosphate. Details of preparation, solubility, and hydrolysis of phosphate of urea, $CO(NH_2)_2 . H_3PO_4$.—**Louis Roy**: The internal thermodynamic potential of an elastic

line with six parameters.—**Joseph Boucher**: A new, or slightly known, property of the radicles of germinated barley. A suggested treatment for diabetes.—**Eugène Donard** and **Henri Labbé**: The existence in the malt dust of germinated barley of a substance possessing hypoglycæmic power and acting in a manner analogous with insulin. The action was proved by experiments on rabbits.—**Long**: The geometric definition of a group of Σ surfaces.—**André Weil**: The series of polynomials of two complex variables.—**F. Marty**: The second and third derivatives of a holomorph and univalent function in the circle unity.—**Alfred Rosenblatt**: The stability of the movements of Couette.—**Henri Porcin**: The stationary cavitations in a fluid in irrotational movement.—**J. Pérès** and **L. Malavard**: Electrical analogies in hydrodynamics.—**Kivelisvitch**: The null velocities in the problem of three bodies.—**G. Rougier**: A photoelectric photometer with amplification for the measurement of feeble illuminations. The instrument is standardised by comparison with a stable light standard after each measurement, and has been applied to numerous observations on the moon.—**Émile Belot**: The origin and evolution of stars and amorphous nebulæ, according to the dualist cosmogony.—**André Berthelot**: The unit of length employed in the first measurements of the earth's circumference. From an examination of the data available, it is concluded that Posidonios and Ptolemy used the same unit of length as Eratosthenes, namely, the Egyptian stadium of 157·5 metres.—**Y. Rocard**: Regulated valve oscillators.—**R. Chevallier**: The magnetisation of ferromagnetic powders in weak fields.—**Th. V. Ionescu** and **C. Mihul**: Free electrons of ionised gases in the magnetic field.—**Léon Dubar**: The constitution of the oxide of rectifiers and of photoelectric cells using cuprous oxide. The rectifying layer has been submitted to examination by chemical, microscopical, X-ray, and electrical methods. Cuprous oxide is a non-conductor, and the cause of the conductivity is disseminated throughout the mass in very small quantity. This hypothetical cause of the conductivity, possibly CuO, can only be present as a solid solution or colloid solution.—**G. Siadbei**: A new method of measuring very small angles of rotation. The method is based on the reflexion from the curved surface of the air bubble in a spirit level. An amplification of 400 is obtained.—**A. Silveira**: The Raman effect in solutions of salts.—**J. J. Agarbiceanu**: The anti-Stokes term in the fluorescence spectrum.—**H. Jedrzejowski**: An example of the mobility of radioactive atoms on the surfaces of solid bodies. A study of the diffusion of polonium over the surface of platinum at various temperatures.—**Francis Perrin**: The existence of neutrons and the constitution of nuclei of light atoms.—**Pierre Auger**: The radioactivity of potassium.—**H. Hering**: The heterogeneous equilibria in the system: cadmium bromide, potassium bromide, and water.—**Martineau**: The oxidation of ethyl alcohol by air in presence of various binary or tertiary catalysts. The catalysts used included charcoal-zirconia, charcoal-thoria, copper-cerium oxide, copper-thoria, and catalysts containing three constituents. One catalyst containing carbon, thoria, and copper caused the production of aldehyde at the ordinary temperature.—**Raymond Buret**: Chlorine and phosphorus compounds derived from dibenzoylmethane.—**Mlle. Madeleine Roy**: Cryoscopic researches on castor oil.—**Jacques Bourcart** and **Mlle. Elisabeth David**: The series of Foraminiferous grits of Ouezzan (Western Morocco).—**Y. Milon**: The extension of Eocene siderolithic formations in the centre of Brittany.—**Thoral**: Tectonic outline of the eastern part of the Monts de Lacaune.—**P. Fallot**: The connexions of the series with Alpine facies identified between Sierra Sagra and Alicante.—**Albert Michel-Lévy**: The existence of pre-Cambrian formations in the Montagne Noire (Hérault).—**R. Bureau**: The daily variation of atmospherics at Paris, 1928–31. The respective influences of the sources and of the propagation.—**P. L. Mercanton**: The inversion of the magnetic inclination during geological epochs. New proofs.—**Ad. Davy de Virville**: The flora of the reefs of the roadstead of Saint-Malo.—**O. Munerati**: The possibility of the beetroot producing seed the first year in Egypt and in other regions with a similar climate. It is proved by experiment that a type with a marked tendency to seed the first year shows clearly the same tendency in regions where the production of seed the first year has never been proved before.—**A. Maige**: The rôle of the plast and cytoplasm in the amylogen condensation.—**Paul Becquerel**: The latent life of the spores of mosses at low temperatures. After 240 hours' exposure to the temperature of liquid nitrogen (−190° C.) the moss spores all germinated with the same regularity as controls. In further experiments on the dried spores of *Atrichum undulatium* and of *Dicranella heteromalla*, exposure for 9 hours in liquid helium at −269° C. and one hour at −271·16° was found to leave the germinating power unaffected.—**Mlle. A. Dusseau**: A hybrid haplodurum resulting from crossing two *Triticum vulgare*.—**Jules Amar**: The coefficient of hydrothermal partition.—**Augustin Boutaric** and **Maurice Doladilhe**: The principle of a physical method by means of which the transformations produced by dilutions in a serum may be followed.—**Nedă Marinesco**: The effect of intense diathermy on plants.—**Maurice Nicloux**: The combustion of alcohol in the homeotherm. The quantity of alcohol burnt in unit time, for unit weight of body is constant. In white mice this constant is 0·65 mgm. per gram-hour.—**Henri Marcelet**: Oil of *Orthagariscus mola*; modifications due to parasites. Abnormal proportion of cholesterol.—**G. Warcollier** and **Aug. Le Moal**: The accidental presence of acrolein in cider brandy.—**Mme. S. Lallemand**: The distribution of chloroform in the egg of the fowl in the course of the intoxication of the germ by this anæsthetic. The order of magnitude of the cellular toxic dose.—**M. Advier**: The existence in the blood of a convalescent plague patient of a principle breaking down Yersin's bacillus.—**R. Pons** and **C. Durieux**: The existence in the bubo of a convalescent plague patient of an agent of transmissible lysis, apart from its presence in the intestine.—**Ph. Lasseur, M. Pierret, A. Dupaix**, and **C. Maguitot**: Remarks concerning the correcting note of M. Lakhovsky.—**André Pling**: Contribution to the study of the bactericidal power of metallic silver with respect to the typhoid bacillus and coli bacillus. It is shown that metallic silver is slightly soluble in water (concentration of the order 1×10^{-5}), and that this affords an explanation of its bactericidal action.

CRACOW

Polish Academy of Science and Letters, Feb. 15.—**Lad. Orlicz**: (1) A certain class of spaces of type B.—(2) The theory of the differential equation $y' = f(x, y)$.—(3) Contributions to the theory of orthogonal developments (Pt. iii.).—**C. Zakrzewski** and **M. Miesowicz**: Feebly damped short electric waves. It has been known for some time that metallic tubes transform the damped electric waves produced by spark vibrators. With tubes of different cross sections, short waves, only slightly damped, can be obtained. The authors have been able to produce by this method waves of a wave-length of 50 mm.—**M. Centnerszwer** and **J. Szper**: The electrolysis of alkaline cyanides. An attempt to put the prepara-

tion of the alkali metals by the electrolysis of the cyanides on a commercial basis.—J. Zawadski and S. Bretsznajder: The course of the reactions between calcium oxide and sulphur dioxide and calcium oxide and carbon dioxide.—J. Tokarski: New microscopic and chemical analyses of the phosphorites from Grodno (Poland).—J. Jarocki and Z. Raabe: Three new genera of Infusoria of the Hypocomidæ family (*Ciliata Thigmotricha*), parasites of fresh-water lamellibranchs.—J. Zacwilichowski: The innervation of the sense organs of the wings of insects (3).

SYDNEY

Royal Society of New South Wales, Dec. 8.—M. B. Welch, F. A. Coombs, and W. McGlynn: Notes on wattle barks (3). An investigation has been made of the tannin content of the barks of the principal species of *Acacia* belonging to the so-called 'decurrens' group. Six species which can be recognised are described and a number of bark analyses are given. *A. mollissima* is the outstanding species with regard to tannin content, although *A. decurrens* and *A. Arundelliana* yield useful barks and may prove of value under conditions which are unfavourable to *A. mollissima*.—E. Cheel and M. B. Welch: A new species of wattle. The new wattle is closely related to the 'silver wattle' (*Acacia dealbata*), but has longer leaflets and not so many pairs of pinnæ, and the whole leaf has a fern-like appearance, which has prompted the colloquial name 'fern-leaf wattle'. It has some resemblance to the 'tan-bark wattle' or so-called 'black wattle' (*Acacia mollissima*), but the 'fern-leaf wattle' flowers during July-August and has broad, flat pods, whereas the 'tan-bark wattle' flowers during November-December months and produces very narrow pods.—M. B. Welch: Notes on the shrinkage of wood. A list is given of the lateral and volumetric shrinkages, densities, etc., measured on a number of the more important woods in use in New South Wales.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, vol. 18, No. 2, Feb. 15).—Arnold Gesell: The developmental morphology of infant behaviour pattern (with a demonstration of methods of systematic cinematography). Twenty-five or more children were examined at lunar month intervals, from four to fifty-six weeks of age, written and cinematograph records being taken to describe posture, locomotion, prehension, and so on. An observation dome 12 ft. in diameter with a special crib at the universal focal area has been built at the Yale Clinic of Child Development; the dome is encased in a white painted wire screen, and when illuminated, the observers and cameras outside the screen are effectively concealed. Illustrative series from films taken are reproduced in the paper.—Alan W. C. Menzies and D. A. Lacoss: Allotropy of liquid benzene. The data of other workers show that the rate of change with temperature of several physical properties alters abruptly at about 40° C.—Wilder D. Bancroft and John W. Ackerman: The fading of lakes and dyed fabrics. An experimental investigation of the fastness of various dyes and mordants under different conditions.—A. Dorothy Bergner and A. F. Blakeslee: Cytology of the *ferox-quercifolia-stramonium* triangle in *Datura*. Differences of chromosome configuration have been found which are interpreted as due to segmental interchange.—G. W. Beadle: A possible influence of the spindle fibre on crossing-over in *Drosophila*. Evidence is found of interference in the immediate neighbourhood of the spindle fibre.—J. L. Walsh: An expansion of meromorphic functions.—A. J. Lotka: Contribution to the mathematical theory of capture. (1) Conditions for capture. Consideration of a system comprising one prey species and one predatory species.—Edward V. Huntington: A new set of independent postulates for the algebra of logic with special reference to Whitehead and Russell's "Principia Mathematica".—D. V. Widder: Preliminary note on the inversion of the Laplace integral.—Francis D. Murnaghan: On the unitary invariants of a square matrix.—Tracy Yerkes Thomas: Conformal tensors (2).—Luther Pfahler Eisenhart: Intransitive groups of motions.—Solomon Lefschetz: On certain properties of separable spaces.—Eberhard Hopf: Complete transitivity and the ergodic principle.—Francis G. Benedict, Edward L. Fox, and V. Coropatchinsky: The incubating python: a temperature study. Sitting and broody hens were thought to have high temperatures; this has been disproved. Lamarre-Picquot claimed in 1832 that the python coils about her eggs to supply heat for their incubation. It has already been shown by Benedict and his collaborators that under ordinary conditions the body temperature of a snake is slightly below that of the environment. Similar studies on an incubating python show that its body temperature is about 3° C. above that of the environment. It is suggested that the incubating python is an intermediate stage between non-incubating reptiles and birds in the scale of evolution from cold- to warm-blooded animals.

Forthcoming Events

FRIDAY, JUNE 3

PHYSICAL SOCIETY OF LONDON AND OPTICAL SOCIETY (at Imperial College of Science and Technology), 2.30 to 5.30, and 7 to 9.30.—Joint Discussion on Vision.

ROYAL SOCIETY OF ARTS (Indian Meeting), at 4.30.—Dr. J. H. Hutton: Census of India, 1931 (Lecture).

ROYAL SOCIETY OF MEDICINE (Disease in Children Section), at 5.30.—Annual General Meeting.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. J. C. McLennan: Electrical Conductivity of Metals at the Lowest Temperatures.

SATURDAY, JUNE 4

ROYAL OBSERVATORY, GREENWICH, at 3.30.—Annual Visitation.

INSTITUTION OF ELECTRICAL ENGINEERS (London Students' Section).—Summer Outing to Southampton.

MONDAY, JUNE 6

VICTORIA INSTITUTE (at Central Buildings, Westminster), at 4.30.—Sir Ambrose Fleming: Some Recent Scientific Discoveries and Theories (Presidential Annual Address).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.—General Meeting.

TUESDAY, JUNE 7

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. J. W. McNee: The Liver and Spleen: their Clinical and Pathological Associations (Croonian Lectures) (2).

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—Prof. W. J. Sollas: The Sagittal Section of the Human Skull. Pt. II.: Palæanthropic Skulls (Lecture).

INSTITUTE OF BRITISH FOUNDRYMEN (Annual Conference) (at Newcastle-upon-Tyne) (*continued on June 8 to 10*).

WEDNESDAY, JUNE 8

GEOLOGICAL SOCIETY OF LONDON.—L. R. Wager: Geological Work in East Greenland during the British Arctic Air-Route Expedition, 1930–31 (Lecture).

UNIVERSITY OF OXFORD (in University Museum).—Dr. R. A. Fisher: Social Selection of Human Fertility (Herbert Spencer Lecture).

THURSDAY, JUNE 9

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. J. W. McNee: The Liver and Spleen: their Clinical and Pathological Associations (Croonian Lectures) (3).

OPTICAL SOCIETY (at Imperial College of Science and Technology), at 7.30.—Annual General Meeting.

CHELSEA PHYSIC GARDEN.—Dame Helen Gwynne Vaughan: The Contribution of Plants to the Study of Heredity (Chadwick Lecture).

FRIDAY, JUNE 10

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section) (Annual General Meeting), at 5.—E. Clarke: Tay's Choroiditis.

ROYAL SOCIETY OF MEDICINE (Laryngology and Otology Sections) (at Eye and Ear Hospital, Portsmouth).—Summer Meeting (*continued on June* 11).

JUNE 16 TO 18

ANNUAL COLLOID SYMPOSIUM (at Ottawa, Canada).

Official Publications Received

BRITISH

Publications of the South African Institute for Medical Research. No. 30: Tuberculosis in South African Natives; with special reference to the Disease amongst the Mine Labourers on the Witwatersrand. Pp. 429+24 plates. (Johannesburg.)

Nyasaland Protectorate: Geological Survey Department. Colonial Development: Water Supply Investigation. Progress Report (No. 1) for the Year 1931. Pp. ii+27+5 plates. (Zomba.)

The British Mycological Society. Transactions. Edited by J. Ramsbottom, B. F. Barnes and H. Wormald. Vol. 16, Part 4, 2 May. Pp. 209-339. (London: Cambridge University Press.) 7*s.* 6*d.*

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1431 (A. 106): Age-Hardening of Aluminium Alloys. By Dr. Marie L. V. Gayler and G. D. Preston. Pp. 19+5 plates. (London: H.M. Stationery Office.) 1*s.* 3*d.* net.

The Scottish Forestry Journal: being the Transactions of the Royal Scottish Forestry Society. Vol. 46, Part 1, March. Pp. xx+98+24. (Edinburgh: Douglas and Foulis.) 7*s.* 6*d.*

Proceedings of the Royal Society. Series A, Vol. 136, No. A829, May 2. Pp. 464. (London: Harrison and Sons, Ltd.) 23*s.* 6*d.*

List of the Linnean Society of London, 1931-1932. Pp. 71. (London: Linnean Society.)

Report of the National Baby Week Council, 1931, presented and adopted at the Fifteenth Annual Meeting of the National Baby Week Council held in London on the 16th March 1932. Pp. 24. (London.)

The Carnegie United Kingdom Trust. Eighteenth Annual Report (for the Year ending December 31st, 1931) approved by the Trustees on March 11th, 1932. Pp. ii+95+4 plates. (Dunfermline.)

Birmingham Bureau of Research on Russian Economic Conditions. Memorandum No. 5: i. Remarks on the Five Year Plan; ii. Agricultural Collectivization; iii. Oil Consumption and Export. Pp. 24. (Birmingham: The University.)

Transactions of the Optical Society. Vol. 33, 1931-32, No. 1. Pp. ii+36. (London: Optical Society.) 10*s.*

University Grants Committee. Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1930-31. Pp. 28. (London: H.M. Stationery Office.) 1*s.* 6*d.* net.

Journal of the Indian Institute of Science. Vol. 15B, Part 1: A New Permeameter. By K. V. Karantha. Pp. 16+14 plates. (Bangalore.) 1.8 rupees.

The Half-yearly Journal of the Mysore University. Vol. 5, No. 1, January. Pp. 190. (Bangalore: The Bangalore Press.) 2 rupees.

Bulletin of the Raffles Museum. No. 6, December 1931. Pp. 154. (Singapore: Raffles Museum.) 1 dollar; 2*s.* 6*d.*

Memoirs of the Queensland Museum. Vol. 10, Part 2, 30th March. Pp. 89-130. (Brisbane: Queensland Museum.)

Canada: Department of Mines: Geological Survey. Summary Report, 1930, Part D. (No. 2288.) Pp. 143D. Summary Report, 1931, Part B. (No. 2300.) Pp. 84B. Memoir 169: Geology and Mineral Deposits of a part of Southeastern Manitoba. By J. F. Wright. (No. 2296.) Pp. iii+150. 25 cents. (Ottawa: F. A. Acland.)

Dominion of Canada. Report of the Department of Mines for the Fiscal Year ending March 31, 1931. (No. 2297.) Pp. v+61. (Ottawa: F. A. Acland.) 25 cents.

Indian Journal of Physics, Vol. 6, Part 6, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 15, Part 6. Conducted by Sir C. V. Raman. Pp. 467-606. (Calcutta.) 3 rupees; 4*s.*

The Institution of Professional Civil Servants. Annual Report of Council for the Year 1931. Pp. xiii+48. (London.)

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1439 (T. 2298): Effects of Sideslip on Rolling and Yawing Moments. By F. B. Bradfield and A. S. Hartshorn. Pp. 4+10 plates. 6*d.* net. No. 1442 (T. 3171): Motions of a Stalled Bristol Fighter fitted with Auto-Control Slots and Interceptors. By A. Ormerod. Pp. 4+4 plates. 4*d.* net. No. 1435 (A. 17.64.88): Dimensional Stability of Heat-treated Aluminium Alloys. By J. D. Grogan and D. Clayton. Pp. 18+13 plates. 1*s.* net. (London: H.M. Stationery Office.)

Southern Rhodesia. Geological Survey Bulletin No. 19: Interim Report on the Geology of part of the Salisbury Gold Belt. By R. Tyndale-Biscoe. Pp. 39+4 plates. (Salisbury.) 2*s.*

Journal of the Society for the Preservation of the Fauna of the Empire. New Series, Part 16. Pp. 64. (Hertford: Stephen Austin and Sons, Ltd., 1932.) 2*s.*

The Proceedings of the Physical Society. Vol. 44, Part 3, No. 243, May 1. Pp. viii+231-438. (London: Physical Society.) 7*s.* net.

The Rhodesian Museum, Bulawayo. Thirtieth Annual Report, 1931. Pp. 15. (Bulawayo.)

Northern Naturalists' Union. Transactions. Edited by Dr. F. C. Garrett. Vol. 1, Part 1. Pp. 77. (Newcastle-on-Tyne: Andrew Reid and Co., Ltd.) 4*s.*

Proceedings of the Royal Society of Edinburgh, Session 1931-1932. Vol. 52, Part 2, No. 8: On the Structure of Vertebraria. By Prof. John Walton and Miss Jessie A. R. Wilson. Pp. 200-207+2 plates. 1*s.* 3*d.* Vol. 52, Part 2, No. 9: Graphical Analysis of Internal Combustion Engine Indicator Diagrams. By Alex. R. Horne. Pp. 208-217. 9*d.* Vol. 52, Part 2, No. 10: The Pigmentary System and the Dopa Reaction. By Evlyn Boyd. Pp. 218-235+4 plates. 2*s.* 6*d.* Vol. 52, Part 2, No. 11: The Zeta Function of Jacobi. By L. M. Milne-Thomson. Pp. 236-250. 1*s.* 3*d.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 70, No. 425, May. Pp. 477-588+xviii. (London: E. and F. N. Spon, Ltd.) 10*s.* 6*d.*

Proceedings of the University of Durham Philosophical Society. Vol. 8, Part 5, 1931-1932, February. Pp. iii+359-467+vi. (Durham.) 5*s.*

Royal Observatory, Edinburgh. Forty-second Annual Report of the Astronomer Royal for Scotland, 1932. Pp. 7. (Edinburgh and London: H.M. Stationery Office.) 2*d.* net.

FOREIGN

Bell Telephone System. Technical Publications, Monograph B-656: Modern Developments in Precision Clocks. By Alfred L. Loomis and W. A. Marrison. Pp. 30. (New York: Bell Telephone Laboratories.)

University of Denver: Department of Anthropology. Archæological Survey of Eastern Colorado, Second Report. By E. B. Renaud. Pp. 45. (Denver, Colo.)

Conseil Permanent International pour l'Exploration de la Mer. Journal du Conseil. Vol. 7, No. 1. Rédigé par E. S. Russell. Pp. 165. (Copenhague: Andr. Fred. Høst et fils.) 4.50 kr.

Conseil International de Recherches. Union Géodésique et Géophysique Internationale: Section de Séismologie. Publications du Bureau Central Séismologique International. Série A, Travaux scientifiques, Fascicule No. 7: Communications présentées à la Conférence de Stockholm (Août 1930). Pp. 128+14 planches. (Strasbourg.)

U.S. Department of Agriculture. Technical Bulletin No. 291: The Effect of Air Drying on the Hydrogen-Ion Concentration of the Soils of the United States and Canada. By Ernest H. Bailey. Pp. 44. (Washington, D.C.: Government Printing Office.) 10 cents.

Smithsonian Institution. Explorations and Field-Work of the Smithsonian Institution in 1931. (Publication 3134.) Pp. iv+190. (Washington, D.C.: Smithsonian Institution.)

Library of Congress. A List of American Doctoral Dissertations printed in 1930. Prepared by Mary Wilson MacNair. Pp. vii+342. (Washington, D.C.: Government Printing Office.)

The Science Reports of the Tôhoku Imperial University, Sendai, Japan. Second Series (Geology), Vol. 15, No. 2. Pp. 41-168+plates 5-10. (Tôkyô and Sendai: Maruzen Co., Ltd.)

Journal of Science of the Hiroshima University. Series A (Mathematics, Physics, Chemistry). Vol. 2, No. 2. Pp. 103-158. 72 sen. Series B, Div. 1 (Zoology). Vol. 1, Articles 5-9. Pp. 65-168. 1.85 yen. Series B, Div. 2 (Botany). Vol. 1, Article 4: Studies on the Hepaticae of Japan, V. By Yoshiwo Horikawa. Pp. 55-76+plates 7-9. 41 sen. Vol. 1, Articles 5-9. Pp. 77-134+plates 10-16. 1.06 yen. (Hiroshima.)

Collection des travaux chimiques de Tchécoslovaquie. Rédigée et publiée par E. Votoček et J. Heyrovský. Année 4, No. 4, Avril. Pp. 145-192. (Prague: Regia Societas Scientiarum Bohemica.)

Proceedings of the Imperial Academy. Vol. 8, No. 3, March. Pp. v-vi+59-112. (Tokyo.)

Acta Photochimica. Edited by Prof. Keita Shibata. Vol. 6, No. 1, April. Pp. 178. (Tokyo: Iwata Institute of Plant Biochemistry.) 3.50 yen; 1.70 dollars.

U.S. Department of Commerce: Coast and Geodetic Survey. Serial 540: Magnetic Declination in the United States, 1930. By Daniel L. Hazard. Pp. 41. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the United States National Museum. Vol. 80, Art. 15: The Copepod Crustaceans of Chesapeake Bay. By Charles Branch Wilson. (No. 2915.) Pp. 54+5 plates. (Washington, D.C.: Government Printing Office.)

Proceedings of the American Philosophical Society. Vol. 71, No. 2. Pp. 39-71. (Philadelphia.)

Annales de l'Observatoire de Paris, Section d'Astrophysique, à Meudon. Publiées par Ernest Esclangon. Tome 6: Cartes synoptiques de la chromosphère solaire et catalogue des filaments de la couche supérieure. Par L. d'Azambuja. Fascicule 5: Années 1925, 1926, 1927. Pp. 88. (Meudon.)

Japanese Journal of Mathematics. Transactions and Abstracts, Vol. 8 (1931) (concluded). Pp. 237-326+27. (Tokyo: National Research Council of Japan.)

Koninklijk Nederlandsch Meteorologische Instituut. No. 106a: Ergebnisse aerologischer Beobachtungen, 19, 1930. Pp. iv+44. 2.50 f. No. 108: Seismische Registrierungen in De Bilt, 17, 1929. Pp. ix+74. 1.20 f. No. 110: Oceanographische en meteorologische Waarnemingen in den Atlantischen Oceaan, September, October, November (1870-1925). Kaarten. Pp. ii+34. 7.50 f. (Amsterdam: Seyffardt's Boekhandel.)

Unione Astronomica Internazionale. Immagini spettroscopiche del bordo solare osservate a Catania, Madrid e Zurigo negli anni 1927 e 1928. Pubblicate per Cura del R. Osservatorio Astrofisico di Arcetri. Pp. 12+21 tavole. (Firenze: R. Osservatorio Astrofisico di Arcetri.)

Pubblicazioni della R. Università degli Studi di Firenze. Fascicolo N. 48: Osservazioni e memorie del R. Osservatorio Astrofisico di Arcetri. Pp. 63. Fascicolo N. 49: Osservazioni e memorie del R. Osservatorio Astrofisico di Arcetri. Pp. 69. (Firenze.)

Zentralanstalt für Meteorologie und Geodynamik. Publikation Nr. 137: Beihefte zu den Jahrbüchern der Zentralanstalt für Meteorologie und Geodynamik. Erstes Heft der Reihe, Beiheft zu Jahrgang 1928 der Jahrbücher. Pp. ii+117. (Wien: Gerold und Ko.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 8, No. 4, April, Research Papers Nos. 427-433. Pp. 445-547. (Washington, D.C.: Government Printing Office.) 40 cents.